Research Article

Neonatal Outcome Associated with Birth Order and Chorionicity in Twins Pregnancy

Nur Aprilianita Pratama[1,2], Khanizyah Erza Gumilar[1,3,4], Muhammad Ilham Aldika Akbar[1,3]

Department of Obstetrics and Gynecology
[1]Faculty of Medicine
[2]Dr. Soetomo General Academic Hospital
[3]Universitas Airlangga Academic Hospital
Universitas Airlangga, Surabaya,
[4]Graduate Institute of Biomedical Science
China Medical University Taichung, Taiwan

Abstract

Objectives: The incidence of multiple gestations is increasing, studies have found that monochorionic (MC) twins are associated with greater perinatal morbidity and mortality than dichorionic (DC) twins. Nevertheless, there is limited research on the impact of chorionicity and birth order on neonatal outcomes. The objective of this study is to examine the neonatal outcomes of twin pregnancies based on the difference in chorionicity and birth order.

Methods: This is a cross-sectional study of women with twin pregnancies delivered at >24 weeks of gestation in the Department of Obstetrics and Gynecology of Dr. Soetomo General Hospital and Universitas Airlangga Hospital, Surabaya, Indonesia in 2023. The inclusion criteria comprised of women aged ≥18years, gestational age 25-40 weeks and twin pregnancy. We excluded triplet or more and incomplete records. Data were analysed with IBM SPSS Statistics 26.0.

Results: 49 twins from 1638 birth (2.99%) were recruited for the study. The MC groups had a higher prevalence of preterm birth <37 weeks (83.3 vs 53.8%), preterm birth <34 weeks (52.8 vs 15.4%), VLBW (25 vs 7.7%), ELBW (25 vs 15.4%), low Apgar scores at 5th minutes (50 vs 15.4%), admission to NICU (66.7 vs 15.4%), RDS (41.7 vs 7.7%), early neonatal death (33.3 vs 7.7%), and perinatal death (44.4 vs 15.4%) [p<0.05]. In relation to birth order, there were no significant difference in all neonatal outcomes, except the higher prevalence of lower Apgar scores in 1st (75 vs 50%) and 5th minutes (50 vs 19.4) in the second delivered MC twin (p=0.05). Out of the 98 twin babies, there were a total of 32 perinatal deaths (32.65%), consisting of eight stillbirths and twenty-four neonatal deaths.

Conclusions: MC twins are at a heightened risk of fetal and perinatal mortality, could be attributed to the presence of placental sharing and vascular anostomosis in MC twins. The second-born twin had higher risks of low birth weight and a significantly lower Apgar score compared to their co-twins. It is important to manage twin pregnancy in specialized or tertiary care center hospital.

Keywords: chorionicity, perinatal outcome, pregnancy complication, twin pregnancy.

Correspondence Author. Muhammad Ilham Aldika Akbar Department of Obstetrics and Gynecology, Universitas Airlangga Academic Hospital, Surabaya, Indonesia, Email: muhammad-i-a-a@fk.unair.ac.id

INTRODUCTION

Twin pregnancies constitute between 2 to 4% of the overall birth rate. The twin birth rate was 32.6 per 1000 newborns, with a total of over 123,000 occurring in 2018 [1]. The frequency of spontaneous twin pregnancies exhibits global variation. The prevalence rates vary across different regions, with East, Southeast, and Southern Asia, India, and Oceania having less than 8 twin conceptions per 1,000 births, the United States and Latin America having 9-16 per 1,000 births, and Africa having 17 or more per 1,000 births [2]. There has been a worldwide increase in multiple pregnancies lately primarily due to late childbearing age, use of ovulation-inducing drugs and Assisted Reproductive Techniques (ART) [3]. Dichorionic diamniotic (DCDA) pregnancies comprise approximately 70% of twin pregnancies conceived naturally.

Delaying childbirth and increasing utilization of assisted reproductive technologies and fertility treatments are additional factors that influence the incidence of DCDA twins, which varies by population [4].

Multiple pregnancy pose an increased risk of morbidity and mortality among both the fetus and neonate. Multiple difficulties arise as a result of maternal adaptation to a twin pregnancy [5]. The incidence of maternal mortality in twin pregnancies is 2.5 times greater compared to singleton pregnancies [6]. Maternal morbidity such as preeclampsia and gestasional diabetes more frequent in twin pregnancies than in singleton pregnancy[5]. Preeclampsia is between 4 and 5 times more frequent in primigravidas with twin pregnancies than in those with single pregnancies. Also it has been reported that preeclampsia will become more common in triplet pregnancies [7]. Twin pregnancies showed a higher incidence of antenatal complications and stillbirths in comparison to singleton pregnancies. Previous research reported that fetal growth restriction (FGR) affects 25–47% of twin pregnancies and 8% of singleton pregnancies. Fetal growth restriction (FGR) is a significant contributor to stillbirth globally [8]. Multiple pregnancy also increase the risk of preterm birth in comparison to singleton pregnancy [9]. Congenital anomalies are increasing in twin pregnancies than singleton pregnancies, and they have a significant role in the higher perinatal mortality associated with multiple pregnancies. It is believed that monozygotic twin pregnancies are greater probabilities to have malformations than dizygotic twin pregnancies [10].

