RESEARCH ARTICLE

Analysis of birth situation and influencing factors of 454 premature infants: A retrospective study

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Abstract

Objective: To analyse the birth characteristics and maternal risk factors associated with preterm infants.

Method: The retrospective study was conducted at the Jinshan Branch of Shanghai Sixth People's Hospital, China, and comprised data related to mothers and their preterm infants delivered between January 1, 2011, and December 31, 2020. Information on maternal age, pregnancy complications, number of births, gestational age at delivery and neonatal outcomes was collected from hospital records to assess risk factors for preterm birth. Data was analysed using SPSS 25.

Results: Among 9,953 total births, 454 (4.56%) were preterm. Of these, 57 (12.56%) were early preterm and 397 (87.44%) were late preterm. The mean gestational age was 34.97±1.60 weeks and the average birth weight was 2,596.87 ± 502.28 g. Independent risk factors included gestational hypertension 56 (12.30%), cholestasis 17 (3.74%), premature rupture of membranes (PROM) 134 (29.52%), hormone use during pregnancy 105 (23.13%), and twin pregnancies 80 (17.62%) ($p<0.01$).

Conclusion: Key maternal risk factors included gestational hypertension, intrahepatic cholestasis of pregnancy, premature rupture of membranes, and multiple gestations.

Keywords: Birth condition, Premature infants, Incidence, Influencing factors. (JPMA 76: 196; 2026)

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Introduction

Preterm labour is defined as the delivery of a foetus before 37 weeks of gestation (≤259 days). In recent years, advances in obstetric care, neonatal intensive care, and assisted reproductive technology have led to an increase in the birth rate of preterm infants in China, accompanied by improvements in survival rates.[1,2] However, as gestational age decreases, the risk of morbidity and mortality among preterm infants increases significantly due to immature organ systems and poor adaptation to extrauterine life, resulting in complications and higher rates of long-term disability.[3]

According to the World Health Organisation (WHO) Global Report on Prematurity, approximately 15 million babies are born preterm each year, accounting for 11% of all live births globally. China has the second-highest number of preterm births worldwide, with an estimated 1.2 million cases annually.[4] Despite improvements in neonatal care, preterm birth remains the leading cause of perinatal and neonatal mortality,[5] especially among very preterm and very low birth-weight (LBW) infants who require intensive and specialised care. Complications related to preterm birth impose a substantial burden on families and health systems due to the high risk of long-term neurodevelopmental impairment and increased socioeconomic costs.[6] As a reflection of its growing clinical importance, the WHO designated November 17 as the World Prematurity Day to raise awareness and promote prevention strategies.

Preterm birth is a multifactorial condition, with its risk factors varying across populations and healthcare settings.[7] Identified risk contributors include maternal reproductive history, like prior preterm birth and extreme maternal age,[8] medical conditions, such as hypertension (HTN), infections, anaemia and diabetes mellitus (DM)[9] and lifestyle factors, including smoking, poor nutrition and stress.[10] Additionally, uterine abnormalities, short cervix, placental disorders, and obstetric interventions have also been linked to preterm labour.[11] Multiple pregnancies significantly elevate the risk[12] as do foetal complications, such as malformations or intrauterine growth restriction (IUGR).[13] Moreover, intrauterine infections and inflammation — often associated with pathogens like *escherichia (E.) coli, group B streptococcus, and listeria (L.) monocytogenes* — are estimated to contribute to 50-80% of spontaneous preterm births.[14]

The current study was planned to analyse the birth characteristics and maternal risk factors associated with preterm infants.

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Materials and Methods

The retrospective study was conducted at the Jinshan Branch of Shanghai Sixth People's Hospital, China, and comprised data related to mothers and their preterm infants delivered between January 1, 2011, and December 31, 2020. After approval from the institutional ethics review committee, data was retrieved from the birth database of the China Neonatal Collaborative Network.[15] Subjects included were preterm infants born between 28 and 36+6 weeks of gestation. Stillbirth cases and those with incomplete records were excluded.

