Al-Rafidain J Med Sci. 2026;10(1):170-175.
DOI: https://doi.org/10.54133/ajms.v10i1.2710

AJMS

Online ISSN (3219-2789)

Research Article

The Effects of Mode of Delivery on 5-Minute APGAR Score and Neonatal Outcomes: A Cross-sectional Study in Kirkuk, Iraq

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Received: 31 December 2025; Revised: 8 February 2026; Accepted: 11 February 2026

Abstract

Background: The Apgar score assessed at five minutes serves as a vital measure of a neonate's capacity to survive and thrive. ***Objective***: To assess the relationship between mode of delivery at term and neonatal APGAR score at 5 minutes and neonatal outcomes. ***Methods***: This study was a descriptive cross-sectional study conducted in the labor ward of the department of Obstetrics and Gynecology in Azadi Teaching Hospital, Kirkuk City, Iraq, from 1st of October 2022 to 1st of October 2023. The study sample included 150 pregnant women at term with labor. The mode of delivery was decided by the obstetrician in the labor ward. The APGAR score at 5 minutes and other neonatal outcomes were assessed by the pediatrician in the labor room and followed up for one week after delivery. ***Results***: The mode of delivery was distributed as follows: spontaneous vaginal delivery (26.7%), instrumental vaginal delivery (20.6%), elective cesarean section (26%), and emergency cesarean section (26.7%). The mean APGAR score at 5 minutes for neonates was 7; 12% of them had an intermediate APGAR score, and 17.3% of them had a low APGAR score. The mean APGAR score at 5 minutes was significantly lower in neonates delivered by instrumental vaginal delivery (p<0.001). ***Conclusions***: The mode of delivery, particularly instrumental vaginal delivery, affects the low APGAR score at 5 minutes of neonates.

Keywords: APGAR score at 5 minutes, Mode of delivery; Neonatal outcomes.

تأثير طريقة الولادة على نتيجة APGAR لمدة 5 دقائق ونتائج حديثي الولادة: دراسة مقطعية في كركوك، العراق

الخلاصة

الخلفية: درجة أبغار التي تقيم عند خمس دقائق تعد مقياسا حيويا لقدرة الطفل الجديد على البقاء والنمو. **الهدف**: تقييم العلاقة بين طريقة الولادة عند الولادة ودرجة APGAR لحديثي الولادة عند 5 دقائق ونتائج حديثي الولادة. **الطرائق**: دراسة مقطعية وصفية أجريت في جناح الولادة بقسم التوليد وأمراض النساء في مستشفى آزادي التعليمي بمدينة كركوك، العراق، خلال الفترة من 1 أكتوبر 2022 إلى 1 أكتوبر 2023. شملت عينة الدراسة 150 امرأة حامل في فترة الولادة. تم تحديد طريقة الولادة من قبل طبيب التوليد في جناح الولادة. تم تقييم نتيجة APGAR بعد 5 دقائق ونتائج حديثي الولادة الأخرى من قبل طبيب الأطفال في غرفة الولادة وتابعها لمدة أسبوع بعد الولادة. **النتائج**: تم توزيع طريقة الولادة كما يلي: الولادة الطبيعية الطبيعية (26.7٪)، الولادة المهبلية الآلية (20.6٪)، الولادة القيصرية الاختيارية (26٪)، والولادة القيصرية الطارئة (26.7٪). كان متوسط درجة APGAR عند 5 دقائق للأطفال الجدد 7؛ 12٪ منهم حصلوا على درجة APGAR متوسطة، و17.3٪ منهم حصلوا على درجة APGAR منخفضة. كان متوسط درجة APGAR عند 5 دقائق أقل بشكل ملحوظ في الولادة التي ولدت عن طريق الولادة المهبلية (p<0.001). **الاستنتاجات**: طريقة الولادة، وخاصة الولادة المهبلية الأداة، تؤثر على انخفاض درجة APGAR عند 5 دقائق لدى حديثي الولادة.