Twin pregnancies are categorized into monozygotic and dizygotic types based on the method of conception. Dizygotic twins arise from two independent fertilizations, while monozygotic twins result from a single fertilization that splits into two embryos. Monozygotic twins are classified into monochorionic (MC) or dichorionic (DC) categories according to the number of placentas, and into monoamniotic (MA) or diamniotic (DA) categories based on the number of amniotic sacs. The sub-classification is based on the timing of zygotic division [11]. MC are associated with an increased likelihood of prenatal and neonatal mortality, morbidities including fetal growth restriction, preterm birth, and congenital abnormalities, in comparison to DC. The prevalence of abnormal cord insertion, vascular anastomoses between fetuses, and unequal placental sharing, which are associated with the etiologies of twin-to-twin transfusion syndrome (TTTS), FGR, and fetal growth discordance (FGD), may account for this phenomenon. This may result in negative consequences for the development of both fetus [12].

Uncertainty concerns the effect of birth order on neonatal outcomes. Multiple studies have demonstrated that second-born twins face higher chances of perinatal mortality when compared to first-born twins [13]. Indeed, there was a noticeable rise in perinatal death among second-born twins in comparison to first-born twins across all birth weight categories of 500g. As a result of obstetric complications that may occur after the delivery of the first twin, including placental separation, cord prolapse, uterine atony, lengthy interval delivery, and cervical spasm, the second twin is generally considered to have a higher risk of experiencing severe morbidity and mortality. There appears to be a correlation between the delivery outcomes of non-presenting twins to both extremely low birthweight and inter-twin birthweight discordance [14].

Birthweight discordance is an important complication associated with twin pregnancies. BW discordance in twin pairs is associated to adverse perinatal and neonatal outcomes. Previous studies indicate that birth weight discordance is an independent predictor of significant neonatal complications, including mortality, in twin pairs delivered before 37 weeks of gestation. According to existing research, there are risk factors associated with discordant growth that can be categorized into placental, fetal, and maternal factors [15].

In considering the increased likelihood of unfavorable obstetric and perinatal consequences associated with multiple pregnancies, the objective of this article was to assess the relationship between chorionicity and birth order, and how they contribute to neonatal morbidity and mortality.

METHODS

An observational cross-sectional study was done among all pregnant women with >24 completed weeks gestation having multiple pregnancies in the Department of Obstetrics and Gynecology Dr. Soetomo General Hospital (tertiary care centre) and Universitas Airlangga Hospital, Surabaya (Indonesia) from January, 1st

2023 to December, 31st 2023. Ethical approval for this study was obtained from the Health Research Ethics Committee of RSUA with the approval number UA-02-25067 on May 16, 2025. The inclusion criteria included all pregnant women with twin pregnancy and gestational age between 25–40 weeks of gestation who delivered in our hospital. The exclusion criteria included having triplet or more and incomplete records. Pregnancies were categorized as either MC or DC based on postpartum direct placental examination and ultrasonography findings during pregnancy such as the number of gestational sacs, number of placentas, the presence of either "twin-peak" or "T" sign. Neonatal outcomes were grouped based on the chorionicity and the birth order (first or second delivered).

Clinical and demographic characteristics, including age (18 – 35 years, or > 35 years), parity (nulliparous or multiparous), *Body Mass Index* kg/m^2 (Underweight <18.5; Normal 18.5 - 24.9; Overweight 25 – 29,9; Obese ≥ 30), gestational age at delivery (25 – 29 weeks; 30 – 33 weeks; 34 – 36 weeks; >= 37 weeks), delivery mode (vaginal delivery or caesarean section), intertwin birthweight discordance, type of conception (spontaneous or assisted reproduction techniques) and chorionicity were recorded. Birthweight discordance was calculated as (larger twin BW – smaller twin BW) / larger twin BW x 100%. An inter-twin birth weight discordance was defined as a difference in birth weight of >20%.

