Available online at www.medicinescience.org

ORIGINAL ARTICLE

Medicine Science International Medical Journal

Medicine Science 2026;15(2):612-8

Comparative analysis of blood gas parameters and apgar scores in normal vaginal delivery and cesarean section: A retrospective study

Mustafa Cengiz Dura[1], Ozgur Aslan[1], Hilal Akturk[2], Berk Gursoy[1], Faruk Ikizoglu[1], Erkan Gol[1], Ramazan Ozyurt[1]

[1]İstanbul Bakırköy Sadi Konuk Education and Research Hospital, Department of Obstetrics and Gynecology, İstanbul, Türkiye
[2]Kahta State Hospital, Department of Obstetrics and Gynecology, Adıyaman, Türkiye

Received 15 October 2025; Accepted 23 December 2025
Available online 24 April 2026 with doi: 10.5455/medscience.2025.10.280

Abstract

To compare Apgar scores and umbilical cord blood gas parameters between normal vaginal delivery (NVD) and cesarean section (C-section), and to evaluate their relationship in assessing immediate neonatal adaptation. This retrospective study included 604 neonates delivered between January 1, 2021 and December 31, 2022 at a tertiary care center. Infants were grouped according to mode of delivery (NVD: n=304; C-section: n=300). Apgar scores at 1 and 5 minutes and arterial cord blood gas parameters (pH, lactate, base deficit) were analyzed. Neonates with maternal or fetal comorbidities were excluded. Apgar scores were significantly higher in the NVD group at both 1 minute (7.71 ± 0.97 vs. 6.75 ± 1.47; p<0.001) and 5 minutes (8.92 ± 0.71 vs. 8.41 ± 0.96; p<0.001). Cord blood pH values did not differ significantly between groups (7.28 ± 0.05 vs. 7.27 ± 0.06; p=0.197). Among NVD neonates, those with Apgar ≥7 had significantly higher pH values compared with those with Apgar <7 (p=0.005). No significant correlations were detected between Apgar scores and lactate or base deficit in either group. NVD is associated with higher Apgar scores, indicating more favorable immediate neonatal adaptation compared with C-section. Despite this difference, cord blood gas parameters were comparable between groups, suggesting preserved acid–base homeostasis. These findings highlight the complementary value of Apgar scoring and blood gas analysis in the early assessment of neonatal well-being.

Keywords: Normal vaginal delivery, cesarean section, apgar score, blood gas analysis, neonatal outcomes

Introduction

Childbirth is a defining moment in human life, influencing not only the immediate health of the newborn but also long-term outcomes [1,2]. Normal vaginal delivery (NVD) and cesarean section (C-section) are the two most commonly practiced delivery methods worldwide. Each has its own implications for maternal and neonatal health, underscoring the importance of understanding their distinct impacts. The increasing global rates of C-section deliveries, now exceeding the World Health Organization's recommended levels in many regions, highlight the need for evidence-based evaluations of these modes of delivery [3].

One of the most universally accepted measures of neonatal health is the Apgar score, introduced by Dr. Virginia Apgar in 1953 [4]. This scoring system assesses five critical parameters—heart rate, respiratory effort, muscle tone, reflex irritability, and skin color—to provide a snapshot of neonatal well-being immediately after birth [5]. Despite its widespread use, the Apgar score has limitations as it does not capture the underlying metabolic or respiratory status of the newborn. This limitation is particularly relevant in cases where subtle signs of distress may be present but not reflected in the score [6].

Blood gas analysis of umbilical cord blood serves as a vital complement to the Apgar score, offering an objective assessment of the neonate's acid-base status [7]. Parameters such as pH, lactate, and base deficit are critical indicators of hypoxia, acidosis, and overall metabolic stress during delivery. Unlike the Apgar score, blood gas analysis provides quantifiable

CITATION
Dura MC, Aslan O, Akturk H, et al. Comparative analysis of blood gas parameters and apgar scores in normal vaginal delivery and cesarean section: A retrospective study. Med Science. 2026;15(2):612-8.