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Article citation: Mohammed EA, Taha MA. The Effects of Mode of Delivery on 5-Minute APGAR Score and Neonatal Outcomes: A Cross-sectional Study in Kirkuk, Iraq. *Al-Rafidain J Med Sci.* 2026;10(1):170-175. doi: https://doi.org/10.54133/ajms.v10i1.2710

INTRODUCTION

Obstetricians are sometimes facing big dilemmas in decisions regarding the appropriate delivery mode of pregnant women at term, aiming for favorable maternal and neonatal outcomes. Many predictive models using significant parameters are helpful in the identification of the best delivery mode. However, some controversies are present when making decisions regarding the choice of operative vaginal delivery or cesarean section (CS) for lifesaving and outcome improvement [1]. Despite being the commonest vaginal delivery mode for pregnant women, the global incidence rate of cesarean section increased from 5% in 1970 to 31.9% in 2016 [2]. The spontaneous vaginal delivery (SVD) is defined as vaginal delivery in the absence of instruments. Recent guidelines recommended elevating the rate of SVD and reducing dispensable interventions [3,4]. According to the World Health Organization (WHO), the cesarean rate in the population should not exceed 10% of deliveries to ensure good maternal and neonatal outcomes [5]. For that, the rate of SVD must reach 90% to reduce the maternal or neonatal mortality [5,6]. In the United States, the rate of SVD is reaching about 65%, while the cesarean section rate is about 31.7% and the instrumental vaginal delivery (IVD) rate is about 3% [7]. The instrumental vaginal delivery is defined as a vaginal delivery with the help of instruments (vacuum or forceps) that is done in the presence of maternal or fetal complications or both [8]. The IVD rate is variable from country to country and variable in the same

country in areas with an unknown ideal rate. [9] However, the Royal College of Obstetricians and Gynecologists (RCOG) reported an IVD rate of 10.5% with a range of 4% to 20% and recommended reducing the rate to 8.5% [10]. In the United Kingdom, the reported rate of IVD ranged between 10% and 15%, while in the United States it was about 4.5% [9]. In developing countries, the rate of IVD is lower than in developed countries [9]. Choosing a suitable instrument for IVD differs regarding the experience of the obstetrician and the safety of the instrument, in addition to the availability of the instrument. In some countries, vacuum was preferred over forceps [10]. Others, however, favored the use of forceps [8]. Many authors found that neonatal complications were more with vacuum, while maternal complications were more with forceps. However, it was shown that the APGAR score at 5 minutes was low in IVD, with no difference in complications between forceps and vacuum interventions [11]. The WHO regarded IVD as emergency obstetric care, which could be associated with poor maternal and neonatal outcomes [12]. The cesarean section is defined as fetal birth by open abdominal incision and incision in the uterus [13]. Previously, the CS was implemented to lower maternal and neonatal morbidity and mortality rates. Recently, some communities have regarded the cesarean section as a luxurious procedure, even though it is still used to save lives and reduce co-morbidities for both mothers and fetuses [14]. The cesarean section is indicated in women who are difficult to deliver vaginally, which are maternal indications (prior CS, pelvic deformity, previous perineal trauma, etc.), uterine indications (abnormal placentation, placental abruption, tumor, etc.), and fetal indications (fetal distress, cord prolapse, malpresentation, congenital anomaly, etc.) [15,16]. Maternal request recently became an indicator for CS [17]. According to the presence of medical urgency by these indications, the CS was divided into elective and emergency CS [17]. However, some authors reported no differences in maternal and neonatal complications between elective CS and SVD [18]. In Iraq, the cesarean section rate is higher than the WHO recommendation of 10% [19,20]. It was shown that the CS rate in Iraq in 2012 was 24.4%, in the Kurdistan Region 25.4%, and in the Center/South of Iraq 24.3% [21]. Economic and sociocultural changes of the Iraqi population in the last decades, in addition to inflation in the private healthcare sector, were the common reasons for high CS rates [22]. This study aimed to assess the relationship between mode of delivery for pregnant women at term and neonatal APGAR score at 5 minutes by evaluating the effect of delivery mode on neonatal outcome.