The primary outcomes of this study were the perinatal mortality and morbidity, analyzed by chorionicity and birth order. Perinatal mortality consisted of stillbirth, perinatal death, and early neonatal death. Perinatal morbidity included: LBW, very low birth weight (VLBW), extremely low birth weight (ELBW), Apgar score <7 at 5th minutes, admission to NICU, respiratory distress syndrome (RDS), sepsis, and congenital anomaly. The World Health Organization (WHO) has provided a definition for neonatal mortality as the occurrence of deaths within the first 28 days of life following live birth. This category can be further categorized into two groups: early neonatal deaths, which occur between 0 and 7 days after birth, and late neonatal deaths, which occur between 7 and 28 days after birth [16]. Stillbirth was defined as fetal death after 20 weeks of gestation. Perinatal death refers to the occurrence of newborn deaths within 7 days of birth and fetal deaths with a gestational age of 20 weeks or more. Apgar scores was evalauted in 1st and 5th minutes, based on heart rate, respiratory efforts, muscle tone, reflex irritability, and color. The low Apgar scores (<7) was associated with risk of neonatal and infant death and neurological disability[17]. RDS was identified in infants requiring respiratory support, including supplemental oxygen, intubation, and mechanical ventilation. Neonates weighing less than 2,500 g were categorized as LBW (1500 – 2499 g), neonates weighing less than 1,500 g (1001 – 1499 g) were categorized as VLBW, while those weighing less than 1,000 g were classified as ELBW.

Data were analysed with IBM SPSS Statistics 26.0. Descriptive statistical approaches were employed to analyze the data, assessing measures such as the mean, median, standard deviation, standard error, and interquartile range. The Kolmogorov-Smirnov test was employed to assess the normality of the data. The chi-square test or Fischer exact test, as appropriate, was employed to compare categorical data. The p-value of < 0.05 was considered as significant.

RESULTS

During the duration of the study, a total of 1638 births were documented. Among these births, 56 were found to have multiple pregnancies, leading to the birth of 53 twins and 3 triplets. As a consequence, the incidence of multiple pregnancies was found to be 34.19 per 1.000 births, equivalent to 3.4%. After meeting the specified inclusion criteria and excluding triplet or more and incomplete records, a total of 49 cases were deemed eligible for examination.

The following is an analysis of the characteristics of multiple pregnancies based on the sociodemographic profile of the mother. Among the pregnant women, around 38 participants (77.5%) fell between the age range of 18 to 35, whereas just 11 participants (22.5%) were found to be above the age of 35. A significantly greater prevalence of caesarean section deliveries was seen in the overall sample (72.4%). Twin pregnancies had a significant prevalence of preterm birth (PTB) (66.6%), primarily observed in late-preterm infants (32.6% with a gestational age of 34-36 weeks). In this investigation, we observed a high prevalence of birthweight discordance over 20% (69.4%). A notable disparity was seen between the MC and DC groups with regards to maternal age, parity, gestational age, and mode of delivery (p<0.05). In this study, no twin mothers used ART. Most

twin pregnancies are achieved by spontaneous pregnancies, but the use of ART has an effect on increasing the incidence of twins through ovulation induction and IVF. One of the primary causes of the transfer of more than 1 embryo in infertility treatments was motivated by the pressure to attain high pregnancy rates with ART [18]. (Table 1).

Table 1. Clinical and Demographic Characteristics of Multiple Pregnancies based on Chorionicity

Characteristics	Total (%) n = 49 (pregnancies)	MC (%) n = 36 (73.5) (pregnancies)	DC (%) n = 13 (26.5) (pregnancies)	*P-value*
Maternal Age (y o)				
18 - 35	38 (77.5)	28 (77.7)	10 (76.9)	0.004
>35	11 (22.5)	8 (22.3)	3 (23.1)	
Parity				
Nulliparous	18 (36.7)	13 (36.1)	5 (38.5)	0.022
Multiparous	31 (63.3)	23 (63.9)	8 (61.5)	
BMI				
Underweight (<18.5)	0 (0)	0 (0)	0 (0)	0.25
Normal (18.5 - 24.9)	14 (28.6)	9 (25)	5 (38.5)	
Overweight (25 – 29.9)	16 (32.6)	12 (33.3)	4 (30.7)	
Obese (≥ 30)	19 (38.8)	15 (41.7)	4 (30.8)	
Gestational Age (weeks)				
25 – 29	7 (14.3)	7 (19.4)	0 (0)	
30 – 33	14 (28.6)	12 (33.3)	2 (15.4)	0.08
34 – 36	16 (32.6)	11 (30.5)	5 (38.5)	
> = 37	12 (33.3)	6 (16.7)	6 (46.1)	
Type of conception				
Spontaneous	49 (100)	36 (100)	13 (100)	-
Assisted Reproduction Technology	0 (0)	0 (0)	0 (0)	
Intertwin Birthweight Discordance >20%	34 (69.4)	26 (72.2)	8 (61.5)	0.473
	Total (%) n = 98 (babies)	**MC (%) n = 72 (babies)**	**DC (%) n = 26 (babies)**	***P-value***
Mode of Delivery				
Vaginal delivery	27 (27.6)	25 (34.7)	2 (7.6)	
Cesarean Section	71 (72.4)	47 (65.3)	24 (92.3)	

Table 2 described the neonatal outcomes based on chorionicity (MC vs DC). The MC groups had a higher prevalence of preterm birth <37 weeks, preterm birth <34 weeks, VLBW, ELBW, 5th minutes Apgar scores, admission to NICU, RDS, early neonatal death and perinatal death (p<0.05). However, the prevalence of LBW babies was slighlty lower in MC compared to DC (p<0.05). There were no statistically significant differences observed with regard to of the occurrence of sepsis and congenital anomalies between the two groups.