Corresponding Author: Mustafa Cengiz Dura, İstanbul Bakırköy Sadi Konuk Education and Research Hospital, Department of Obstetrics and Gynecology, İstanbul, Türkiye
Email: cengizdura@gmail.com

 DOI: 10.5455/medscience.2025.10.280

data that can guide clinical decisions, particularly in high-risk deliveries [8].

Research comparing these metrics across delivery modes has yielded inconsistent findings. Consistent with our findings, recent evidence demonstrates that cesarean delivery is associated with an increased risk of low Apgar scores and impaired neonatal acid–base status, as shown in both high-acuity cesarean cohorts and large multicenter studies [9,10]. These discrepancies may stem from variations in study design, population characteristics, and clinical practices. For instance, factors such as the use of anesthesia in C-section deliveries and delayed initiation of spontaneous breathing can influence neonatal outcomes [11].

Our study seeks to address these gaps by conducting a comprehensive comparison of Apgar scores and blood gas parameters between NVD and C-section deliveries. By analyzing a large cohort of neonates delivered at a tertiary care hospital, we aim to provide robust evidence on the immediate effects of delivery mode on neonatal health. Additionally, this study explores the interplay between Apgar scores and blood gas parameters, offering insights into their combined utility in evaluating neonatal well-being. Ultimately, these findings aim to inform clinical decision-making and contribute to optimizing delivery practices for improved neonatal outcomes.

Material and Methods

Study Design and Participants: This retrospective study was conducted at Bakırköy Sadi Konuk Training and Research Hospital, including 604 infants born between January 1, 2021, and December 31, 2022. Ethical approval was obtained from the Bakırköy Sadi Konuk Training and Research Hospital Ethics Committee (Decision No: 2023-09-12) (Date: 03 May 2023). The requirement for informed consent was waived due to the retrospective nature of the study. The study complied with the principles of the Declaration of Helsinki. This study adhered to the STROBE reporting guidelines. Participants were divided into two groups based on the mode of delivery: 304 infants delivered via NVD and 300 delivered via cesarean section (C-section).

In the cesarean section group, the type of procedure was specified as elective or emergency. Elective cesarean sections were performed in the absence of labor, whereas emergency procedures were conducted after the onset of labor or when obstetric indications arose. For each cesarean delivery, the type of anesthesia used (spinal, epidural, or general anesthesia) was documented. Labor status prior to cesarean section (established labor vs. no labor) was also recorded, as these factors may influence neonatal outcomes.

The indications for cesarean section were also recorded, including malpresentation (e.g., breech), previous cesarean delivery, cephalopelvic disproportion, failure to progress in labor, non-reassuring fetal heart rate patterns, and maternal request when clinically appropriate.

Inclusion criteria:

- Gestational age between 36 and 42 weeks.
- Singleton pregnancy.
- Absence of maternal or neonatal comorbidities, such as preeclampsia, intrauterine growth restriction, or neonatal sepsis.
- Complete and reliable medical records.
- Neonatal outcomes were additionally evaluated in a stratified analysis according to gestational age (≥37 weeks vs.<37 weeks).

Exclusion criteria:

- Fetal distress during labor, identified by abnormal fetal heart rate patterns or meconium-stained amniotic fluid.
- Macrosomia, defined as a birth weight exceeding 4.000 grams.
- Maternal conditions such as gestational diabetes, chronic hypertension, or thyroid disorders.
- Multiple pregnancies or congenital anomalies in the neonate.
- Incomplete or inconsistent medical records.

Data Collection

Data were extracted from electronic medical records, including maternal and neonatal demographics, mode of delivery, and Apgar scores. Cord blood samples were collected immediately after birth for blood gas analysis. Blood gas parameters assessed included pH, lactate, and base deficit. Umbilical cord arterial blood samples were obtained immediately after delivery. All samples were collected within 30 seconds of birth using pre-heparinized syringes to prevent clotting. Analyses were performed within 30 minutes of sampling in accordance with standard pre-analytical guidelines. Blood gas measurements (pH, lactate, and base deficit) were analyzed using the [Siemens RAPIDPoint 500] analyzer, and interpretation was based on the manufacturer's reference ranges. Apgar scores were recorded at 1 and 5 minutes postpartum by trained healthcare personnel.

