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# Elective Cesarean Section Beyond 39 Weeks of Gestation Decreases Prenatal Morbidities and Improve Psychomotor Development One Year After Birth

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**ABSTRACT**

**Background & Objective:** This study aimed to compare the neonatal outcomes and infant development one year after birth at different gestational ages of elective cesarean section (CS) beyond 38 weeks.

**Materials & Methods:** This retrospective cohort study was recruited in an academic hospital affiliated with Tehran University of Medical Sciences between June 2018 and June 2020. The subjects of the study were the women who were scheduled for elective CS and divided into 3 groups according to the gestational age (38 0/7 to 38 6/7 as group A, 39 0/7 to 39 6/7 as group B, and 40 0/7 to 40 6/7 as group C). The neonatal outcomes and the growth and development status were evaluated by ages and stages questionnaires® (ASQ) after 12 months and compared between groups.

**Results:** Totally, 952 neonates were eligible for this study. In groups A, B, and C, CS was performed in 314, 409, and 229 neonates, respectively. The first minute Apgar was significantly lower in the neonates with lesser gestational age at delivery ($P$=0.026). Indeed, neonatal hospitalization, hypoglycemia, and jaundice in group A were significantly higher than in other groups ($P$<0.001). Regarding psychomotor development, the scores related to gross motor and problem-solving abilities in group A were significantly lower than those in other groups ($P$<0.05).

**Conclusion:** It is suggested to plan elective CS beyond 39 weeks of gestation to decrease prenatal morbidities and improve psychomotor development one year after birth.

**Keywords:** Elective cesarean section, Development, Gestational Age, Growth, Neonate, Morbidity



## Introduction

Cesarean section (CS), despite the associated side effects and costs, has increased worldwide **(1)**. This upward trend is multi-factorial and not limited to malpresentation, fetal macrosomia, multiple gestations, structural abnormalities, repeated cesarean section, improved surgical techniques, increased maternal age, earlier diagnosis of adverse prenatal outcome and loss of accessibility to fetal monitoring, fear of childbirth, urinary and fecal incontinence after vaginal delivery, fear of litigation and clinician's attitude **(2, 3)**. Only 5 to 10% of all elective CSs achieve satisfactory outcomes, and more than 15% of them are associated with higher maternal and/or neonatal mortality and morbidity **(4)**.

Women, especially in developing countries, believe CS is much safer than normal vaginal delivery (NVD). The association between CS and increased risk of neonatal morbidity and mortality is mentioned in previous studies **(5)**. On the other hand, although planned CS may be protective for premature neonates, it could also be traumatic and hazardous for both mother and neonate **(6)**.

Also, an increased risk of respiratory distress with elective cesarean section delivery may be seen even after 37 weeks of gestation **(7)**. Moreover, the risk of admission in a neonatal intensive care unit (NICU) for more than 7 days was increased by CS **(6)**. It is also noted more unexplained stillbirth in the next pregnancy by CS in comparison with vaginal delivery **(8)**.

International guidelines reported that CS at or after 39 weeks of gestation is the best time for elective CS. However, more elective cesarean delivery often occurs before this time **(9)**.

Psychomotor and mental development indices significantly ameliorate with increasing gestational age in delivery **(10, 11)** that may be evident among school-age children **(12)**.

Considering the growing trend of cesarean section in Iran during the past 3 decades **(13)**, timely scheduling of elective cesarean section is important to prevent neonatal adverse outcomes and improve infant development. Therefore, we aimed to evaluate the infantile growth and psychomotor developmental status 12 months after elective CS in different gestational ages beyond 38 weeks.

## Methods

This retrospective cohort study was performed in Yas Hospital affiliated with Tehran University of Medical Sciences, Tehran, Iran, from June 2018 to June 2020. The study population was women scheduled for elective CS from 38 0/7 to 40 6/7 weeks of gestation. They were divided according to the gestational age into 3 groups. Group A, were born at 38 0/7-38 6/7, group B were born at 39 0/7-39 6/7 and group C were born at 40 0/7 40 weeks of gestation. The inclusion criteria were the women with term elective cesarean section scheduled from 38 0/7 to 40 6/7 weeks. The emergency CS due to maternal indications such as placenta abruption, prolonged rupture of the membrane, multiple gestations, mentally ill mothers and chronic condition of mothers, and fetal indications including fetal distress, neonatal demise, and congenital anomalies were excluded from the study.