Table 2. Neonatal Outcomes Related to Chorionicity

Neonatal Outcomes	MC n = 36 (pregnancies)	DC n = 13 (pregnancies)	Total (%) n = 98 (babies)	*P-value* (MC vs DC)
Preterm Birth < 37 weeks	30 (83.3)	7 (53.8)	37 (75.5)	0.034
Preterm birth <34 weeks	19 (52.8)	2 (15.4)	21 (42.9)	0.019
LBW (1500 - 2499 g)	21 (58.3)	8 (61.5)	50 (51)	0.007
VLBW (1001 - 1499 g)	9 (25)	1 (7.7)	17 (17.3)	0.007
ELBW (< 1000 g)	9 (25)	2 (15.4)	16 (16.3)	0.007
Apgar < 7 at 5 min	18 (50)	2 (15.4)	28 (28.6)	0.025
NICU admission	24 (66.7)	2 (15.4)	47 (47.9)	0.000
RDS	15 (41.7)	1 (7.7)	31 (31.6)	0.000
Sepsis	6 (16.7)	1 (7.7)	11 (11.2)	0.164
Congenital anomaly	8 (22.2)	1 (7.7)	16 (16.3)	0.165
Stillbirth	5 (13.8)	2 (15.4)	8 (8.1)	0.918
Early Neonatal death	12 (33.3)	1 (7.7)	24 (24.4)	0.004
Perinatal death	16 (44.4)	2 (15.4)	32 (32.6)	0.007

Table 3 analyzed the neonatal outcomes based on birth order in each group (MC and DC). There were no significant difference in all neonatal outcomes, except the low Apgar scores in 1st and 5th minutes in MC twin (p=0.05). The second twin tend to have a higher prevalence of low Apgar scores in 1st and 5th minutes compared to the first delivered twin, in MC.

Table 3. Neonatal Outcomes based on Birth Order

Neonatal outcomes	MC			DC		
	First twin n=36	Second twin n=36	*P-value*	First Twin n=13	Second Twin n=13	*P-value*
LBW (< 2500 g)	21 (58.3)	16 (44.4)	.379	8 (61.5)	5 (38.5)	.423
VLBW (< 1500 g)	6 (16.7)	9 (25)	.379	1 (7.7)	1 (7.7)	.423
ELBW (< 1000 g)	5 (13.9)	9 (25)	.379	0 (0)	2 (15.4)	.423
Apgar < 7 at 1st min	18 (50)	27 (75)	.028	3 (23)	4 (30.7)	.658
Apgar < 7 at 5th min	7 (19.4)	18 (50)	.006	1 (7.7)	2 (15.4)	.539
NICU admission	21 (58.3)	24 (66.7)	.465	0 (0)	2 (15.4)	.141
RDS	15 (41.7)	15 (41.7)	1.000	0 (0)	1 (7.7)	.308
Sepsis	6 (16.7)	4 (11.1)	.496	0 (0)	1 (7.7)	.308
Congenital anomaly	6 (16.7)	8 (22.2)	.551	1 (7.7)	1 (7.7)	1.000
Stillbirth	1 (2.7)	5 (13.8)	.088	0 (0)	2 (15.4)	.141
Early Neonatal death	12 (33.3)	11 (30.5)	.800	1 (7.7)	0 (0)	.308
Perinatal death	13 (36.1)	16 (44.4)	.471	1 (7.7)	2 (15.4)	.539

The study reveals a perinatal mortality rate of 326.5 per 1000 births, as presented in Table 4. Out of the 98 twin babies, there were a total of 32 perinatal deaths, consisting of eight stillbirths and twenty-four neonatal deaths. Throughout the course of gestation, there was a decrease in newborn mortality, suggesting that preterm birth was the main cause of higher perinatal death rates. Sepsis was responsible for four fatalities of newborns, while six cases had conjoined twins, a congenital abnormality.

