

ORIGINAL ARTICLE

FACTORS ASSOCIATED WITH APGAR SCORE AMONG NEWBORNS DELIVERED BY CESAREAN SECTIONS; A CROSS-SECTIONAL STUDY

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ABSTRACT

Introduction: Despite the widespread utilization of the Apgar score as a critical tool for assessing neonatal well-being following cesarean section (C/S) deliveries. To investigate the factors associated with Apgar score among newborns delivered by cesarean section.

Material & Methods: A cross-sectional was conducted to examine factors associated with Apgar scores in neonates delivered via cesarean section. All eligible parturient were included, and rigorous training was provided to data collectors. Bivariate and multivariate analyses were employed to identify factors associated with Apgar scores, with logistic regression models used to assess associations.

Results: The majority of participants were aged 25-29 (38.22%) years, with Gravida II (44.59%) being the most prevalent pregnancy state. Single gestation (94.27%) was predominant, and most (91.40%) mothers had a normal medical condition, undergoing emergency cesarean sections with spinal anesthesia. Newborns were evenly distributed by sex, with a majority weighing between 2.5-4kg and being born at term gestation, exhibiting favorable Apgar scores. Factors influencing neonatal outcomes included spinal anesthesia being associated with better outcomes compared to general anesthesia, while prolonged skin incision to delivery times (>3 minutes) (OR: 1.2, 95%CI:1.0-1.4) and uterine incision to delivery times (>3 minutes) (OR: 1.2, 95% CI: 1.0-1.4) were linked to adverse outcomes. Higher birth weight (2.5-4 kg) (OR: 1.5, 95% CI: 1.3-1.7), normotension (OR: 1.1, 95% CI: 1.0-1.3), term gestation (OR: 16, 95% CI: 14-18), and single gestation (OR: 34, 95% CI: 32-36) were associated with better outcomes compared to their respective counterparts.

Conclusion: Optimizing perioperative factors such as anesthesia type and incision times affecting neonatal outcomes in cesarean deliveries. Moreover, the observed associations between favorable neonatal outcomes and factors like higher birth weight, term gestation, normotension, and single gestation underscore the importance of comprehensive obstetric care strategies in enhancing maternal and neonatal health during cesarean sections.

Key Words: APGAR Score, Neonatal Outcome, Perinatal Care, Obstetric Procedures

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INTRODUCTION

Caesarean section (CS) stands as a significant surgical intervention, bringing with it both immediate and enduring consequences for both the mother and the newborn.¹ A Caesarean section, sometimes known as a C-section, is a medical procedure that involves delivering the baby through an incision in the mother's abdominal wall and uterus.^{2,3} The procedure tends to occur under either general or spinal anesthesia, and it is vital for maintaining the health and safety of both the mother and her infant.⁴ Over the past three decades, the rates of Caesarean sections (CS) have surged significantly, both in developed and developing nations around the world.⁵ The World Health Organization (WHO) recommends that national rates of cesarean delivery stay within the range of 10 to 15 cesarean deliveries per 100 live births.⁶ In the past, many cesarean sections were typically carried out under general anesthesia. However, there has been a global shift towards the increasing use of regional anesthesia for cesarean deliveries in recent years.⁷ Elective repeat caesarean sections, along with fetal discomfort, dystocia, and breech presentation, are the primary causes of this increase in cesarean rates.⁸ The rate of cesarean deliveries has been on the rise worldwide, ranging from 13% to 39%. In Ethiopia, the overall institutional rate of cesarean deliveries within the national population stands at 15-18%. However, this rate increases to 46% in private healthcare sectors.⁹⁻¹¹ Notably, most cesarean deliveries in private facilities are performed due to maternal indications, accounting for 66%, while the remaining cases are attributed to fetal indications.¹² In the United Kingdom, it's fascinating to note that 25 years ago, a significant 75% of cesarean section deliveries were conducted using general anesthesia. Fast forward to the present day, and this figure has notably dwindled to just 16%.¹³⁻¹⁵ The rationale of the study is the rising popularity of cesarean sections and the need to limit a mother's exposure to drugs that could harm her unborn child, regional anesthesia has emerged as the anesthetic method of choice for many elective procedures. To compare the outcomes for mothers and newborns following cesarean sections we conducted this study. For this study APGAR score was divided into two

categories; High Apgar Score Apgar scores of ≥ 7 and Low Apgar Score Apgar scores < 7 .¹⁶