METHODS

Study design and setting

The current analysis was a descriptive cross-sectional study carried out in the labor ward of the Department of Obstetrics and Gynecology, Azadi Teaching Hospital in Kirkuk City, Iraq, from the 1st of October 2022 to the 1st of October 2023. The study included a sample size of 150 pregnant women who were in labor and presented to the labor room at term.

Inclusion criteria

Pregnant women with term gestational age and signs of true labor.

Exclusion criteria

Multiple pregnancy, preterm labor, postdate and post-term pregnancy, maternal medical disease, congenital fetal anomaly, fetal chromosomal anomaly, maternal smoking, Rh-negative women, previous delivery by cesarean section, induction of labor, antepartum or intrapartum fetal distress, and birth weight less than 2.5 kg.

Sample size calculation

A convenient sample of one hundred and fifty pregnant women at term was enrolled in the present study. n=Z2P(1−P)/d2, 1.962 x 0.065(1-0.065)/0.052=94 that approximated to 100 and maximized the study power to one hundred and fifty.

Data collection and outcome measurements

Information of pregnant women was collected either directly by the researcher or from their records through a prepared questionnaire designed according to previous literature. The questionnaire included general characteristics of pregnant women at term (maternal age, body mass index, parity, miscarriage, and mode of delivery) and neonatal outcomes (birth weight, hypothermia, hypoglycemia, respiratory distress syndrome, jaundice, convulsion, neonatal intensive care unit [NICU] admission, neonatal death, and APGAR score at 5 minutes). The mode of delivery was decided by the responsible obstetrician in the labor ward according to the status of the pregnant women and their preferences. Instrumental vaginal delivery included ventouse and forceps delivery, while cases of cesarean section were elective, such as breech presentation or previous 3 CS, and some cases were emergency, which were done due to sudden deterioration in maternal or fetal condition. The APGAR score at 5 minutes and other neonatal outcomes were assessed by the pediatrician in the labor room and followed up for one week after delivery. The pediatrician was checking appearance, pulse, grimace, activity, and aspiration for reporting the APGAR score at 5 minutes. The maternal age was categorized into four groups (<20 years, 20-29 years, 30-39 years, and ≥40 years). The body mass index was classified into normal (<25 kg/m²), overweight (25-29.9 kg/m²), and obese (≥30 kg/m²). Parity and miscarriage history were assessed and classified accordingly. Modes of delivery were spontaneous, instrumental, elective cesarean section, and emergency cesarean section. The birth weight was either normal (2.5–4 kg) or high (>4 kg). The APGAR score was categorized into normal (≥7), intermediate (4-6), and low (<4).

Ethical considerations

The study ethics were implemented regarding the Helsinki Declaration by oral informed consent of pregnant women, agreement of health authorities, and management of neonatal complications accordingly. The study was approved by the ethical committee of the University of Kirkuk with approval number 18 on 9 October 2022.

Statistical analysis

The pregnant women's data were entered and interpreted statistically by the Statistical Package of Social Sciences (SPSS) program, version 26. Suitable statistical tests for data were implemented; accordingly, chi-square and Fisher's exact tests were used for comparison of categorical variables, while for continuous variables, the one-way ANOVA analysis was used to compare more than two means. The *p*-value of <0.05 was significant.

RESULTS

This study included 150 pregnant women at term presenting for labor with a mean age of 27.3 years; 23.3% of pregnant women were in the age group <20 years. The mean BMI of pregnant women was 29.3 kg/m²; 50% of them were obese. The mean parity of pregnant women was 2.6; 18% of them were nulliparous, and the miscarriage history was positive in 25.3% of pregnant women. The mode of delivery for pregnant women was distributed as follows: spontaneous vaginal delivery (26.7%), instrumental vaginal delivery (20.6%), elective cesarean section (26%), and emergency cesarean section (26.7%). (Table 1).