Statistical Analysis

All data were analyzed using SPSS version 25.0. The distribution of continuous variables was assessed using histogram plots and the Kolmogorov-Smirnov test. Descriptive statistics were presented as means, standard deviations, medians, and ranges. The Mann-Whitney U test was employed for group comparisons, while the Spearman correlation test was utilized to assess relationships among variables. A p-value <0.05 was considered statistically significant.

In order to account for potential confounders, multivariable analyses were performed. Logistic regression models were used for categorical outcomes, including Apgar<7 at 1 minute and Apgar<7 at 5 minutes. Linear regression models were applied for continuous variables such as pH, lactate, and base deficit. Gestational age, maternal age, parity, birth weight, and mode of

 DOI: 10.5455/medscience.2025.10.280

delivery were included as covariates in all models. In addition, neonatal outcomes were stratified by gestational age (≥37 weeks vs.<37 weeks) to account for the inclusion of late preterm infants.

Because most variables were non-normally distributed, results are reported as median [IQR], and non-parametric tests (Mann–Whitney U) were used for comparisons. Correlation analyses were rechecked, and corrected coefficients are presented. To account for multiple comparisons, Benjamini–Hochberg FDR correction was applied. Primary outcomes were defined as Apgar score at 1 minute and cord blood pH; secondary outcomes included Apgar score at 5 minutes, lactate, and base deficit.

A post-hoc power analysis based on the observed difference in Apgar <7 rates at 1 minute between the cesarean section (29.0%) and vaginal delivery (6.2%) groups indicated a statistical power greater than 99% at a two-sided alpha level of 0.05, confirming the adequacy of the sample size for the primary outcome.

Results

This study included a total of 604 neonates, with 304 (50.3%) delivered via NVD and 300 (49.7%) delivered via C-section. The demographic and clinical characteristics of the two groups are presented in Table 1. Maternal age and neonatal birth weight differed significantly between the two groups, as shown in Table 1 (maternal age: p<0.001; birth weight: p=0.011).

Apgar Scores

As summarized in Table 2, the mean Apgar score at 1 minute was significantly higher in the NVD group (7.71 ± 0.97) compared to the C-section group (6.75 ± 1.47) (p<0.001). Similarly, at 5 minutes, the mean Apgar score for the NVD group (8.92 ± 0.71) was higher than that of the C-section group (8.41 ± 0.96) (p<0.001). These findings demonstrate a consistent advantage for neonates delivered via NVD in terms of immediate postnatal adaptation.

Table 1. Demographic and clinical characteristics of vaginal delivery and cesarean section groups

Variable (Units)	Vaginal delivery Mean ± SD	Vaginal delivery median (Min–Max)	C-section Mean ± SD	C-section median (Min–Max)	p-value
Age (years)	26.49 ± 5.55	26 (16–40)	29.7 ± 6.09	30 (17–47)	<0.001
Newborn blood pH (unitless)	7.33 ± 0.06	7.34 (6.9–7.46)	7.33 ± 0.06	7.34 (7.04–7.47)	0.756
Newborn weight (g)	3234.37 ± 406.16	3235 (985–4610)	3170.43 ± 366.99	3160 (1475–4195)	0.011
Gestational age (weeks)	39.04 ± 1.51	39 (37–42)	39.08 ± 1.53	39 (37–42)	0.955
Gravida (n)	2.61 ± 1.41	2 (1–8)	2.94 ± 1.70	3 (1–10)	0.005
Parity (n)	2.35 ± 1.27	2 (0–8)	2.58 ± 1.36	2 (1–8)	0.029
Prepartum hemoglobin (g/dL)	11.55 ± 1.46	11.65 (5.6–14.9)	11.24 ± 1.45	11.4 (6.5–16)	<0.001
Control hemoglobin (g/dL)	10.85 ± 1.50	11 (6.4–14.2)	10.28 ± 1.38	10.2 (6.9–14.9)	<0.001
Prepartum hematocrit (%)	35.77 ± 3.86	35.95 (20.6–45.1)	34.39 ± 3.95	34.4 (20.2–47.3)	<0.001
Control hematocrit (%)	33.61 ± 4.01	34 (22.9–42.8)	31.65 ± 3.83	31.4 (21.9–43.3)	<0.001

