Comparison of short-term neonatal hemodynamic and metabolic outcomes in preterm births by mode of delivery

Comparación de los resultados hemodinámicos y metabólicos neonatales a corto plazo en nacimientos prematuros según el modo de parto

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Abstract

Introduction: Preterm birth remains a significant public health challenge due to the high risk of complications involving immature cardiopulmonary, renal, and metabolic systems. Despite various interventions, the optimal mode of delivery for preterm infants—particularly in relation to cardiovascular and hemodynamic stability—remains controversial. This study aimed to compare short-term neonatal outcomes following vaginal and cesarean deliveries in preterm births, with a focus on common complications related to circulatory, respiratory, and metabolic functions.

Methods: This cohort study was conducted at Afzalipour Hospital in Kerman, Iran, between 2010 and 2018. Pregnant women with preterm labor were included and categorized based on mode of delivery: vaginal (n=425) and cesarean section (n=330). Each group was stratified by gestational age (≤24, 25–27, 28–30, 31–33, and 34–36 weeks). Key neonatal outcomes—including respiratory distress syndrome (RDS), hyperbilirubinemia, patent ductus arteriosus (PDA), ventilator dependence, and NICU admission—were recorded and analysed using SPSS-20.

Results: The incidence of RDS (52.5% vs. 43.3%, p=0.02), neonatal jaundice (24.4% vs. 17.3%, p=0.03), and ventilator dependence (20.2% vs. 11.2%, p=0.01) was significantly higher in neonates delivered by cesarean section. Among appropriate-for-gestational-age (AGA) infants, PDA was less frequent following vaginal delivery (5.9% vs. 11.2%, p=0.01). NICU admission was significantly higher for AGA infants delivered by cesarean at 28–30 weeks (p=0.04) and for large-for-gestational-age (LGA) infants above 34 weeks (p=0.04).

Conclusion: The findings suggest that vaginal delivery in preterm births may lead to more favourable early neonatal outcomes, particularly in terms of respiratory function, hemodynamic stability, and metabolic adaptation. These results can contribute to improved clinical decision-making for high-risk pregnancies, with a focus on optimising cardiovascular and systemic outcomes in premature newborns.

Keywords: Preterm birth, neonatal outcomes, cesarean section, vaginal delivery, hemodynamics, respiratory distress, PDA, NICU, metabolic complications.

Resumen

Introducción y antecedentes. El parto prematuro sigue siendo un importante reto para la salud pública debido al alto riesgo de complicaciones que afectan a los sistemas cardiopulmonar, renal y metabólico inmaduros. A pesar de diversas intervenciones, la modalidad óptima de parto para los prematuros, en particular en relación con la estabilidad cardiovascular y hemodinámica, sigue siendo controvertida. Este estudio tuvo como objetivo comparar los resultados neonatales a corto plazo tras partos vaginales y cesáreas en prematuros, centrándose en las complicaciones comunes relacionadas con las funciones circulatoria, respiratoria y metabólica.

Métodos. Este estudio de cohorte se realizó en el Hospital Afzalipour de Kermán, Irán, entre 2010 y 2018. Se incluyeron mujeres embarazadas con trabajo de parto prematuro, categorizadas según la vía de parto: vaginal (n = 425) y cesárea (n = 330). Cada grupo se estratificó por edad gestacional (≤24, 25-27, 28-30, 31-33 y 34-36 semanas). Los resultados neonatales clave, como el síndrome de dificultad respiratoria (SDR), la hiperbilirrubinemia, el conducto arterioso persistente (CAP), la dependencia del respirador y el ingreso en la UCIN, se registraron y analizaron mediante el programa SPSS-20.

Resultados. La incidencia de SDR (52,5 % frente a 43,3 %, p = 0,02), ictericia neonatal (24,4 % frente a 17,3 %, p = 0,03) y dependencia de ventilación mecánica (20,2 % frente a 11,2 %, p = 0,01) fue significativamente mayor en los neonatos nacidos por cesárea. Entre los neonatos con edad gestacional adecuada (AEG), el DAP fue menos frecuente tras el parto vaginal (5,9 % frente a 11,2 %, p = 0,01). El ingreso en la UCIN fue significativamente mayor en los neonatos con edad gestacional adecuada (AEG) nacidos por cesárea entre las 28 y 30 semanas (p = 0,04) y en los neonatos grandes para la edad gestacional (GEG) mayores de 34 semanas (p = 0,04).