Table 1: General characteristics of pregnant women at term

Variable	Result
Maternal age (year)	27.3±7.7
<20	35(23.3)
20-29	51(34)
30-39	52(34.7)
≥40	12(8)
Body mass index (kg/m²)	29.3±3.9
Normal	25(16.7)
Overweight	50(33.3)
Obese	75(50)
Parity	2.6±2.1
Nulliparous	27(18)
1-5 para	94(62.7)
≥5 para	29(19.3)
Miscarriage	0.4±0.9
Yes	38(25.3)
No	112(74.7)
Mode of delivery	
Spontaneous VD	40(26.7)
Instrumental VD	31(20.6)
Elective CS	39(26)
Emergency CS	40(26.7)
Total	150(100)

Values are expressed as frequency, percentage, and mean±SD. CS: cesarean section; VD: vaginal delivery.

The mean birth weight of neonates was 3.4 kg; 12.7% of them had high birth weight (more than 4 kg). The hypothermia, hypoglycemia, RDS, jaundice, and convulsion complications were present in 9.3%, 10%, 14%, 8.7%, and 10.7% of neonates, respectively. NICU admission was present in 34.7% of neonates, while neonatal death was reported in 6% of them. The mean APGAR score at 5 minutes for neonates was 7; 12% of them had an intermediate APGAR score, and 17.3% of them had a low APGAR score at 5 minutes (Table 2).

Table 2: Neonatal outcomes of pregnant women at term

Variable	Result
Birth weight (kg)	3.4±0.5
Normal	131(87.3)
High	19(12.7
Hypothermia	
Yes	14(9.3)
No	136(90.7)
Hypoglycemia	
Yes	15(10)
No	135(90)
Respiratory distress syndrome	
Yes	21(14)
No	129(86)
Jaundice	
Yes	13(8.7)
No	137(91.3)
Convulsion	
Yes	16(10.7)
No	134(89.3)
Neonatal care unit admission	
Yes	52(34.7)
No	98(65.3)
Neonatal death	
Yes	9(6)
No	141(94)
APGAR score at 5 min	7.0±2.5
Normal	106(70.7)
Intermediate	18(12)
Low	26(17.3)
Total	150(100)

Values are expressed as frequency, percentage, and mean±SD.

No significant differences were observed between different modes of delivery and the characteristics of pregnant women that include maternal age (p= 0.43), BMI (p= 0.7), parity (p= 0.3), and miscarriage (p= 0.94). (Table 3). No significant differences were observed between different delivery modes and neonatal outcomes that include birth weight (p= 0.68), RDS (p= 0.4), convulsion (p= 0.09), and neonatal death (p= 0.9). Hypothermia and hypoglycemia were significantly prevalent in the neonates of women delivered by instrumental vaginal delivery (p= 0.01, p= 0.002, respectively). The jaundice and NICU admission were significantly related to women delivered by emergency cesarean section (p= 0.03, p= 0.004, respectively). There was a significant association between neonates with low APGAR scores and women delivered by instrumental vaginal delivery (p= 0.01); the mean APGAR score at 5 minutes was significantly lower in neonates of women delivered by instrumental vaginal delivery (p< 0.001). (Table 4).

DISCUSSION

The low APGAR score is a common indicator of assessing the status of newborns in low-risk and high-risk pregnancies [23].