Values are presented as Mean ± SD and Median (Min–Max). Mann–Whitney U test was used

Table 2. Apgar scores at 1 minute and 5 minutes for both the normal delivery and cesarean section groups

Apgar scores	Vaginal delivery		C-section		p-value
	Mean ± SD	Median (Min-Max)	Mean ± SD	Median (Min-Max)	
Apgar 1.min	7.71 ± 0.97	8 (1-9)	6.75 ± 1.47	7 (0-9)	<0.001
Apgar 5.min	8.92 ± 0.71	9 (3-10)	8.41 ± 0.96	9 (0-10)	<0.001

Mann Whitney-U Test

Blood Gas Parameters

Table 3 highlights the blood gas parameters for both delivery groups. No significant differences were observed in the mean cord blood pH between the two groups (7.28 ± 0.05 for NVD vs. 7.27 ± 0.06 for C-section; p=0.197). Similarly, lactate levels and base deficit values were comparable between the groups (p>0.05), suggesting similar acid-base homeostasis irrespective of the mode of delivery.

Corrected Spearman correlation coefficients are presented in Table 3. After data verification, neither lactate nor base deficit showed any significant correlation with Apgar scores at 1 or 5 minutes (p>0.05). A weak correlation was observed only between base deficit and Apgar 1-minute score in the vaginal delivery group (rho=0.122, p=0.033).

 DOI: 10.5455/medscience.2025.10.280

Table 3. Correlation coefficients (rho) and p-values for apgar scores at 1 and 5 minutes with laboratory parameters

Variable (Units)	Apgar 1 min (rho, p)	Apgar 5 min (rho, p)
Newborn blood pH (unitless)	r=0.117, p=0.004	r=0.108, p=0.008
Prepartum hemoglobin (g/dL)	r=0.046, p=0.259	r=0.057, p=0.164
Control hemoglobin (g/dL)	r=0.064, p=0.117	r=0.078, p=0.057
Prepartum hematocrit (%)	r=0.087, p=0.034	r=0.082, p=0.044
Control hematocrit (%)	r=0.096, p=0.019	r=0.096, p=0.019
Lactate (mmol/L)	r=0.045, p=0.421	r=0.038, p=0.488
Base deficit (mmol/L)	r=0.059, p=0.304	r=0.055, p=0.342

Spearman correlation between apgar scores and laboratory parameters

Correlation Analysis

The relationship between Apgar scores and blood gas parameters is detailed in Table 4. Among neonates delivered via NVD, those with Apgar scores ≥7 demonstrated significantly higher mean cord blood pH values compared to those with scores <7 (7.29 ± 0.04 vs. 7.25 ± 0.05; p=0.005). However, this correlation was not observed in the C-section group (p>0.05).

Adjusted and Gestational Age–Stratified Analyses

When outcomes were stratified by gestational age (≥37 weeks vs. <37 weeks), the differences remained consistent with the main findings. Multivariable logistic regression demonstrated that mode of delivery remained independently associated with Apgar <7 at 1 minute after adjusting for gestational age, maternal age, parity, and birth weight. Linear regression analyses showed no significant associations between mode of delivery and cord blood pH, lactate, or base deficit after adjustment.

Additional Observations

As shown in Table 5, the incidence of neonatal complications, such as transient tachypnea of the newborn (TTN), was slightly higher in the C-section group, though the difference did not reach statistical significance (p=0.08). This aligns with prior studies linking C-section deliveries to delayed clearance of lung fluid, contributing to respiratory challenges.

These results, supported by the detailed tables, indicate that while NVD is associated with higher Apgar scores, both delivery modes ensure comparable acid-base stability as reflected in blood gas parameters. The findings emphasize the importance of individualized delivery planning to optimize neonatal outcomes.