Maternal and neonatal demographic data including parental ages, gravida, para, abortion, the time interval between pregnancies, obstetrical complications, gestational age at cesarean section (based on the 11-13 weeks ultrasound), indication for cesarean section, neonatal weight, height, and head circumference, the Apgar in first and 5$^{th}$ minutes, fetal demise, as well as the NICU admission, duration of hospitalization, complicated jaundice that was led to phototherapy or blood exchange and type of feeding (breastfeeding or formula) were gathered from the medical records.

The parents were asked by telephone for a visit to the hospital for a follow-up 12 months after delivery. All infants' growth and development status were assessed by the expert pediatricians who were blinded to the assigned group (based on the gestational age at delivery) by age and stage Questionnaires® version 3 (ASQ-3). This version of ASQ was translated to Persian and validated for Iranian infants **(14)**.

The conclusions were reported as normal or abnormal according to the cut-off point for each domain. ASQ consists of 30 items as well as six questions in five fields to evaluate fine and gross motor control, personal and social communication, and problem-solving ability. All parents were asked to complete the ASQ 12 months after birth. Scores of 10, 5, and 0 were considered as 'yes', 'sometimes', and 'not yet', respectively. Age-specific norms less than 2 standard deviations (SD) on each domain were considered as ASQ fail **(15, 16)**.

### Statistical Analysis

The data were analyzed by version 13 of STATA software. Quantitative and qualitative data were reported by mean±SD and frequency (%), respectively. The t-test, Pearson's correlation, and one-way ANOVA were applied to analyze the correlations between the group's variables. The study had a power of 80%, and P-value<0.05 was used as statistical significance.

### Ethical Considerations

Data were considered confidential, and no extra costs were imposed on the families. All parents agreed and signed the informed consent. The ethics approval for the study was obtained from the institutional review board of Tehran University of Medical Sciences according to the Helsinki declaration.

## Results

Totally, 952 elective cesarean sections were eligible for this study. CSs were performed in 314, 409 and 229 of the neonate in gestational age of 38 0/7-38 6/7 (Group A), 39 0/7-39 6/7 (group B), and 40 0/7- 40 6/7 (group C) respectively. The mean±SD of mothers' age was 29±5.35 years, and 27.13% of them had nonacademic literacy, whereas, in the fathers, the mean±SD of age was 32.91±5.5 years. The obstetrical characteristics of the participants are listed in Table 1.

The characteristics of the neonates in different groups are also listed in Table 2.

The first minute Apgar was significantly lower in lesser gestational age at delivery ($P$=0.026). Among the groups, the analysis showed a significant difference between groups A and B regarding the first minute Apgar ($P$=0.009). However, this difference was not significant comparing groups A and C or B and C ($P$=0.100 and $P$=0.300). Although, this difference was not observed in the 5$^{th}$ minute Apgar ($P$=0.142).

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**Table 1. The obstetrical characteristics of the participants**

| variables | N (%) |
|---|---|
| **Gravid** | |
| **1** | 432 (25.54) |
| **2** | 258 (42.77) |
| **3** | 222 (21.98) |
| **Para** | |
| **0** | 352 (34.85) |
| **1** | 510 (50.50) |
| **2** | 132 (13.07) |
| **History of fetal demise** | 30 (2.97) |
| **History of abortion** | 261 (25.84) |
| **The median interval between pregnancies (month)** | 66 |
| **Height (centimeter)** | 162.2±5.66* |
| **Weight (kilogram)** | 78.6±9.4* |
| **Body mass index** | 29.9±3.3* |
| **Cesarean section indication** | |
| **Former cesarean section** | 510 (50.50) |
| **Malpresentation** | 127 (12.57) |
| **Macrosomia** | 79 (7.02) |