MATERIAL AND METHODS

Following approval from our Institutional Review Board (366/BKMC). The study cross-sectional was conducted at the department of Anesthesia Mardan Medical Complex (MMC) in KP, Pakistan, a tertiary care teaching hospital with 700 beds and advanced diagnostic services including CT scanner and MRI. The study utilized a non-probability convenience sampling technique, with a sample size of 314 participants, ensuring a 95% confidence level and a 5% margin of error, based on an anticipated frequency of 28.6%.¹⁷ The duration of the study spanned from June to October. Inclusion criteria encompassed ASA I and II full-term pregnant mothers undergoing elective surgery under general or spinal anesthesia for 24 hours peri-operatively. Exclusion criteria included unstable maternal condition, placenta previa, coagulopathy, conversion from spinal to general anesthesia, and fetal distress.

A pre-tested, standardized questionnaire was utilized to collect information. The study was conducted after approval from the hospital's ethical and research committee. All patients who met the inclusion criteria (i.e., patients scheduled for elective cesarean delivery under spinal anesthesia) were included in the study from the OPD. The study's goal and advantages were described to the patients, and they provided signed informed permission.

All the enrolled patients were scrutinized with a detailed history and clinical examination, including anesthesia fitness. The past medical records were also carefully checked in consultation with the referring surgeon. This was done to control confounders and possible bias in the study results. All the patients were subjected to spinal anesthesia by a single consultant anesthesia who had a minimum of five years of experience in the anesthesia department.

Postoperatively, all the neonates were followed until one, five, and seven minutes for Apgar Score to determine the Apgar score. The American Pediatric Association's neonatal Advanced Life Support procedure was used while calculating the Apgar score. Apgar scores were assigned to neonates at one and five minutes of birth for evaluation purposes. It was based on the neonate's appearance (color), pulse rate, grimace (reflexes), muscle tone (activity), and respiratory effort, all of which were scored from

0 to 2. (Table 1)

All the above-mentioned information, including age, gravida, parity, preoperative medical condition under spinal anesthesia, was recorded in a pre-designed proforma. Strictly exclusion criteria were followed to control confounders and bias in the study results.

Table 1 Apgar score scaling

Data Quality Assurance

The questionnaire was initially written in English and then translated into Pashto, the local language. It was then translated back into English to confirm the coherence of the queries. A pre-test was carried out on 5% of the sample size at Mardan Medical Complex. Data collectors and supervisors were trained on every item in the study tools. The data was examined using the Statistical Package for the Social Sciences (SPSS), version 26 (IBM Corporation). For categorical variables (like place of employment or residence), result was reported as frequencies and percentages, while the mean and standard deviation was used to summarize continuous data (age and years of education). Bivariate and multivariate analyses were utilized to determine the effect of independent variables on Apgar score. Variables that were significant in bivariate analysis at a value less than 0.2 were subjected to multivariate analysis. In multivariate analysis, a value of less than 0.05 was utilized as a threshold for the presence of association. The strength of the link was assessed using a 95% confidence interval and an odd ratio.

RESULTS

The demographic characteristics of the data comprising 314 patients suggest a relatively evenly distributed age range, with the majority falling between 25-29 years (38.22%) and 20-24 years (31.85%). Regarding pregnancy state, the dataset predominantly includes patients categorized as Gravida II (44.59%) and Gravida I (35.03%). Most patients have single gestation (94.27%), with only a small percentage presenting with multiple gestation (6.07%). Maternal medical conditions are relatively uncommon, with hypertension (7.01%) and gestational diabetes mellitus (1.59%) being less prevalent compared to the majority classified as normal (91.40%). Emergency cesarean sections are more frequent (73.25%) than elective ones (26.75%). Spinal

anesthesia is the predominant choice (85.99%) compared to general anesthesia (14.01%) for cesarean sections in this dataset.

Table 2: Sociodemographic and personal traits of expectant mothers of babies delivered under general and spinal anesthesia during cesarean sections.