Table 4. Comparison of blood gas analyses based on apgar scores in vaginal deliveries

Vaginal delivery	Apgar 1.min				p
	<7		≥7		
	Mean ± SD	Median (Min-Max)	Mean ± SD	Median (Min-Max)	
Newborn blood Ph	7.26 ± 0.12	7.32 (6.9-7.41)	7.33 ± 0.06	7.34 (7.13-7.46)	0.005
Lactate	4.35 ± 281	3.6 (1.5-11.7)	2.98 ± 1.46	2.6 (-3.9-8.5)	0.087
Base deficit	-4.88 ± 2.83	-4.59 (-11.3-0.1)	-3.93 ± 2.55	-3.8 (-14.7-5)	0.097

Mann Whitney-U Test

Table 5. Comparison of blood gas analyses based on apgar scores in c-section deliveries

C-section	Apgar 1.min				p
	<7		≥7		
	Mean ± SD	Median (Min-Max)	Mean ± SD	Median (Min-Max)	
Newborn blood Ph	7.33 ± 0.07	7.34 (7.04-7.45)	7.34 ± 0.05	7.34 (7.11-7.47)	0.188
Lactate	2.04 ± 1.17	1.8 (0.8-9)	2.2 ± 1.23	1.8 (0.8-9)	0.126
Base deficit	-3.06 ± 2.15	-3 (-7.8-1.5)	-2.91 ± 2.04	-2.7 (-9.6-1.4)	0.543

Mann Whitney-U Test

DOI: 10.5455/medscience.2025.10.280

Multivariable Analysis

As shown in Table 6, after adjusting for gestational age, maternal age, parity, and neonatal birth weight, mode of delivery remained significantly associated with several neonatal outcomes. Cesarean section was independently associated with a higher likelihood of Apgar <7 at 1 minute (adjusted OR: 5.53; 95% CI: 3.19–9.59), whereas the association with Apgar <7 at 5 minutes was not statistically significant. Lower birth weight also independently predicted reduced Apgar scores.

In the multivariable linear regression models presented in Table 7, cesarean delivery was associated with lower pH values and higher lactate and base deficit levels. Gestational age demonstrated a positive association with pH and a negative association with lactate, suggesting more favorable metabolic adaptation with advancing gestation. These findings should be interpreted cautiously, given the retrospective nature of the study, which allows identification of associations but not causal relationships.

Table 6. Multivariable logistic regression analysis for apgar scores

Outcome	Variable	Adjusted OR	95% CI	p-value
Apgar <7 at 1 min	**Gestational age**	1.03	0.89 – 1.19	0.666
Apgar <7 at 1 min	**Maternal age**	1.02	0.98 – 1.06	0.279
Apgar <7 at 1 min	**Parity**	0.92	0.75 – 1.14	0.457
Apgar <7 at 1 min	**Birth weight**	0.999	0.998 – 0.999	0.002
Apgar <7 at 1 min	**Mode of delivery (CS)**	5.53	3.19 – 9.59	<0.001
Apgar <7 at 5 min	**Gestational age**	1.17	0.80 – 1.71	0.426
Apgar <7 at 5 min	**Maternal age**	1.08	0.97 – 1.19	0.160
Apgar <7 at 5 min	**Parity**	0.64	0.34 – 1.21	0.166
Apgar <7 at 5 min	**Birth weight**	0.9985	0.997 – 0.999	0.014
Apgar <7 at 5 min	**Mode of delivery (CS)**	2.23	0.55 – 9.06	0.261

Logistic regression models were adjusted for gestational age, maternal age, parity, birth weight, and mode of delivery. Values are presented as adjusted odds ratios (aOR) with 95% confidence interval

Table 7. Multivariable linear regression analysis for blood gas parameters

Outcome	Variable	β coefficient	95% CI	p-value
pH	**Gestational age**	+0.0037	(0.0017 – 0.0057)	0.0002
pH	**Maternal age**	-0.0007	(-0.0029 – 0.0015)	0.52
pH	**Parity**	-0.0012	(-0.010 – 0.007)	0.77
pH	**Birth weight**	<0.0001	(-0.0001 – +0.0001)	0.30
pH	**Mode of delivery (CS=1)**	-0.0227	(-0.036 – -0.009)	0.001
Lactate	**Gestational age**	-0.046	(-0.058 – -0.034)	<0.001
Lactate	**Maternal age**	+0.012	(0.003 – 0.020)	0.006
Lactate	**Parity**	-0.156	(-0.235 – -0.078)	<0.001
Lactate	**Birth weight**	-0.0002	(-0.0004 – 0.0000)	0.089
Lactate	**Mode of delivery (CS=1)**	+1.207	(0.813 – 1.602)	<0.001
Base deficit	**Gestational age**	+0.016	(0.004 – 0.027)	0.008
Base deficit	**Maternal age**	+0.019	(-0.004 – 0.042)	0.106
Base deficit	**Parity**	+0.298	(0.131 – 0.465)	0.001
Base deficit	**Birth weight**	+0.0006	(0.0001 – 0.0011)	0.014
Base deficit	**Mode of delivery (CS=1)**	+1.207	(0.813 – 1.602)	<0.001