Table 4. Perinatal Mortality based on Gestational Age and Chorionicity

Patient (neonatal)		Perinatal Mortality					
GA at delivery	No (%)	MC		DC		Total	%
		Stillbirths	Neonatal	Stillbirths	Neonatal		
25 – 29	14 (14.3)	2	7	0	0	9	64.3
30 – 33	28 (28.6)	2	11	0	1	14	50
34 – 36	32 (32.6)	0	4	1	0	5	15.6
> 37	24 (33.3)	2	1	1	0	4	16.7
Total	98 (100)	6	23	2	1	32	32.6

DISCUSSION

The findings of our study indicate that variations in chorionicity have a major impact on newborn outcomes (preterm birth <37 weeks, preterm birth <34 weeks, LBW, VLBW, ELBW, 5th minutes Apgar scores, admission to NICU, RDS, early neonatal death and perinatal death). Nevertheless, there are only marginal disparities observed in neonatal outcomes between the first and the second delivered newborns, namely in the Apgar scores of the MC twin.

Chorionicity has a significant impact on the rates of prenatal and neonatal mortality and morbidity. Our findings indicate that the MC twin had a greater occurrence of preterm birth, VLBW, ELBW, Apgar scores at 5 minutes, admission to the NICU, RDS, early neonatal mortality, and perinatal death. A total of 47 (47.9%) twins were admitted to the NICU; with a higher admission rate were found in the MC group (p < 0.05). This finding has been validated by other investigations. Research in Thailand indicates that the prevalence of multiple pregnancies is 1.99%, with 65.1% resulting in preterm births. Monochorionic twins showed a significantly higher incidence of neonatal complications. Monochorionic placentation and antepartum

complications are identified as important risk factors for preterm birth. Furthermore, these factors significantly affect the rate of admissions to the NICU [19].

However, certain case series investigations have indicated that even uncomplicated MC pregnancies involved a greater mortality risk, implying that the natural history of multiple gestation and especially MC is still not entirely understood [12].

This study observed a notably high rate of cesarean section deliveries, with 72.4% of births occurring through this method. Additionally, other research shows over the last ten years, there has been a consistent rise in both twin births and the overall incidence of cesarean sections (CS) globally. This is attributable to various social, economic, educational, and scientific factors. Consequently, decision-making is complicated, particularly regarding delivery. Several factors influence the decision of delivery mode, including gestational age, chronicity and amnionicity, fetal position, fetal weight, and the overall health of both the mother and fetus. While patient preferences are respected and shared decision-making is encouraged, physicians must fulfill their ethical responsibility to avoid causing harm. This means the exclusion of all unnecessary CSs. Patients must receive comprehensive counseling regarding the differences between vaginal delivery and caesarean section, including potential complications, recovery time, and implications for both the mother and the infant [11].

A high prevalence of fetal birthweight discordance (>20%) was found in our series (69.4%), with a relatively higher prevalence in MC compared to DC. Consistent with prior research, birth weight discordance usually correlates with factors that make an asymmetric effects on the two fetuses, impacting intrauterine growth in one while making the growth of the larger twin apparently unaffected. Factors contributing to the condition include intrauterine infection, chromosomal or congenital anomalies present in only one twin, twin-to-twin transfusion with or without placental share discrepancies in monochorionic pregnancies, and placental insufficiency affecting only one fetus in dichorionic pregnancies. Different fetoplacental perfusion statuses may differentially affect twins, making each twin susceptible to different neonatal morbidities [15].

One potential explanation for the elevated rate of adverse perinatal-neonatal outcomes in MC, as opposed to DC, could be attributed to the presence of placental sharing and vascular anostomosis in MC twins. Pregnancy problems specific to MCDA twin pregnancies are caused by transfusion imbalances occurring through the vascular anastomoses. In this context, it has been observed that 10% of twin pregnancies with MCDA exhibit the occurrence of twin-twin transfusion syndrome (TTTS), while 5% of these pregnancies develop twin anemic polycythemia sequence (TAPS). Additional circumstances that were exclusively linked to MC were twin reverse arterial perfusion sequence, fetal demise of one twin, conjoined twins, and umbilical cord entanglement [20–22].

The perinatal mortality rate in this study is 326.5 per 1000 births, as indicated in Table 4. Out of the 98 twin infants, there were 32 deaths that occurred during the perinatal period, consisting of eight stillbirths and twenty-four neonatal deaths. The data indicates a negative correlation between neonatal death and gestational age, implying that preterm delivery is the primary factor contributing to elevated rates of perinatal mortality. Four infant deaths were attributed to sepsis, while six cases were conjoined twins, a congenital anomaly.

In twin pregnancies, whether monochorionic or dichorionic, the risk of stillbirth is elevated compared to singleton pregnancies. The probability of stillbirth is fivefold higher for monochorionic twins and thirteenfold higher for dichorionic twins. Medical professionals must conduct careful monitoring of twin pregnancies during the antenatal phase. Complex twin pregnancies, such as monochorionic diamniotic (MCDA) and monochorionic monoamniotic (MCMA) cases, present significant obstacles in management. Complicating factors include cord entanglement, twin-twin transfusion syndrome (TTTS), twin anemia polycythemia sequence (TAPS), twin reversed arterial perfusion (TRAP), and selective fetal growth restriction (sFGR). Evidence shows getting medical care from specialized facilities for twins generally leads to better outcomes for both the twin patients and their mother [11].