Conclusión. Los hallazgos sugieren que el parto vaginal en partos prematuros puede conducir a resultados neonatales tempranos más favorables, especialmente en términos de función respiratoria, estabilidad hemodinámica y adaptación metabólica. Estos resultados pueden contribuir a una mejor toma de decisiones clínicas en embarazos de alto riesgo, con especial atención a la optimización de los resultados cardiovasculares y sistémicos en recién nacidos prematuros.

Palabras clave: Nacimiento prematuro, resultados neonatales, cesárea, parto vaginal, hemodinámica, dificultad respiratoria, PCA, UCIN, complicaciones metabólicas.

Introduction

Preterm birth, or birth before 37 weeks of gestation, is a leading cause of neonatal morbidity and mortality[1-3], influencing 15 million infants annually on a global scale[4]. According to a meta-analysis conducted in Iran in 2017, out of 41,773 newborns studied in 19 articles, the overall rate of preterm babies in Iran was about 10%; the lowest rate of which was related to the Bam City (Kerman Province) (4.5%), while the highest was reported in Tehran province (19.8%)[5].

Preterm birth not only increases the risk of death but also poses serious threats to immature organ systems, including cardiovascular, pulmonary, renal, and metabolic functions[6,7]. It has been determined that for premature infants, C-section delivery can decrease the neonatal mortality risk because of the reduction of trauma and stress compared to vaginal delivery[8,9]. However, the impacts delivery modes have on preterm infants' outcomes remains unclear. Due to the enhanced maternal morbidity and costs related to preterm C-section deliveries, it is crucial to limit this mode of delivery only to situations where there is a clear advantage for either the infant or the mother[8].

Furthermore, the hemodynamic adaptation of neonates, especially the transition from fetal to neonatal circulation, may vary between delivery methods and influence early neonatal outcomes[8].

Previous research has been controversial. Deulofeut et al., conducted a study on preterm infants born before 34 weeks gestation, finding a decrease in mortality and incidences of Intracranial hemorrhage (IVH) associated with vaginal delivery[10]. In addition, Lee & Gould, demonstrated a reduction in mortality rates among fully developed preterm infants delivered vaginally[11]. Other studies have reported significant differences in outcomes between c-section and vaginal deliveries[12,13]. However, in another study, no significant differences between vaginal and cesarean deliveries were observed, except for neonatal respiratory distress syndrome, except for a decrease in neonatal respiratory distress syndrome associated with vaginal deliveries[14]. This decrease was attributed to better pulmonary fluid clearance and improved spontaneous respiration in vaginally delivered neonates, which supports early cardiopulmonary stability.

Given the increase in premature birth cases, identifying the most appropriate delivery method may reduce complications such as respiratory failure, metabolic imbalance, hypotension, renal dysfunction, and extended NICU hospitalization. Therefore, this research purpose is to compare short-term complications in preterm newborns based on the two most common delivery modes in Iran: cesarean section and vaginal delivery.

Study Population

This cohort study, carried out between 2010 (1390 AH) and 2018 (1398 AH) after approval by the Kerman University of Medical Sciences Ethics Committee with the code IR.KMU.AH.REC.1398.137, focused on pregnant women who were referred to Kerman's Afzalipur Hospital (Kerman City, Iran) with symptoms of premature labor (defined as less than 37 weeks gestation by last menstrual time or less than 20 weeks by ultrasound). The potential occurrences of complications in newborns were prospectively monitored for each case in the vaginal delivery and C-section delivery groups.

Acceptable indications for cesarean delivery included breech presentation, history of previous cesarean section, C-section due to the history of infertility, prior colporrhaphy surgery, non-uterine birth canal anomalies, cephalopelvic disproportion, and elective cesarean section.