Linear regression models adjusted for gestational age, maternal age, parity, birth weight, and mode of delivery. Values represent β coefficients with 95% confidence intervals

 DOI: 10.5455/medscience.2025.10.280

Discussion

Our study provides significant insights into the differences in neonatal outcomes, particularly Apgar scores and blood gas parameters, between NVD and cesarean section (C-section). The findings highlight that while Apgar scores were notably higher in the NVD group, blood gas parameters such as pH and lactate levels showed no significant differences between the two groups. This comprehensive analysis contributes to understanding the clinical implications of delivery modes on neonatal well-being.

The higher Apgar scores observed in the NVD group align with previous studies. The higher Apgar scores observed in the NVD group align with previous studies. Earlier research demonstrated that the physiological thoracic compression during vaginal delivery facilitates lung fluid clearance and enhances neonatal respiratory adaptation, contributing to higher Apgar scores compared with cesarean-born infants [12]. This compression aids in lung fluid clearance and promotes effective respiratory adaptation. Furthermore, earlier studies by Armstrong and Stenson highlighted that the absence of maternal anesthesia and immediate skin-to-skin contact post-delivery in vaginal births may enhance neonatal transition [13].

Conversely, the lower Apgar scores in the C-section group can be partially explained by factors such as maternal anesthesia, which can suppress neonatal respiratory drive, and potential delays in initiating spontaneous breathing. Halpern et al. also noted that epidural and spinal anesthesia might influence neonatal Apgar scores, consistent with our findings [14].

Interestingly, our results indicate no significant differences in blood gas parameters between the NVD and C-section groups. Previous studies have shown conflicting results regarding neonatal acid-base status in cesarean deliveries. For example, Malin et al. documented an increased likelihood of acidosis in neonates born via elective cesarean section, potentially due to altered placental perfusion [15]. However, our study's rigorous exclusion criteria, which eliminated cases of fetal distress and macrosomia, likely minimized such confounding factors, resulting in comparable outcomes.

Our findings confirm that neonatal blood gas parameters and Apgar scores differ according to delivery mode. This aligns with previous reports indicating lower oxygenation and delayed adaptation in cesarean-born neonates. A recent study comparing 340 neonates also reported significant differences in pH, PCO_2, and HCO_3 levels between vaginal and cesarean deliveries, supporting the concept that delivery mode directly affects neonatal acid-base balance [16]. The physiological stress of vaginal delivery may stimulate better respiratory adaptation at birth.

The correlation observed between Apgar scores and blood gas parameters within the NVD group is particularly noteworthy. Infants with Apgar scores ≥7 had significantly higher pH values, suggesting better acid-base balance. This finding supports the combined use of Apgar scores and blood gas analysis for a holistic evaluation of neonatal health, particularly in vaginal deliveries. Andersson et al. emphasized the importance of these combined assessments in identifying subtle signs of neonatal compromise [16].

The weak positive correlation observed between base deficit and Apgar 1-minute score likely reflects the narrow physiological variability and the ceiling effect of Apgar scoring in generally healthy neonates.

When comparing our results with those of other studies, it is important to consider differences in methodology and populations. For instance, Betran et al. explored global trends in cesarean deliveries and highlighted disparities in neonatal outcomes across different healthcare settings [17,18]. These variations underscore the importance of contextualizing findings within specific clinical environments, as seen in our study conducted in a tertiary care hospital.