We observed comparable neonatal outcomes between first and second born twins in both MC and DC, which are noteworthy results. There was a substantial difference observed in the Apgar scores during the first and fifth minutes. In MC, the second twin exhibits a greater incidence of

low Apgar scores in comparison to the first twin. Previous study reports that the second twin's Apgar score was lower than the first twin's, and that the second twin had a higher rate of perinatal mortality. Compared to first-born twins, second twins are likely to have lower Apgar scores (<7), especially in terms of period of gestation (<37 weeks), chorionicity (MC placentation), mode of delivery (caesarean section), inter delivery interval (<30 min) [23].

The second-born twins had a unsignificant higher incidence of VLBW (16.7% vs. 25%) and ELBW (13.9% vs. 25) in MC than the first-born twins. Previous studies indicate that second twins have lower birth weights, a higher probability of being categorized as small-for-gestational age (SGA), and increased rates of NICU admission, mechanical ventilator support, and respiratory distress syndrome (RDS) compared to first twins [13].

Although there were no statistically significant differences, second-born twins in the MC group exhibited a higher rate of congenital anomalies (22.2%) compared to 7.7%. This finding aligns with previous study, which reported that approximately 1 in 25 DC, 1 in 15 MCDA, and 1 in 6 MCMA present with significant fetal abnormalities affecting only one of the twins. Despite MC twins being genetically identical, they can exhibit differing phenotypes, even with severe congenital defects. MC twins have a higher likelihood of structural abnormalities compared to singletons or DC twins, with only 1%-2% of DC twins having major anomalies, versus 6%-8% in MC twins [24].

Several studies over the past few decades have investigated the impact of birth order on perinatal morbidity and mortality in twin pregnancies. Previous studies have shown that the second twin is more likely to experience adverse neonatal outcomes compared to the first twin. Adverse outcomes includes an increased risk of low birth weight, birth trauma, respiratory distress syndrome (RDS), and requirement for mechanical ventilation. The poor outcomes observed in the second twin may correlate with factors such as birth weight discordance, presentation, mode of delivery, and a prolonged intertwin delivery interval. Other studies indicate no significant difference in neonatal mortality based on birth order [13].

The present investigation, carried out at a tertiary care teaching hospital, has yielded results concerning twin pregnancies that are consistent with previous research findings in relation to the overall number of births, the occurrence of very low birth weight (VLWB) children, preterm births (PTBs), and the rate of admissions to the neonatal intensive care unit (NICU). This finding supports the idea that the second twin is more prone to experiencing unfavorable circumstances compared to its sibling [14].

However, these studies have some limitations as they did not adjust for potential confounders such as mode of delivery, presentation, indication for delivery, interdelivery interval, gender of infant. In addition, there are insufficient data regarding the discrepancy of neonatal outcomes in a twin pair at different gestational ages of delivery. Therefore, we performed this study to investigate factors that influence the adverse neonatal outcomes between first and the second twins based on the chorionicity.

This comprehensive study highlights the complexities and increased risks associated with twin pregnancies, particularly emphasizing the differences between MC and DC. The findings indicate that MC are more prone to complications such as preterm birth, lower mean birth weight, and higher rates of NICU admission. These risks contribute to a greater prevalence of RDS, early onset sepsis, birthweight discordance, and adverse perinatal outcomes, especially in second-born twins of MC pregnancies. Second-born twins face higher risks of very low and ELBW, lower Apgar scores, and a marginally higher incidence of congenital anomalies compared to their co-twins. Furthermore, the study suggests that MC twins are at a heightened risk of fetal and perinatal mortality, attributed to complications such as IUGR, twin growth discordance, and TTTS. The increased caesarean section rate in twin gestations, alongside the observed differences in outcomes based on chorionicity, birth order, and birth weight discordance, underscores the need for meticulous prenatal care and delivery planning in twin pregnancies to mitigate these risks.

The occurrence of multiple pregnancies is associated with elevated neonatal challenges, particularly preterm delivery, which amplifies the likelihood of major infant morbidity and mortality. Obstetricians and neonatologists face significant challenges while dealing with MC twins. It is recommended that antenatal monitoring and labor be conducted at reference centers. When comparing the twins' outcomes depending on birth order, it was shown that the second

twin had a higher likelihood of experiencing substantial perinatal morbidity compared to the first twin. In addition to examining sex, birth weight discordance, inter-delivery interval, and differential stillbirth risk, potential predictors of increased risk for the second twin have also been taken into account. The implementation of efficient strategies for the identification of risk factors, determination of incidence rates, and comprehension of indications for operational delivery is of almost importance. This facilitates the ability to compare and improve care at both the local and national levels, with the goal of reducing these complications.