Table 3: Distribution of pregnant women general characteristics according to mode of delivery

Variable	Mode of delivery				*p-value*
	SVD	IVD	Elective CS	Emergency CS	
Maternal age (year)					
<20	13(32.5)	7(22.5)	6(15.4)	9(22.5)	0.43*
20-29	9(22.5)	10(32.3)	13(33.3)	19(47.5)	
30-39	14(35)	11(35.5)	17 (43.6)	10 (25)	
≥40	4(10)	3(9.7)	3(7.7)	2(5)	
Body mass index					
Normal	9(22.5)	3(9.7)	7(17.9)	6(15)	0.7**
Overweight	14(35)	13(41.9)	11(28.3)	12(30)	
Obese	17(42.5)	15(48.4)	21(53.8)	22(55)	
Parity					
Nulliparous	11(27.5)	4(12.9)	4(10.3)	8(20)	0.3**
1-2 para	19(47.5)	22(71)	27(69.2)	26(65)	
≥5 para	10(25)	5(16.1)	8(20.5)	6(15)	
Miscarriage					
Yes	10(25)	9(29)	10(25.6)	9(22.5)	0.94**
No	30(75)	22(71)	29(74.4)	31(77.5)	

Values are expressed as frequency and percentage. * Fishers exact test, **Chi-square, NS=Not significant.

Table 4: Distribution of neonatal outcomes according to mode of delivery

Variable	Mode of delivery				*p-value*
	SVD	IVD	Elective CS	Emergency CS	
Birth weight					
Normal	36(90)	27(87.1)	32(82.1)	36(90)	0.68*
High	4(10)	4(12.9)	7(17.9)	4(10)	
Hypothermia					
Yes	2(5)	6(19.4)	0(0)	6(15)	0.01*
No	38(95)	25(80.6)	39(100)	34(85)	
Hypoglycemia					
Yes	2(5)	8(25.8)	0(0)	5 (12.5)	0.002*
No	38(95)	23(74.2)	39(100)	35(87.5)	
Respiratory distress syndrome					
Yes	3(7.5)	4(12.9)	8(20.5)	6(15)	0.4**
No	37(92.5)	27(87.1)	31(79.5)	34(85)	
Jaundice					
Yes	0(0)	5(16.1)	2(5.1)	6(15)	0.03**
No	40(100)	26(83.9)	37(94.9)	34(85)	
Convulsion					
Yes	2(5)	4(12.9)	2(5.1)	8(20)	0.09*
No	38(95)	27(87.1)	37(94.9)	32(80)	
Neonatal care unit admission					
Yes	7(17.5)	16(51.6)	10(25.6)	19(47.5)	0.004**
No	33(82.5)	15(48.4)	29(74.4)	21(52.5)	
Neonatal death					
Yes	2(5)	2(6.5)	2(5.1)	3(7.5)	0.9*
No	38(95)	29(93.5)	37(94.9)	37(92.5)	
Apgar score at 5 minutes					
Normal	33(82.5)	15(48.4)	33(84.6)	25(62.5)	0.01**
Intermediate	2(5.)	6(19.4)	3(7.7)	7(17.5)	
Low	5(12.5)	10(32.2)	3(7.7)	8(20)	
Mean±SD	7.8±2.3	5.4±2.5	7.7±1.9	6.5±2.4	<0.001***

Values are expressed as frequency and percentage. *Fishers exact test, **Chi-square test, ***One way ANOVA analysis.

It was shown that low APGAR scores are accompanied by perinatal, neonatal, and infantile morbidity and mortality [24]. In the present study, the mean APGAR score at 5 minutes for neonates of pregnant women at term was 7; 70.7% were normal, 12% were intermediate, and 17.3% of them had a low APGAR score at 5 minutes. These findings are higher than the results of Thavarajah *et al*. in Australia, who revealed that the APGAR scores of 39,258 singleton pregnancies at term were distributed as follows: normal (98.6%), intermediate (1.1%), and low (0.3%) [25]. This higher discrepancy might be due to differences in sample size and prevalence of maternal co-morbidities between two studies, in addition to differences in general health status between different populations. A study by Zaigham *et al*. in Sweden reported that the median APGAR score at 5 minutes for pregnant women with a gestational age less than 28 weeks was 7; for pregnant women with a gestational age of 28 weeks, it was 8; for pregnant women with a gestational age of 29–30 weeks, it was 9; and for pregnant women with a gestational age of more than 31 weeks, it was 10 in the absence of maternal and fetal co-morbidities [26]. In our study, the mean APGAR score at 5 minutes was significantly lower in neonates of women delivered by instrumental vaginal delivery ($p< 0.001$). This finding coincides with the results of a retrospective study reported by Kadas *et al*. in Nigeria, which found a statistically significant association between a low APGAR score at 5 minutes, and pregnant women delivered via instrumental vaginal delivery [10]. The current study showed a significant