*mean±SD

**Table 2. Comparison of neonatal characteristics between groups at delivery**

| Variables | Group A n= 314 mean±SD | Group B n=409 mean±SD | Group C n=229 mean±SD | *P* |
|---|---|---|---|---|
| **Growth indices** | | | | |
| **Birth weight (gram)** | 3189.2±421.2 | 3194.4±406.8 | 3339.3±464.0 | 0.070 |
| **Length (centimeter)** | 48.6±7.6 | 49.1±5.2 | 49.6±6.9 | |
| **Head circumference** | 34.6±1.0 | 34.6±1.0 | 35.0±1.0 | |
| **Apgar (first minute)** | 8.81±.57 | 8.89±.40 | 8.90±.392 | 0.026 |
| **Apgar (5th minute)** | 9.90±.30 | 9.93±.25 | 9.95±.26 | 0.142 |

Hypoglycemia in neonates in group B was significantly higher than others ($P$<0.001). In group A, 82, in group B, 84, and group C, 37 neonates had jaundice that showed a significant correlation between neonatal jaundice leading to hospitalization and low gestational age ($P$<0.001). This complication was more frequent among group A (26.13%) other than those in group B ($P$=0.005) and C ($P$=0.010).

Although sepsis in group A was more frequent, this difference was not statistically significant ($P$=0.081). No correlations were observed between groups regarding asphyxia, apnea, bradycardia, hypothermia, and respiratory disorders with age at cesarean section ($P$>0.05).

NICU admission was significantly more frequent in group A than the other groups ($P$=0.019, f=7.928), however by One-way ANOVA analysis, no significant differences were observed concerning the hospitalization days among the 3 groups ($P$=0.121, f=2.115).

Regarding growth and psychomotor development at 12 months, no correlation was found between gestational age at birth and growth indices after one year. Furthermore, no differences were observed regarding the ability to communicate ($P$=0.163, f=1.815). Also, the gross motor ability scores in group A were significantly lower than in other groups ($P$<0.001, f=1.039). However, no differences were observed in fine motor and personal and social ability between the 3 groups ($P$=0.681, f=0.384 and $P$=0.733,

f=0.310), respectively. There was indeed a significant correlation between gestational age and problem-solving ability (*P*=0.039, f=3.255). The detailed data are shown in Table 3

**Table 3. Comparison of the growth and developmental status between groups after 12 months of delivery**

| Variables | Group A n= 314 mean±SD | Group B n=409 mean±SD | Group C n=229 mean±SD | *P* |
|---|---|---|---|---|
| **Weight at 12 months (gram)** | 8643.0±804.9 | 8551.2±803.0 | 8816.2±807.0 | 0.560 |
| **height at 12 months (centimeter)** | 72.8±12.6 | 70.3±787.5 | 71.7±17.2 | 0.450 |
| **Communication** | 30.8±6.7 | 31.6±6.7 | 31.9±6.7 | 0.163 |
| **Gross motor** | 41.0±10.6 | 43.9±9.6 | 44.3±8.3 | 0.001 |
| **Fine motor** | 43.8±8.2 | 44.2±8.2 | 44.4±7.4 | 0.750 |
| **Problem solving** | 41.9±6.5 | 42.7±5.9 | 43.2±6.3 | 0.039 |
| **personal-social** | 41.1±7.1 | 41.6±7.1 | 41.4±7.1 | 0.550 |

## Discussion

The present study results showed that neonates born at 38 weeks (38 0/7-38 6/7) were prone to more morbidity in infantile periods and a less developmental scale compared to higher gestational age at delivery. These results may be beneficial for the clinicians to warn against the risk of early planned elective cesarean delivery.

Van den Berg *et al.* **(17)** showed a lower incidence of respiratory morbidity among neonates beyond 39 weeks of gestation compared to earlier gestational ages. Hourani *et al.* also demonstrated higher risks of neonatal outcomes among neonates with early CS **(18)**. In another study, the lowest incidence of morbidity and mortality rates was reported to be among neonates with gestational age between 38 to 40 weeks, independent of delivery mode **(19)**. In our study, we could not find any difference between (gestational age 39 and 40 weeks about the poor neonatal outcome that may be concluded that in high-risk pregnancies, waiting to 40 weeks of gestation would be a waste of time and hazardous.