Inclusion and Exclusion Criteria

Maternal criteria for exclusion from the study included the presence of specific obstetric indications such as pre-eclampsia necessitating the termination of a premature pregnancy, multiple gestation, premature rupture of fetal membranes lasted more than 18 hours, first trimester bleeding, placental abruption, uterine anomalies, weight below 45 kilograms, height under 150 cm, RH incompatibility, and epilepsy. Pregnant women with sexually transmitted diseases, as well as those with underlying conditions such as cardiovascular diseases, anemia, diabetes, thyroid disorders, and autoimmune diseases, and those with addictions to alcohol, smoking, or drugs, were also excluded. Neonatal exclusion criteria encompassed congenital anomalies, breech delivery, fetal distress necessitating termination of pregnancy, and the requirement for immediate neonatal surgery.

Data Collection

The data collection method involved taking a medical history, interviewing the mother, examining the mother, reviewing the hospitalization file post-delivery, and monitoring the newborns' health status through medical history collection and phone calls to the mothers during the five days and one month following birth. The demographic information of the mother, as well as details regarding preterm infants, including the baby's gender, gestational age, Apgar score, birth time, need for NICU hospitalization, duration of hospitalization, ventilator dependence, factors contributing to death during hospitalization, duration before initiation of oral feeding, weight upon NICU admission and discharge, and the presence of respiratory distress syndrome, neonatal jaundice, neonatal infections, PDA (patent ductus arteriosus), Intracranial hemorrhage, asphyxia, and NEC (necrotizing enterocolitis), were documented in the data collection forms.

In the present study, we used the 10th and 90th percentiles to categorize infants' weight as SGA (small for gestational age), AGA (appropriate for gestational age), and LGA (large for gestational age) at various gestational weeks. Infants with a weight below the 10th percentile were classified as SGA, those with a weight falling between the 10th-90th percentiles were classified as AGA, and infants with a weight > 90th percentile were classified as LGA. The gestational age of the mothers was categorized into five groups: 24 weeks and below, 25-27 weeks, 28-30 weeks, 31-33 weeks, and 34 weeks and above.

Statistical Analysis

Utilizing SPSS (version 20) software, descriptive statistics were generated using frequency, relative frequency, and Mean value. Analytical statistics included the use of chi-square tests to study qualitative variables between the groups, and independent t-tests for quantitative variables.

Results

In this study, a total of 1005 individuals were assessed, of whom 755 met the inclusion criteria. Among the eligible participants, 425 individuals were classified in the Vaginal Delivery delivery group, while 330 individuals were categorized in the C-section Delivery group. In the Vaginal delivery group, the average age of mothers was 26.6±6.29, which was significantly lower than the average age of mothers in the C-section Delivery group at 30.69±5.73 (p-value=0.001). The two groups under study did not exhibit significant differences in gravidity, parity, frequency of abortion, number of live children, and frequency of stillbirths. In the Vaginal Delivery group, 400 participants (94.1%), and in the C-section Delivery group, 316 (95.8%) had received consistent prenatal care. In the Vaginal Delivery group, 11 women (2.6%) had a history of preterm labor, while in the C-section Delivery group, 15 (4.5%) had such a history. No remarkable differences were reported between the two groups in regards to prenatal care and history of preterm labor. In both groups, the rate of male births (natural birth: 54.4%, cesarean delivery: 58.5%) exceeded that of female births (natural birth: 45.6%, cesarean delivery: 41.5%). Nonetheless, there was no statistically remarkable difference between the two groups (p=0.25).

The average weight of newborns delivered via vaginal delivery (2126.47±33.36) was lower than that of those delivered via cesarean section (2177.59±38.57), although the differences were not statistically notable (p-value=0.31). The average gestational age in the vaginal delivery group (32.83±3.26) was lower than that of women in the C-section delivery group (33.47±2.69), and this difference was statistically remarkable (p-value=0.004). The frequency of infant weight classification and gestational age at birth is shown in **Table 1**.

In the analysis of birth weight between two groups by mode of delivery, statistical significances were observed only in the gestational age categories of 31-33 weeks (p=0. 01) and 34-36 weeks (p=0. 001) for both natural and cesarean deliveries T **Table 2**.