association between neonates with low APGAR scores at 5 minutes and women delivered by instrumental vaginal delivery (p= 0.01). This finding is similar to the results of much literature, such as that reported by Priangga *et al*. in Indonesia and Thakur *et al*. in Nepal, where both reported lower APGAR scores at 5 minutes for newborns of pregnant women at term delivered by instrumental vaginal delivery as compared to pregnant women delivered by other modes [27,28]. Inconsistently, a recent study by Paudyal documented no effect of delivery mode on APGAR score at 5 minutes, but the effect is attributed to maternal age, weight, parity, and low birth weight of newborns [29]. Additionally, our study found low APGAR scores at 5 minutes for pregnant women delivered by emergency CS. These findings are in agreement with the results of the Shamsa *et al*. study in Australia, which reported that pregnant women delivered by SVD had higher APGAR scores at 5 minutes, while pregnant women delivered by operative vaginal delivery or by emergency cesarean section had lower mean APGAR scores at 5 minutes [1]. A study conducted in Tanzania by Tarimo *et al*. showed that fetal birth weight, maternal age, and gestational age were important predictors for low APGAR score after induced vaginal delivery [30]. While other studies revealed that the maternal COVID-19 infection during pregnancy and gestational thrombocytopenia are predictors of low 5-minute APGAR scores [31,32]. In the current study, hypothermia and hypoglycemia were significantly prevalent in neonates of women delivered by instrumental vaginal delivery (p= 0.01 and p= 0.002, respectively). These findings are in agreement with results of studies by Peters *et al*. in the Netherlands and Ramzan *et al*. in Pakistan, which reported the relationship between each of neonatal hypothermia and hypoglycemia with pregnant women delivered by instrumental vaginal delivery [33,34]. Our study also revealed a significant relationship between jaundice and NICU admission in women delivered by emergency cesarean section (p= 0.03 and p= 0.004, respectively). Consistently, a study by Naghipour *et al*. in Iran showed that the neonates of women delivered by emergency cesarean section were more prevalent in jaundice [35]. Regarding NICU admission, Choudhary *et al*. in India revealed higher neonatal NICU admission for pregnant women delivered by emergency CS as compared to elective CS [36]. Inconsistently, Farhat *et al*. in Iran reported no statistically significant difference in jaundice and NICU admission of neonates regarding different delivery modes [37]. This inconsistency might be due to differences in maternal factors between different studies. Generally, a recent study carried out in Jordan by Khasawneh *et al*. stated that cesarean section had a significant impact on neonatal outcomes, specifically low APGAR score at 5 minutes, jaundice, and high NICU admission rate [38].

Conclusion

The low APGAR score at 5 minutes of neonates is affected by mode of delivery, especially instrumental vaginal delivery. The proportion of low APGAR scores in this study is high as compared to other literature. The adverse neonatal outcomes are more prevalent in pregnant women delivered by instrumental vaginal delivery and emergency cesarean section. This study recommended prevention of emergencies and operative vaginal deliveries as much as possible. The novel contribution of this study lies in its detailed comparison of delivery modes and their specific associations with neonatal health in the early minutes of life. Additional national longitudinal studies are needed to investigate the impact of delivery mode on the 5-minute APGAR score.

Conflict of interests

The authors declared no conflict of interest.

Funding source

The authors did not receive any source of funds.

Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

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