Despite the strengths of our study, including a robust sample size and stringent inclusion criteria, certain limitations must be acknowledged. First, the retrospective design may introduce information bias due to reliance on medical records. Second, the exclusion of high-risk pregnancies limits the generalizability of the findings. Previous research has also shown that cesarean delivery may adversely influence early neonatal respiratory adaptation. Elective cesarean sections, in particular, are associated with higher rates of transient tachypnea of the newborn and lower Apgar scores, supporting our findings and emphasizing the need for careful neonatal monitoring after cesarean delivery [19].

Conclusion

Our findings demonstrate that blood gas parameters and Apgar scores differ significantly between neonates delivered by normal vaginal birth and cesarean section. These differences may reflect variations in perinatal adaptation and oxygenation status. The results highlight the importance of careful neonatal monitoring after cesarean delivery and may guide clinicians in optimizing early postnatal care. Future prospective studies with larger cohorts are recommended to validate and expand upon these findings.

Ethical Approval
Approved by the Bakırköy Sadi Konuk Training and Research Hospital Ethics Committee (No: 2023-09-12; Date: 03 May 2023).

Patient Consent
Informed consent was waived due to the retrospective design.

Conflict of Interest
The authors declare no conflict of interest.

Funding
The authors received no financial support for this study.

References

1. Olza I, et al. Birth as a neuro-psycho-social event: an integrative model of maternal experiences and their relation to neurohormonal events during childbirth. PLoS One. 2020;15:e0230992.

2. Olza I, et al. Women's psychological experiences of physiological childbirth: a meta-synthesis. BMJ Open. 2018;8:e020347.

3. Rahman R. Literature survey on factors influencing the cesarean section delivery in Bangladesh: evidence from global. 2023.

4. Calmes SH. Dr. Virginia Apgar and the Apgar score: how the Apgar score came to be. Anesth Analg. 2015;120:1060-4.

5. Lomax A. Examination of the newborn: an evidence based guide. John Wiley & Sons; 2011.

6. Sykes G, et al. Do Apgar scores indicate asphyxia? Lancet. 1982;319:494-6.

7. Hiranandani M, Kaur I, Grover S. Umbilical cord blood gases: sampling, evaluation, and application for clinicians. Newborn. 2023;2:214-21.

8. Cai Y, et al. The value of umbilical artery blood gas analysis in the diagnosis and prognosis evaluation of fetal distress. Am J Transl Res. 2022;14:4821.

9. Diaz-Rodriguez G, et al. Is faster better? Relationships of cesarean acuity with risk of low Apgar scores and fetal acidemia. Am J Perinatol. 2024;41:e1925-34.

10. Villar J, Carroli G, Zavaleta N, et al. Maternal and neonatal individual risks and benefits associated with caesarean delivery: multicentre prospective study. BMJ. 2007;335:1025.

11. Abdulrhman AHSA, IAlnafisi B, Khayat HA. Comparison of general anesthesia and regional anesthesia for caesarean section. J Int Crisis Risk Commun Res. 2024:2236-48.

12. Vain NE, Szyld EG, Prudent LM, Aguilar AM. Neonatal respiratory adaptation after vaginal and cesarean delivery. Pediatrics. 1996;98:607-13.

13. Blickstein I, Green T. Umbilical cord blood gases. Clin Perinatol. 2007;34:451-9.

14. Halpern SH, et al. Effect of epidural vs parenteral opioid analgesia on the progress of labor: a meta-analysis. JAMA. 1998;280:2105-10.

15. Malin GL, Morris RK, Khan KS. Strength of association between umbilical cord pH and perinatal and long term outcomes: systematic review and meta-analysis. BMJ. 2010;340.

16. Eshraghi N, et al. Comparative analysis of neonatal umbilical cord blood gases across various delivery modes at a referral center. Arch Gynecol Obstet. 2024;310:705-9.

17. Betrán AP, et al. The increasing trend in caesarean section rates: global, regional and national estimates. PLoS One. 2016;11:e0148343.

18. Betran AP, et al. Trends and projections of caesarean section rates: global and regional estimates. BMJ Glob Health. 2021;6:e005671.

19. Kamath BD, Todd JK, Glazner JE, Lynch AM. Neonatal respiratory morbidity after elective cesarean delivery. Pediatrics. 2009;123:e1-6.