As this was a retrospective study, no prior sample size calculation was performed. All preterm births meeting the inclusion criteria during the study period were included through consecutive sampling, thereby minimising selection bias.

The variables collected for analysis were maternal age, number of pregnancies, complications during pregnancy, like gestational HTN and cholestasis, gestational age at delivery, neonatal birth-weight, and birth outcomes, including Appearance-Pulse-Grimace-Activity-Respiration (APGAR) score, resuscitation, and hospitalisation.

Data was analysed using Excel and SPSS 25. Descriptive statistics, including mean±standard deviation for continuous variables, and frequencies and percentages for categorical variables, were computed. Comparisons between preterm and term births were performed using chi-square test. Binary logistic regression was used to identify independent risk factors for preterm birth. The odds ratio (OR) and 95% confidence intervals (CIs) were calculated for each factor. P<0.05 indicated statistical significance.

Results

Of the total 9,953 births, 454 (4.56%) were preterm. Among these, 57 (12.56%) were early preterm and 397 (87.44%) were late preterm. The mean gestational age was 34.97±1.60 weeks, and the mean birth weight was 2,596.87±502.28 g. The annual incidence of preterm births from 2011 to 2020 showed a gradual increase, rising from 304 (3.05%) in 2011 to 664 (6.68%) in 2019, with a noticeable upward trend peaking in 2019 (p<0.05) (Figure 1).

There was a significant association between maternal age and the likelihood of preterm birth, with younger mothers (<18 years) and older mothers (≥35 years) being more likely to experience preterm deliveries (Table 1). Figure 2 illustrates the distribution of birth weight and gestational age across different maternal age groups, demonstrating that both lower birth weight and shorter gestational age were more common among mothers <18 years and ≥35 years.

The rate of maternal complications was significantly higher in the preterm group than in term infants (p<0.05). The top

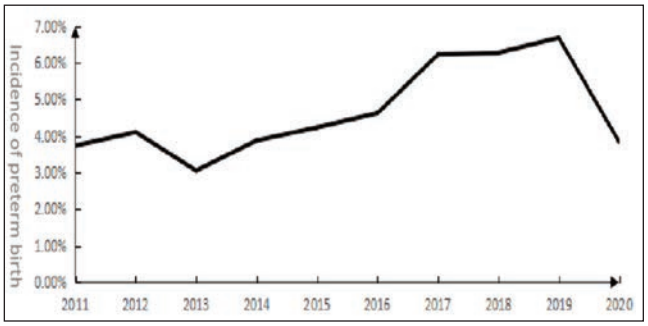

Figure-1: Trends in the incidence of preterm birth from 2011 to 2020.

Table-1: Preterm delivery among pregnant women of different ages.

Maternal age	Weight		Gestational weeks	
	< 2500 g	≥ 2500 g	$28\text{-}33^{+6}$	$34\text{-}36^{+6}$
<18 (9, 1.98%)	4 (44.44%)	5 (55.56%)	3 (33.33%)	6 (66.67%)
18-34 (387, 85.2%)	137 (35.40%)	250 (64.60%)	40 (10.34%)	347 (89.66%)
≥35 (58, 24.14%)	22 (37.93%)	36 (62.07%)	14 (24.14%)	44 (75.86%)
χ^2	0.43		12.36	
***p*-value**	0.81		0.002	

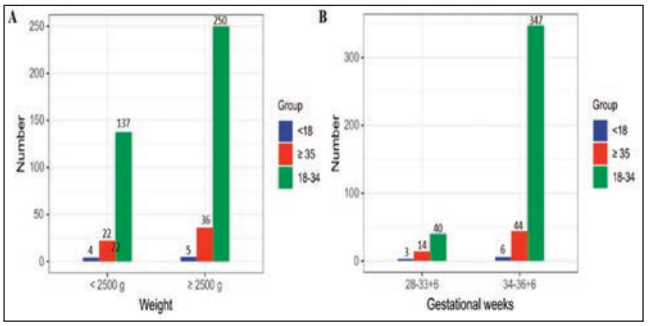

Figure-2: Weight (A) and gestational age (B) of newborns in relation to maternal age.