Based on the results, a significant positive correlation was observed between the first minute Apgar score and the gestational age at CS. Newborns born via CS in the 38 weeks of gestation had a lower first-minute Apgar score (less than 7) compared to the other groups. More analysis showed that this value was more notable between 38 and 39 weeks. A few percentages of newborns at 40 weeks had Apgar score less than 7, while none of the newborns with gestational age 39 weeks had such a situation. Therefore, besides the gestational age, other factors such as birth weight may also be involved in low Apgar scores relating to lower gestational age (38 weeks).

No correlation was observed between the low Apgar score at the 5$^{th}$ minute and gestational age at delivery time, which can be referred to prompt and proper medical interventions after birth. Another study showed different findings and reported a correlation between low Apgar scores at 5$^{th}$ minutes (<7) and neonatal morbidity **(20)**.

According to the results, a significant correlation was observed between neonatal hypoglycemia and gestational age in which the frequency of hypoglycemia in neonates with the cesarean section at 38 weeks was higher than those born at greater than 38 weeks. In line with our results, Alan *et al.* demonstrated such an inverse correlation between the incidence of hypoglycemia and gestational age **(21)**. On the other hand, Hourani *et al.* showed no difference between age at birth (before or after 38 weeks of gestation) and incidence of hypoglycemia **(22)**.

Although NICU admission was more frequent in the early gestational age, no significant differences were observed with regard to the number of hospitalization days between the 3 groups. Pirjani *et al.* also showed that NICU admission in neonates by elective CS at 38–9 weeks' gestation was more common than neonates born after 39 completed gestational weeks **(23)**.

A significant correlation was observed between lower gestational age and neonatal jaundice, which may be due to neonatal poor nutrition or immaturity in the hepatic system that was in line with Resende *et al.*, which revealed a higher frequency of NICU hospitalization and hyperbilirubinemia among neonates born before 39 weeks in comparison with those born after 39 weeks **(9)**.

Regarding psychomotor developmental status at 12 months, results showed that the timing of planned birth might also influence early childhood development. There was a significant positive correlation between the gestational age at birth and gross motor or problem-solving abilities. A positive correlation between the duration of fetal growth and postnatal developmental status was notable. Yang *et al.* indicated that cognitive ability in both genders was promoted with each additional week of gestation between 37 to 41 weeks. In addition, a gradual increase of full-scale intelligence quotient (IQ) score was notable by increasing weeks of

gestation from 37 to 40 **(24)**. Kinney *et al.* also demonstrated beneficial and critical effects of each additional week of gestation (at least up to 39 weeks) for developing the nervous system **(25)**.

In accordance with our findings, Bentley *et al.* showed an inverse association between the timing of planned birth and the risk of poor development. These poor developments were observed in 5 main domains, including physical health and well-being, language and cognitive skills, social competence, emotional maturity, communication skills, and general knowledge in children at school age **(12)**.

Regarding the results of this study, no significant differences were found between gestational age at CS and other abilities like communication, fine motor and personal and social between the 3 groups. According to other studies, it is hypothesized that assessment of correlation between different gestational ages at birth and the developmental outcome may need a longer time, at least 18 to 24 months after birth **(14)**.

Our study had some limitations; we did not consider the different factors related to sex, birth weight, anesthesia, duration of operation, and premedication before CS. We did not compare results with delaying delivery in 41 weeks and beyond. Moreover, no testing for lung maturity was performed in neonates of different gestational ages at delivery.

## Conclusion

Admission to NICU, neonatal hypoglycemia, hyperbilirubinemia, and delayed postnatal psychomotor status development were associated with gestational age at the time of elective cesarean delivery. To decrease neonatal morbidity and to improve postnatal psychomotor development, it is suggested that the timing of planned elective cesareans should be postponed beyond 39 weeks of gestation.

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## Conflict of Interest

The authors declared no conflict of interest.

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