Table 3 presents the short-term complications in preterm newborns for both Vaginal Delivery and C-section Delivery groups, categorized by birth weight and gestational week. The frequencies of live births immediately after delivery, within the first five days, and the first-month post-delivery have been provided in this table. No remarkable differences were reported between the two modes of delivery, vaginal and C-section, about gestational age. In analyzing the frequency of hospitalization in NICU, it was found that this variable was significant for infants born at 28-30 weeks of gestation within the AGA weight category (p-value=0.04). Furthermore, all infants in this category who were delivered via cesarean section were admitted to the NICU. The frequency of NICU stay for LGA infants born at 34 weeks gestation and above was found to be significant (p-value=0.04). Additionally, the frequency of neonates hospitalized in the NICU from the C-section Delivery group was more than that of the vaginal delivery group. For the remaining studied groups, the differences were not statistically significant.

Table 4 demonstrates higher rates of respiratory distress syndrome (69.7% vs. 38.7%), neonatal jaundice (45.7% vs. 16.1%), and ventilator dependence (34.8% vs. 12.9%) for SGA newborns delivered via cesarean compared to vaginal delivery. These differences were found to be statistically significant (p-value=0.007 for respiratory distress syndrome and neonatal jaundice, and p-value=0.03 for ventilator dependence). However, no significant differences were reported in the incidence rates of Intracranial hemorrhage, PDA, neonatal infections, asphyxia, and NEC between SGA newborns of Vaginal Delivery and C-section Delivery groups.

Table 1. Frequency of gestational age at the time of birth for two groups of C-section delivery and vaginal delivery

Row		Vaginal delivery	C-section delivery	P-value
Gestational age	23-24 weeks	21(4.9)	12 (3.6)	0.12
	25-27 weeks	29(6.8)	10(3)	
	28-30 weeks	41(9.6)	29(8.8)	
	31-33 weeks	87 (20.5)	67 (20.3)	
	34-36 weeks	247 (58.1)	212 (64.2)	
Birth Weight	SGA	31(7.3)	46 (13.9)	0.001
	AGA	358 (84.2)	242 (73.3)	
	LGA	36(8.5)	42(12.7)	

Table 2. Frequency of birth weight for two groups of Vaginal Delivery and C-Section Delivery by gestational age

Row			Vaginal Delivery	C-Section Delivery	p-value
Gestational age	23-24 weeks	SGA	5(23.8)	0	0.13
		AGA	9 (42.9)	5(41.7)	
		LGA	7(33.3)	7(58.3)	
	25-27 weeks	SGA	4(13.8)	0	0.45
		AGA	23 (79.3)	9(90)	
		LGA	2(6.9)	1(10)	
	28-30 weeks	SGA	5(12.2)	6(20.7)	0.16
		AGA	32(78)	23 (79.3)	
		LGA	4(9.8)	0	
	31-33 weeks	SGA	3(3.4)	11 (16.4)	0.01
		AGA	75(86.2)	48 (72.6)	
		LGA	9(10.3)	8 (11.9)	
	34-36 weeks	SGA	14 (5.7)	29 (13.7)	0.001
		AGA	219 (88.7)	157 (74.1)	
		LGA	14 (5.7)	26 (12.3)	

Table 3. Frequency of short-term neonatal results in preterm births for Vaginal Delivery and C-Section Delivery groups by gestational week and birth weight