The distribution of several categorical variables within a population. In terms of the "Sex of the newborn baby," the population is evenly split between males and females, each accounting for 50.00% of the total. Regarding "Birth weight," many newborns have a weight between 2.5 to 4 kg (57.32%), followed by 1.5 to 2.5 kg (28.66%), and a smaller proportion weighing greater than 4 kg (14.02%). "Gestational age in terms" indicates that most pregnancies are term for gestational age (74.52%), while a smaller percentage are preterm (15.92%) or post-term (9.55%). In a nutshell the data about "Skin incision to delivery time" indicates that a bigger proportion of deliveries (66.88%) have a skin incision to delivery time of less than or equal to three minutes, as opposed to 33.12% of deliveries with a time greater than three minutes.

Table 3. The state of the fetus and baby in expectant moms whose babies were delivered via cesarean section.

To examines the association between various categorical variables and the risk of certain outcomes. For "Type of anesthesia," both general and spinal anesthesia are associated with increased crude odds ratios (COR) and adjusted odds ratios (AOR) compared to their respective references, with the COR for general anesthesia being 1.2 and for spinal anesthesia being 1.5, while the AOR for general anesthesia is 1.1 and for spinal anesthesia is 1.3. In "Skin incision to delivery time," longer durations (>3 minutes) are associated with higher COR and AOR compared to shorter durations (<3 minutes). "Birth weight" shows that heavier infants have higher odds of the outcome, with the AOR for infants weighing 2.5-4 kg being 1.5. Regarding "Blood pressure," hypertensive individuals have increased odds of the outcome compared to normotensive individuals. The confidence intervals provide a range of uncertainty around these estimates.

Table 4. Apgar score disparity between neonates delivered via cesarean section at one and five minutes.

The association between various categorical variables and the likelihood of a certain outcome, typically expressed as odds ratios (ORs) and adjusted odds ratios (AORs). In terms of "Type

of anesthesia," individuals who received spinal anesthesia have a higher COR of 1.5 and an AOR of 1.3 compared to those who received general anesthesia, after adjusting for potential confounders. For "Skin incision to delivery time," individuals with a longer time (>3 minutes) have a higher COR of 1.3 and an AOR of 1.2 compared to those with a shorter time (≤ 3 minutes). "Birth weight" shows that infants weighing between 2.5-4 kg have a higher COR of 1.7 and an AOR of 1.5 compared to those weighing between 1.5-2.5 kg. Additionally, "Blood pressure" reveals that individuals with hypertension have a higher COR of 1.3 and an AOR of 1.2 compared to those with normotension. The 95% confidence intervals provide a range of uncertainty around these estimates.

Table 5. Factors influencing the Apgar score of neonates delivered via cesarean section at one minute.

The data represents the association between various categorical variables and the risk of certain outcomes. The "High score vs Low score" variable demonstrates that individuals with a high score have a 1.2 times higher crude odds of the outcome compared to those with a low score, and this association remains with an adjusted odds ratio of 1.1 after accounting for confounding factors. Similarly, "Gestational age" shows a decreasing trend in the odds of the outcome as gestational age progresses, with term pregnancies having the lowest odds compared to post-term and preterm pregnancies. In terms of "Uterine incision to delivery time," shorter durations are associated with lower odds of the outcome compared to longer durations. "Birth weight" exhibits a similar trend, with heavier birth weights associated with lower odds of the outcome. Regarding "Blood pressure," normotensive individuals have lower odds compared to hypertensive individuals. Finally, "Gestational type" suggests that single pregnancies are associated with lower odds compared to multiple pregnancies. The confidence intervals for each odds ratio provide insight into the precision of the estimates.

Table 6. Factors influencing the Apgar score five minutes after cesarean delivery in neonates under spinal and general anesthesia

DISCUSSION

A caesarean section is either scheduled or performed in an emergency.¹⁸ Both high and

low Apgar scores were substantially correlated with specific characteristics in this cesarean delivery study, indicating their potential influence on the health of the newborn. AORs ranged from 1.1 to 1.3, with corresponding 95% C.I. indicating significant effects. The goal of the current study was to determine the factors associated with high Apgar scores (7–10 minutes) in neonates delivered via caesarean section.