Table-2: Comparison between preterm and term infants.

Indicators	Preterm infant (454)	Term infant (9499)	χ^2	*p*-value
Diabetes	19.38%	14.59%	16.870	<0.001
Pregnancy hypertension	12.30%	3.16%	125.980	<0.001
Cholestasis	3.74%	0.54%	65.700	<0.001
PROM	29.52%	9.58%	183.410	<0.001
Infection during pregnancy	16.74%	7.10%	57.850	<0.001
Chorioamnionitis	3.52%	0.52%	60.440	<0.001
Bleeding during pregnancy	16.52%	14.75%	1.080	0.300
Hormone use during pregnancy	23.13%	0.40%	1580.50	<0.001
Intrauterine distress	10.13%	10.27%	0.010	0.920
Twins	17.62%	1.20%	611.340	<0.001
Caesarean	50.00%	43.02%	8.580	0.003
Resuscitation of asphyxia	12.33%	1.84%	210.420	<0.001
Hospitalization	70.48%	6.72%	2025.48	<0.001

PROM: Premature rupture of membranes.

Table-3: Variables in the logistic regression analysis affecting the occurrence of preterm birth.

Variable	Name	Explanation
Preterm infant	y	y=1 for full-term infants, y=2 for preterm infants
Maternal age	x_1	x_1=1 for < 18， x_1=2 for 18-34， x_1=3 for ≥ 35
Bleeding during pregnancy	x_2	x_2=1 for no bleeding during pregnancy x_2=2 for bleeding during pregnancy
Pregnancy hypertension	x_3	x_3=1 for no pregnancy hypertension x_3=2 for pregnancy hypertension
Diabetes	x_4	x_4=1 for no diabetes， x_4=2 for diabetes
Cholestasis	x_5	x_5=1 for no cholestasis， x_5=2 for cholestasis
Infection during pregnancy	x_6	x_6=1 for no infection during pregnancy x_6=2 for infection during pregnancy
Chorioamnionitis	x_7	x_7=1 for no chorioamnionitis x_7=2 for chorioamnionitis
PROM	x_8	x_8=1 for no PROM， x_8=2 for PROM
Hormone use	x_9	x_9=1 for no hormone use during， x_9=2 for hormone use during
Twins	x_{10}	x_{10}=1 for single birth， x_{10}=2 for twins

Table-4: Binary logistic regression analysis of multiple factors affecting the occurrence of preterm birth.

Factors	B	SE	Wald	*p*-value	OR	OR: 95% CI	
						Lower limit	Upper limit
Maternal age	-	-	4.198	0.123	-	-	-
<18	-0.885	0.524	2.851	0.091	0.413	0.148	1.153
18-34	0.105	0.183	0.331	0.565	1.111	0.776	1.590
Bleeding during pregnancy	0.040	0.172	0.055	0.815	1.041	0.743	1.458
Pregnancy hypertension	0.882	0.227	15.156	0	2.417	1.550	3.768
Diabetes	0.028	0.165	0.028	0.866	1.028	0.744	1.422
Cholestasis	1.380	0.411	11.280	0.001	3.975	1.776	8.893
Infection during pregnancy	-0.069	0.187	0.135	0.713	0.934	0.647	1.347
Chorioamnionitis	0.160	0.442	0.131	0.718	1.173	0.494	2.787
PROM	1.264	0.145	76.443	0	3.541	2.667	4.701
Hormone use	2.277	0.282	134.965	0	26.486	15.238	46.035
Twins	2.077	0.236	77.769	0	7.983	5.031	12.666

PROM: Premature rupture of membranes, OR: Odds ratio, CI: Confidence interval.

three complications were premature rupture of membranes (PROM), gestational DM (GDM), and infections during pregnancy, while asphyxia resuscitation and hospitalisation rates after birth were significantly higher in preterm infants than in term infants (p<0.05) (Table 2).