Row			Vaginal Delivery	C-Section Delivery	p-value
23-24 weeks	SGA	Alive at birth	4(80)	-	-
		admission in NICU	1(20)	-	-
		Alive within the first 5 days	5(100)	-	-
		Alive within the first-month post-delivery	1(20)	-	-
	AGA	Alive at birth	8 (88.9)	5(100)	0.43
		admission in NICU	3(33.3)	3(60)	0.33
		Alive within the first 5 days	1 (11.1)	2(40)	0.2
		Alive within the first-month post-delivery	1 (11.1)	0	0.43
	LGA	Alive at birth	6 (85.7)	7(100)	0.29
		admission in NICU	5(71.4)	5(71.4)	1
		Alive within the first 5 days	4(57.1)	5(71.4)	0.57
		Alive within the first-month post-delivery	4(57.1)	3 (42.9)	0.78
25-27 weeks	SGA	Alive at birth	3(75)	-	-
		admission in NICU	2(50)	-	-
		Alive within the first 5 days	2(50)	-	-
		Alive within the first-month post-delivery	1(25)	-	-
	AGA	Alive at birth	21 (91.3)	8 (88.9)	0.83
		admission in NICU	15 (65.2)	8 (88.9)	0.18
		Alive within the first 5 days	9(39.1)	4(44.4)	0.78
		Alive within the first-month post-delivery	4 (17.4)	3(33.3)	0.32
	LGA	Alive at birth	2(100)	1(100)	-
		admission in NICU	2(100)	1(100)	-
		Alive within the first 5 days	1(50)	1(100)	0.38
		Alive within the first-month post-delivery	1(50)	1(100)	0.38
28-30 weeks	SGA	Alive at birth	5(100)	6(100)	-
		admission in NICU	3(60)	5(83.3)	0.38
		Alive within the first 5 days	1(20)	2(33.3)	0.62
		Alive within the first-month post-delivery	0	1 (16.7)	0.49
	AGA	Alive at birth	29 (90.6)	23(100)	0.13
		admission in NICU	27 (84.4)	23(100)	0.04
		Alive within the first 5 days	25 (78.1)	17 (73.9)	0.71
		Alive within the first-month post-delivery	7(21.9)	5(21.7)	0.83
	LGA	Alive at birth	4(100)	-	-
		admission in NICU	4(100)	-	-
		Alive within the first 5 days	4(100)	-	-
		Alive within the first-month post-delivery	2(50)	-	-
31-33 weeks	SGA	Alive at birth	2 (66.7)	10 (90.9)	0.28
		admission in NICU	2 (66.7)	9(81.8)	0.57
		Alive within the first 5 days	2 (66.7)	8 (72.7)	0.83
		Alive within the first-month post-delivery	1(33.3)	2(18.2)	0.84
	AGA	Alive at birth	74 (98.7)	48(100)	0.42
		admission in NICU	65 (36.7)	42 (87.5)	0.89
		Alive within the first 5 days	68 (90.7)	42 (87.5)	0.57
		Alive within the first-month post-delivery	58 (77.3)	29 (60.4)	0.055
	LGA	Alive at birth	9(100)	8(100)	-
		admission in NICU	7(77.8)	6(75)	0.89
		Alive within the first 5 days	9(100)	7(87.5)	0.27
		Alive within the first-month post-delivery	9(100)	6(75)	0.11
34 weeks and above	SGA	Alive at birth	14(100)	29(100)	-
		admission in NICU	14(100)	24 (82.8)	0.09
		Alive within the first 5 days	13 (92.9)	26 (89.7)	0.73
		Alive within the first-month post-delivery	11 (78.6)	21 (72.4)	0.19
	AGA	Alive at birth	216 (98.6)	157(100)	0.14
		admission in NICU	130 (59.4)	100 (63.7)	0.39
		Alive within the first 5 days	209 (95.4)	155 (98.7)	0.07
		Alive within the first-month post-delivery	206 (94.1)	152 (96.8)	0.26
	LGA	Alive at birth	14(100)	26(100)	-
		admission in NICU	3(21.4)	14 (53.8)	0.04
		Alive within the first 5 days	13 (92.9)	26(100)	0.16
		Alive within the first-month post-delivery	13 (92.9)	25(96.2)	0.45

Table 4. Frequencies of short-term complications in preterm newborns for two groups of Vaginal Delivery and C-Section Delivery by birth weight