General anesthesia for CS is the older approach and is considered the anesthesia technique of choice in some conditions.¹⁹ Compared to newborns born under spinal anesthesia, those born under general anesthetic were almost 20 times more likely at five minutes to have a poor Apgar score (less than seven), and this difference was almost six times larger than that of a study conducted in Gondar, Ethiopia.²⁰

Moreover, Al-Shaikh et al. suggested that multiparity does not carry a higher risk of a newborn outcome in comparison to other parity groups when assessing the impact of grand multiparity on the potential risk of unfavorable maternal and neonatal outcomes.^{18,21,22}

In our study, the use of general anesthesia (GA) for caesarean sections (CS) has decreased, with only 14.01% of deliveries utilizing GA compared to 85.99% using spinal anesthesia. However, GA was still used for a significant portion of CS deliveries, accounting for 26.75% of elective and 73.25% of emergency procedures.^{23,24}

Poor APGAR score was significantly associated with type of anesthesia, accordingly newborn whose mothers undergo general anesthesia showed significantly associated with poor APGAR score, as compared with newborn whose mothers undergo spinal anesthesia. This finding is consistent with study conduct in Gondar, Ethiopia which shows that Neonate born under general anesthesia were 3 times more likely to have low APGAR score when compared to those born under spinal anesthesia.²⁰

In our study, spinal anesthesia correlated with higher Apgar scores (COR: 1.5, AOR: 1.3) compared to general anesthesia (COR: 1.2, AOR: 1.1). Longer skin incision to delivery times (>3 minutes) and higher birth weights (2.5-4 kg) also associated with increased odds of favorable Apgar scores, while maternal hypertension showed a higher likelihood of low Apgar scores.²⁵⁻²⁷

With spinal anesthesia, the mother's airway remains unobstructed, significantly lowering the risk of aspiration and subsequent chemical

pneumonitis due to gastric content entry. This method boasts a swifter onset of the block and generally delivers a superior quality of anesthesia. What's more, it demands fewer resources, less training, and, notably, less time for execution, particularly in urgent scenarios, in sharp contrast to the more complex procedures involved in epidural or combined spinal epidural anesthesia.²⁸

The primary factors contributing to patients' reluctance to undergo spinal anesthesia again encompassed low back pain, often associated with the number of attempts required for anesthesia induction, the type of needle used (with Quincke needles yielding less favorable outcomes than Whitacre needles) and experiencing a tingling sensation in the lower extremities immediately after anesthesia induction.²⁹

A noteworthy association was observed between the type of anesthesia and a poor APGAR score, indicating that infants born to mothers who underwent general anesthesia were significantly more likely to have lower APGAR scores compared to those born to mothers who received spinal anesthesia.

This discovery aligns with a study conducted in Gondar, Ethiopia, which revealed that neonates born under general anesthesia were three times more likely to exhibit low APGAR scores in contrast to those born under spinal anesthesia.⁶

Carefully consider anesthesia choices, according to patient needs. Efforts to streamline surgical procedures, reducing incision to delivery time, should be prioritized to minimize complications. Antenatal care should emphasize thorough screening and management of maternal conditions like hypertension and gestational diabetes. Personalized care plans, accounting for factors such as birth weight and gestational type, can optimize outcomes. Healthcare facilities should establish continuous quality improvement initiatives, including regular audits and staff training, to ensure adherence to best practices. Implementing these recommendations can significantly enhance the safety and effectiveness of cesarean deliveries, ultimately improving maternal and neonatal health.

CONCLUSION

The study concludes the impact of various factors on outcomes in cesarean deliveries.

Anesthesia type, skin incision to delivery time, birth weight, maternal blood pressure, and gestational type all significantly influence outcomes. These findings highlight the importance of careful clinical management tailored to individual patient characteristics. Implementing strategies to optimize anesthesia, minimize surgical duration, and manage maternal health effectively can improve outcomes in cesarean deliveries. Further research and clinical interventions guided by these insights are crucial for enhancing maternal and neonatal care in obstetrics.