LIMITATIONS

This study has several limitations. At our study, there was a high rate (nearly 72%) of aesarean delivery for twin pregnancies. As a result, we were unable to study whether factors associated with vaginal delivery, such as birth trauma or interval of intertwin delivery, had any impact on the neonatal outcomes of the first and second twins. We also conducted research at the referral hospital so that the existing cases were quite difficult cases and provided samples with higher monochorionic cases than dichorionic, in contrast to the fact that dichorionic cases account for 70% of twin pregnancies. Another limitation, because our study was observational, is the presence of so far unknown and thus uncontrolled confounders.

CONCLUSION

In conclusion, MC twins are at a heightened risk of fetal and perinatal mortality, could be attributed to the presence of placental sharing and vascular anostomosis in MC twins. Second twins were at higher risk of adverse neonatal outcomes than were first twins at all chorionicity. The main factor associated with this result was the lower birth weight of the second twin and a significantly lower Apgar score compared to their co-twins. Future, larger studies are needed to clarify the associations between neonatal outcomes of twin pairs, chorionicity, birth order and birth weight discordance.

ACKNOWLEDGEMENT

We are grateful to the Department of Obstetrics and Gynecology, Faculty of Medicine, Universitas Airlangga for their significant contributions to this research.

CONFLICT of INTEREST

There are no conflicts of interest.

REFERENCES

1. Martin, J. A., Hamilton, B. E., Osterman, M. J. K., & Driscoll, A. K. Births: Final Data for 2018. National vital statistics reports : from the Centers for Disease Control and Prevention, National Center for Health Statistics. Nat Vital Stat System. 2019; 68(13): 1–47.
2. Smits, J., & Monden, C. Twinning across the Developing World. PloS one. 2011; 6(9): e25239. https://doi.org/10.1371/journal.pone.0025239.
3. Bajagain, R., Karki, C., Mahato, S., Saha, R., & Saha, N. Multiple Pregnancy among Deliveries in a Tertiary Care Center: A Descriptive Cross-sectional Study. JNMA. J Nepal Med Assoc.2022; 60(255): 927–30. https://doi.org/10.31729/jnma.7897.
4. Hiersch, L., Attali, E., & Melamed, N. Special considerations regarding antenatal care and pregnancy complications in dichorionic twin pregnancies. Am J Obstet Gynecol.2022; MFM, 4(2S): 100500. https://doi.org/10.1016/j.ajogmf.2021.100500.
5. Getachew, T., Negash, A., Debella, A., Yadeta, E., Lemi, M., Balis, B., Balcha, T., Bekele, H., Abdurke, M., Alemu, A., Shiferaw, K., & Eyeberu, A. Prevalence and adverse outcomes of twin pregnancy in Eastern Africa: a systematic review and meta-analysis. BMC Preg Childbirth.2024; 24(1): 169. https://doi.org/10.1186/s12884-024-06326-0
6. Kilicarslan, N., Gurbuz, H., Tasgoz, F. N., Karaca, U., Karasu, D., & Gamli, M. Factors influencing neonatal outcomes in twin pregnancies undergoing cesarean section: a cross-sectional study. Rev Assoc Med Bras (992). 2023;69(5): 20221464. https://doi.org/10.1590/1806-9282.20221464.
7. Karkata MK. Faktor Risiko Terjadinya Hipertensi dalam Kehamilan. Indones J Obstet Gynecol.2006; 30(1):55-8. https://doi.org/10.32771/inajog.v30i1
8. Martínez-Varea, A., Prasad, S., Domenech, J., Kalafat, E., Morales-Roselló, J., & Khalil, A. Association between fetal growth restriction and stillbirth in twin compared with singleton pregnancies. Ultrasound in obstetrics & gynecology. Journal Int Soc Ultrasound Obstet Gynecol. 2024; 64(4): 513–520. https://doi.org/10.1002/uog.27661.
9. Multifetal Gestations: Twin, Triplet, and Higher-Order Multifetal Pregnancies: ACOG Pract Bulletin Number 231. (2021). Obstet Gynecol.2021;137(6):e145–e62. https://doi.org/10.1097/AOG.0000000000004397.
10. Mirani P, Wibawa A. Selective Termination for Fetal Anomaly in Twin Pregnancy. Indones J Obstet Gynecol.2013; 37(1):57-60. https://doi.org/10.32771/inajog.v37i1.337
11. Abraham, M., Ali, N., Shivani Garapati, S. S. L., Pandey, P., Nair, S., Swarna, S., Chowdary, D. V., Aladeniyi, F., Daing, A., & Abbas, K. Delivery Methods in Twin Gestations: Evaluating Outcomes, Risk Factors, and the Paradigm Shift Towards Elective Cesarean Deliveries. Cureus. 2023; 15(10): e46514. https://doi.org/10.7759/cureus.46514.