Row			Vaginal Delivery	C-Section delivery	p-value
Birth weight category	SGA	Respiratory distress syndrome	12 (38.7)	32 (69.6)	0.007
		Neonatal jaundice	5(16.1)	21 (45.7)	0.007
		PDA	1(3.2)	7(15.2)	0.09
		Ventilator dependence	4(12.9)	16 (34.8)	0.03
		Neonatal infections	3(9.7)	4(8.7)	0.88
		Intracranial hemorrhage	1(3.2)	1(2.2)	0.77
		Asphyxia	2(6.5)	2(4.3)	0.68
		NEC	1(3.2)	0	0.4
	AGA	Respiratory distress syndrome	155 (43.3)	127 (52.5)	0.02
		Neonatal jaundice	62 (17.3)	59 (24.4)	0.034
		PDA	21(5.9)	27(11.2)	0.01
		Ventilator dependence	40 (11.2)	49(20.2)	0.002
		Neonatal infections	14 (3.9)	11(4.5)	0.7
		Intracranial hemorrhage	6(1.7)	3(1.2)	0.66
		Asphyxia	5(1.4)	3(1.2)	0.86
		NEC	1(3.0)	1(4.0)	0.64
	LGA	Respiratory distress syndrome	13 (36.1)	18 (42.9)	0.54
		Neonatal jaundice	6 (16.7)	10 (23.8)	0.43
		PDA	2(5.6)	4(9.5)	0.51
		Ventilator dependence	2(5.6)	6(14.3)	0.20
		Neonatal infections	1(2.8)	2(4.8)	0.65
		Intracranial hemorrhage	0	3(7.1)	0.10
		Asphyxia	0	2(4.8)	0.18
		NEC	-	-	-

Table 4 also displays significantly higher rates of respiratory distress syndrome (52.5% vs. 43.3%, p=0.02), neonatal jaundice (24.4% vs. 17.3%, p=0.03), PDA(11.2% vs. 5.9%, p=0.01) and ventilator dependence (20.2% vs. 11.2%, p=0.01) for AGA newborns from the group of C-section delivery compared to the group of vaginal delivery. However, the incidence rates of Intracranial hemorrhage, neonatal infections, asphyxia, and NEC were not significant for the AGA subgroups of both main groups (Vaginal Delivery and C-section Delivery).

As presented in **Table 4**, the incidence rates of Intracranial hemorrhage, respiratory distress syndrome, neonatal jaundice, ventilator dependence, PDA, neonatal infections, asphyxia, and NEC were not significant for LGA newborns of both Vaginal Delivery and C-section Delivery Groups.

Discussion

The current research objective is to investigate the impacts of the mode of delivery on short-term complications in premature newborns. To date, several efforts have been made to determine the optimal method of delivery for premature infants through prospective randomized studies.

The utilization of cesarean section delivery in early pregnancies is significantly higher than for term pregnancies, due to various factors that necessitate surgical measures for the delivery of preterm infants. To conduct a vaginal delivery for preterm infants, certain criteria must be met. Other reasons for an elective cesarean section include congenital conditions that contraindicate vaginal delivery. Published data indicate that infants of SGA are

at an elevated risk of experiencing complications during their 1st year of life[10-13]. These consecutive complications may be contributing factors to the increase in cesarean deliveries for infants of preterm SGA, which increased from 50% to 61% from 1995 to 2003[14,15].

Cesarean delivery, however, may alter the physiological transition at birth, particularly affecting neonatal hemodynamics, renal perfusion, and the regulation of blood pressure, which are critical in preterm infants.

The findings of our research show that preterm infants of SGA and AGA delivered via vaginal birth exhibit better outcomes concerning respiratory distress syndrome, neonatal jaundice, and ventilator dependence. There were remarkable differences in incidence rates of PDA between AGA preterm newborns delivered vaginally and those delivered via cesarean section. This may suggest that spontaneous vaginal delivery supports more favourable cardiopulmonary adaptation and improved ductal closure postnatally, potentially reducing risks of systemic hypotension and renal hypoperfusion. Similar to our study, a US study on infants of SGA delivered at 25-34 weeks of gestation stated that cesarean section delivery was not related to improved neonatal complications but to a higher risk of respiratory distress syndrome[14]. In the study conducted by Kardum et al., it was stated that the incidence rates of respiratory distress syndrome associated with cesarean delivery were higher than that associated with vaginal delivery (39. 2% vs. 25. 6%)[16]. In Mitta et al., study, the respiratory distress syndrome incidence following cesarean delivery was reported higher than that following vaginal delivery. These authors concluded that vaginal delivery before 30 weeks of gestation significantly reduces the incidence rates of respiratory distress syndrome[17].