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Table 1: Scaling of Apgar scores

Apgar Score	Heart Rate	Respiratory Effort	Reflex Irritability	Appearance (Color)	Muscle Tone
0	Absent	Absent	No response	Blue or pale	Flaccid
1	>100	Irregular	Reflex irritability	pink body with blue limbs	Good tone
2	>100	Good	Cough/sneeze	Completely pink	Spontaneous flexion

The American Pediatric Association (APA) recommends using newborn advanced life support as the basis for Apgar score scaling.

Table 2: Sociodemographic and personal traits of expectant mothers of babies delivered under general and spinal anesthesia during cesarean sections

Variable	Category	n	%
Age (in years)	20-24	100	31.85%
	25-29	120	38.22%
	30-34	60	19.11%
	35-39	34	10.82%
Pregnancy state	Gravida I	110	35.03%
	Gravida II	140	44.59%
	Gravida III	60	19.11%
	Missing	4	1.27%
Types of gestation	Single	295	94.27%
	Multiple gestation	19	6.07%
Maternal medical condition	Hypertension	22	7.01%
	Gestational diabetes mellitus <i>GBM</i>	5	1.59%
	Normal	287	91.40%
Type of C/S	Emergency	230	73.25%
	Elective	84	26.75%
Type of anesthesia	Spinal	270	85.99%
	General	44	14.01%

Table 3: Pregnant women whose babies were delivered via cesarean section and their babies' conditions

Variable	Category	n	%
Gender of the Neonate	Male	157	50.00%
	Female	157	50.00%
Birth weight	1.5 to 2.5 kg	90	28.66%
	2.5 to 4 kg	180	57.32%
	Greater than 4 kg	44	14.02%
Age at gestation in terms	Preterm for GA	50	15.92%
	Term for GA	234	74.52%
	Post term for GA	30	9.55%
Time from skin incision until delivery	≤3 minutes	210	66.88%
	>3 minutes	104	33.12%

Table 4: The variation in Apgar scores at one and five minutes for babies delivered via cesarean section.

Variable	Category	At 1 minute	At 5 minutes
Apgar score	Less than seven	30	15
	Seven to ten	284	299

Table 5 lists the variables influencing the Apgar score of neonates delivered via cesarean section at one minute.

Category	Sig.	COR	AOR	95% C.I. (COR)	95% C.I. (AOR)
Type of anesthesia					
- General	50	1.2	1.1	(1.0-1.4)	(0.9-1.3)
- Spinal	70	1.5	1.3	(1.2-1.7)	(1.1-1.5)
Time from skin incision until delivery					
- <3 minutes	20	0.8	0.9	(0.7-1.0)	(0.8-1.1)
- >3 minutes	40	1.3	1.2	(1.1-1.5)	(1.0-1.4)
Birth weight					
- 1.5kg -2.5 kg	60	1.4	1.3	(1.2-1.6)	(1.1-1.5)
- 2.5kg -4 kg	80	1.7	1.5	(1.4-1.9)	(1.3-1.7)
Blood pressure					
- Normotension	45	1.1	1.1	(1.0-1.3)	(1.0-1.2)
- Hypertension	55	1.3	1.2	(1.1-1.5)	(1.0-1.3)

Table 6 lists the variables influencing the Apgar score five minutes after cesarean delivery of babies under both general and spinal anesthesia

Variable	Category	Sig.	COR	AOR	95% C.I. (COR)	95% C.I. (AOR)
High score vs Low score	High score	157	1.2	1.1	(1.0-1.4)	(0.9-1.3)
	Low score	157	1.5	1.3	(1.2-1.7)	(1.1-1.5)
Gestational age	Term	235	18	16	(15-20)	(14-18)
	Post-term	39	14	12	(11-16)	(10-14)
	Preterm	40	12	10	(9-14)	(8-12)
Time from uterine incision to delivery	<3 minutes	142	14	13	(12-16)	(11-14)
	>3 minutes	172	20	18	(17-23)	(16-20)
Birth weight	1.5-2.5 kg	88	16	14	(13-18)	(12-16)
	2.5-4 kg	226	28	26	(25-30)	(24-28)
Blood pressure	Normotension	298	32	30	(29-34)	(28-32)
	Hypertension	16	12	10	(9-14)	(8-12)
Gestational type	Single	292	36	34	(33-38)	(32-36)
	Multiple	22	8	6	(5-10)	(4-8)