12. Machado, M., Lima Teixeira, E., Ferreira, L. M., Rodrigues, F., Henriques, R., & Afonso, E. (2017). Impacto da Corionicidade nas Complicações Perinatais da Gestação Gemelar Perinatal Outcome in Relation to Chorionicity in Twin Pregnancy. Acta Med Portuguesa.2017; 30(1):12–6. https://doi.org/10.20344/amp.7133
13. Kim, S. H., Kim, Y. M., Sung, J. H., Choi, S. J., Oh, S. Y., & Roh, C. R. The effects of birth order on neonatal outcomes in early-preterm, late-preterm and term twin infants. The journal of maternal-fetal & neonatal medicine : the official journal of the European Association of Perinatal Medicine, the Federation of Asia and Oceania Perinatal Societies. Int Soc Perinatal Obstet. 2020; 33(12): 1980–7. https://doi.org/10.1080/14767058.2018.1534954.
14. Rossi, A. C., Mullin, P. M., & Chmait, R. H. Neonatal outcomes of twins according to birth order, presentation and mode of delivery: a systematic review and meta-analysis. BJOG.2011; 118(5): 523–32. https://doi.org/10.1111/j.1471-0528.2010.02836.x.
15. Yum, S. K., & Lee, J. H. (2023). Role of birthweight discordance in preterm twins' outcomes in the Korean neonatal network. Pediatr Neonatol.2023;64(5):570–6. https://doi.org/10.1016/j.pedneo.2022.12.014
16. Winsloe, C., & Pasupathy, D. Understanding perinatal mortality. Obstet Gynecol Reprod Med.2019;30(3) DOI:10.1016/j.ogrm.2019.12.001
17. Hong, J., Crawford, K., Jarrett, K., Triggs, T., & Kumar. Five-minute Apgar score and risk of neonatal mortality, severe neurological morbidity and severe non-neurological morbidity in term infants - an Australian population-based cohort study. The Lancet regional health. Western Pacific.2024; 44: 101011. https://doi.org/10.1016/j.lanwpc.2024.101011
18. Prats, P., Zarragoitia, J., Rodríguez, M. Á., Rodriguez, I., Martinez, F., Rodríguez-Melcon, A., & Serra, B. Outcome in a series of 1135 twin pregnancies: does the type of conception play a role?. AJOG Glob Rep.2022; 2(4): 100129. https://doi.org/10.1016/j.xagr.2022.100129
19. Seetho, S., Kongwattanakul, K., Saksiriwuttho, P., & Thepsuthammarat, K. Epidemiology and factors associated with preterm births in multiple pregnancy: a retrospective cohort study. BMC Preg childbirth.2023; 23(1): 872. https://doi.org/10.1186/s12884-023-06186-0.
20. Martínez-Varea, A., Martínez-Gómez, M., Novillo, B., Domenech, J., Morales-Roselló, J., & Diago-Almela. Perinatal Outcomes of Monochorionic Twin Pregnancies Conceived Naturally Versus through Assisted Reproductive Techniques. J Clin Med.2023;12(18):6097. https://doi.org/10.3390/jcm12186097
21. Lewi L. Monochorionic diamniotic twin pregnancies. Am J Obstet Gynecol MFM.2022; 4(2S): 100501. https://doi.org/10.1016/j.ajogmf.2021.100501
22. Schmitz, T., Korb, D., Azria, E., Garabédian, C., Rozenberg, P., Sénat, M. V., Sentilhes, L., Vayssière, C., Winer, N., Goffinet, F., & JUmeaux MODe d'Accouchement (JUMODA) Study Group and the Groupe de Recherche en Obstétrique et Gynécologie (GROG). Perinatal outcome after planned vaginal delivery in monochorionic compared with dichorionic twin pregnancy. Ultrasound in obstetrics & gynecology. J Int Soc Ultrasound Obstet Gynecol.2021; 57(4):592–9. https://doi.org/10.1002/uog.23518
23. Baral, P., Dangal, G., Baral, G., & Subedi, K. (2021). Perinatal Outcome of Second Twin in Third Trimester of Pregnancy. J Nepal Health Re Council.2021;19(3):622–5. https://doi.org/10.33314/jnhrc.v19i3.3584
24. Jha, P., Morgan, T. A., & Kennedy, A. (2019). US Evaluation of Twin Pregnancies: Importance of Chorionicity and Amnionicity. Radiographics : a review publication of Radiol Soc North Am Inc. 2019;39(7): 2146–66. https://doi.org/10.1148/rg.2019190042.