NICU stays for AGA and LGA preterm infants born respectively at 28-30 weeks and 34 weeks and above of gestation were significantly higher following cesarean delivery compared to vaginal delivery. Similar to our research, Mitta et al., found that the rates of hospitalization in the NICU following cesarean delivery were higher than those following natural delivery[17]. In a 2019 study conducted by WHO in collaboration with 21 other countries, it was demonstrated that cesarean delivery elevates the risk of NICU stay[17]. Contrary to our study, Thanh et al., study reported no significant association between NICU stay, asphyxia, and the delivery mode (cesarean vs. vaginal section)[19]. These differences may be related to the variation in sample size.

In our study, no remarkable differences were reported in the incidence rates of Intracranial hemorrhage between two groups Vaginal Delivery and C-section Delivery at various gestational weeks. Similar to our study, Schneider study also reported no notable differences in the incidence rates of Intracranial hemorrhage between cesarean and vaginal mode of delivery[20].

According to Nugraha & Anggraini, vaginal delivery is related to an increased risk of Intracranial hemorrhage for infants weighing less than 1250 grams and less than 750 grams[21]. Discrepancies in results may be due to differences in sample size between their study and ours.

In our study, no significant differences were observed between vaginal delivery and cesarean-section delivery regarding neonatal infections, asphyxia, and NEC across various gestational weeks. In a cohort study conducted by Schneider involving infants born at 24-29 weeks' gestation and with low birth weight, no remarkable differences were reported in the incidence rates of NEC, sepsis, renal complications, or retinopathy between preterm infants delivered vaginally or by using C-section delivery[20]. This suggests that delivery method may not significantly influence inflammatory or metabolic outcomes such as neonatal sepsis or necrotising enterocolitis, which depend more on gestational age and organ maturity. In Thanh et al., study, there was no statistically significant correlation found between asphyxia incidences rates in preterm newborns delivered by vaginally or cesarean[19].

In an article by Sonkusare and a similar article by Demertzidou et al., it was indicated that cesarean section, in comparison to natural delivery, enhances the mortality risk in preterm infants[22]. In a 2019 study conducted by the WHO (World Health Organization) in collaboration with 21 other countries, it was demonstrated that cesarean sections reduce the rates of perinatal death and stillbirth when compared to natural childbirth[23-27].

Despite assessing all patients referred to Afzalipour Hospital, the only referral university hospital in Kerman Province, over ten years, this study has some limitations. Among them, there is a lack of information in the hospital records of a number of patients, and despite direct communication and approporiate cooperation from patients, this information could not be retrieved. Also, in this study, neonatal outcomes such as metabolic dysregulation (e.g., hypoglycaemia) or electrolyte imbalance were not examined in detail, particularly in relation to delivery mode. In addition, this study did not compare neonatal outcomes between mothers who received preventive treatments for premature birth and those who delivered spontaneously without medical intervention.

Conclusions

This study revealed that the incidence rates of neonatal complications were generally lower in vaginal childbirth compared to cesarean section. Results of our study demonstrated significantly higher incidence rates of neonatal jaundice, respiratory distress syndrome, PDA and ventilator dependence in both AGA and SGA weight groups born via cesarean section. Additionally, infants in the AGA weight group born via cesarean section at 28-30 weeks of gestation experienced longer NICU stays compared to those born vaginally, while infants in the LGA weight group born via cesarean section at 34 weeks or later also had significantly longer NICU stays than those delivered vaginally. No other significant differences were observed between the two modes of delivery. It is anticipated that the findings of our research, in conjunction with other studies, may assist in identifying the optimal delivery mode for improving neonatal outcomes in preterm deliveries.

Compliance with ethical guidelines

This cohort study, carried out between 2010 (1390 AH) and 2018 (1398 AH) after approval by the Kerman University of Medical Sciences Ethics Committee with the code IR.KMU.AH.REC.1398.137, focused on pregnant women who were referred to Kerman's Afzalipur Hospital (Kerman City, Iran) with symptoms of premature labor (defined as less than 37 weeks gestation by last menstrual time or less than 20 weeks by ultrasound). The potential occurrences of complications in newborns were prospectively monitored for each case in the vaginal delivery and C-section delivery groups.

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Conflict of interest

The authors declared no conflict of interest.

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