Multivariate analysis showed that mothers with gestational HTN, cholestasis, PROM, prenatal use of hormones, and twin births were more likely to result in preterm delivery (p>0.05) (Table 3).

In binary logistic regression analysis, gestational HTN, cholestasis, PROM and twin pregnancies significantly increased the odds of preterm delivery (p<0.001) (Table 4).

Discussion

The study found that the incidence of preterm births at the study site over the past 10 years was 4.56%, which was lower than the global average of 10% preterm births, and also lower than the 7.1-9.9% reported earlier from China, with an overall increasing trend, and late preterm babies predominated among preterm babies, accounting for 87.44% of preterm babies, which was in line with the preterm delivery pattern of a Grade 2A general hospital.[16,17] Compared with early preterm infants, late preterm infants tend to receive less attention and are easily overlooked. On the contrary, late preterm infants are the main force of preterm infants, and the number of mid- to late-term preterm infants has exceeded 70% of preterm infants worldwide. The clinical problems of late preterm infants are mainly the immaturity of various organ systems, which makes them prone to infections, respiratory distress, hypoglycaemia, hypothermia, kernel jaundice, and neurological hypoplasia.[18] Compared to full-term infants, late preterm infants have a high incidence of near-term complications and poor long-term growth and development. For a comprehensive second-class A hospital, strengthening the care of late preterm infants and improving the ability of neonatology staff to treat late preterm infants is one of the main focuses of work. Continuous and effective interventions for late preterm infants at an early stage can reduce the incidence of near-term complications and the risk of long-term stunting.

In the analysis of factors affecting the occurrence of preterm infants, the current study found that PROM, gestational HTN and cholestasis significantly increased the incidence of preterm infants, which is in line with the results of an studies.[19,20] PROM increases the chance of infection in preterm infants.[21]. A large number of studies have shown that PROM is a risk factor for preterm labour.[14,21] Inflammatory factors mediate a strong inflammatory response, leading to foetal membrane damage, rupture of the membranes, increased uterine contractions, and biochemical and structural changes in the cervix, which can lead to preterm rupture of membranes and chorioamnionitis. PROM can stimulate the production of prostaglandins in the meconium, resulting in chorioamnionitis and intrauterine foetal infection, which can lead to preterm labour. Gestational HTN has a great impact on the cardiovascular system, blood system, nervous system, retinopathy, growth and development of preterm infants.[22] Changes in the small spiral arteries in the myometrium of pregnant women with gestational HTN are not obvious. Due to the spasm of small arteries in the whole body and vascular lesions of the placenta, especially acute atherosclerosis of the blood vessels in the myometrium and other parts of the meconium, the blood flow of the mother's blood stream to the foetus is reduced, leading to insufficient blood supply to the placenta causing

the placental villi to undergo degenerative changes and placental insufficiency. On the other hand, the blood of pregnant women with gestational HTN is in a state of hypercoagulability and blood viscosity increases, on the basis of which the endothelium of blood vessels is damaged and thrombus is easily formed, aggravating the insufficiency of blood supply to the placenta. Besides, cholestasis increases the incidence of intrauterine distress, preterm labour and neonatal asphyxia.[23] When pregnant women are combined with intrahepatic cholestasis in pregnancy, high bile acids can impair the synthesis and transport function of the placenta, and at the same time can pass through the placenta into the foetus, affecting foetal respiration and metabolism, and ultimately causing intrauterine distress and LBW. Therefore, actively preventing and treating complications during pregnancy can effectively reduce the incidence of preterm infants and decrease the number of incidences of near-term postnatal complications in preterm infants as well as the impact on long-term growth and development.

Compared with term infants, preterm infants have significantly higher rates of caesarean section (CS), neonatal asphyxia resuscitation, hospitalisation, and neonatal near-term and long-term complications than term infants, and the younger the gestational age, the higher the incidence. Therefore, strengthening healthcare during pregnancy, preventing and actively treating pregnancy complications, reducing the occurrence of preterm infants, especially early preterm infants, and prolonging the gestational age are the focus of obstetrics. Enhancing the ability to save preterm infants, preventing preterm complications, and improving the quality of life of preterm infants are the priorities of neonatology medical care.

Twin pregnancy is also a non-negligible factor in increasing the incidence of preterm labour.[24] With the development of assisted reproductive technology and the improvement of medical technology, the incidence of twin pregnancies is increasing, which also greatly increases the incidence of preterm labour. The current study found that the proportion of twin foetuses among preterm infants increased significantly, and the younger the gestational age, the higher was the incidence, with twin foetuses accounting for 1.20% of full-term infants and 17.62% of preterm infants. Preterm labour is most common in multiple pregnancies, with a 5-10 times increased risk of preterm labour in twins compared to singletons. The rate of preterm labour in multiple pregnancies is on the rise with the increase of iatrogenic preterm labour. Studies have compared the factors causing preterm labour in singleton and twin foetuses, reporting that PROM was the first cause of preterm labour in both singleton and twin foetuses.[12,24]

In addition to PROM, the causes of preterm labour in singletons were mainly maternal or maternal-foetal factors, leading to medically-induced preterm labour, while in twins, the causes were mainly spontaneous preterm labour. In twin foetuses, the main causes of preterm labour are spontaneous preterm labour and medical preterm labour caused by foetal factors.

The specific reasons for the occurrence of preterm labour in twin foetuses are several. In twin pregnancies, the uterine cavity is subjected to the pressure from two foetuses and their appendages at the same time, and the membranes of the foetuses are subjected to excessive or unequal forces, which leads to spontaneous rupture. Further, the placenta of a twin foetus is large in size, which can secrete a large number of cytokines that promote uterine contraction, inducing spontaneous and regular contraction, and along with the natural dilatation of the uterine orifice, preterm labour is inevitable. Also, mothers carrying twin foetuses themselves are susceptible to preterm labour. Twin foetuses are prone to various diseases that cause abnormalities in placental metabolism and increase the risk of preterm labour in singleton foetuses, and may have the same effect in twin foetuses. Most of the mothers obtain twin pregnancies through assisted reproduction techniques. These women's own infertility factors and the drugs used and treatments received during assisted reproduction may be a potential risk for preterm labour in the future. Twin pregnancies are more prone to various complications and risk factors than single pregnancies, so the prevention of preterm labour in twin pregnancies is more important. In the current study, 28 of the 80 cases of twin pregnancies were conceived by assisted reproductive technology, accounting for 35%. While vigorously developing reproductive technology, it is necessary to increase the efforts regarding awareness and education, and should not artificially promote ovulation or in vitro-assisted reproduction of multiple foetuses because of the blind pursuit of multiple births.

At the same time, women should be encouraged to give birth at the optimal childbearing age. The current study found that early preterm births were more likely to occur at ages younger than 18 years and older than 35 years. There are relevant studies at home and abroad showing that the age of the pregnant mother leads to preterm labour, and preterm labour often occurs at age <19 years or >35 years.[7,8]

The current study has limitations of a small sample size. Besides, the study only analysed the factors associated with preterm birth from the basic data of pregnant women and newborns, and did not address the environmental, social and psychological factors associated with preterm birth.

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Author Contribution:
SF: Concept and design.
YW: Conducted the investigation.
YB: Data analysis and writing the original draft.
WS: Writing the original draft and helped in methodology.