Original Article

Evaluation of maternal risk factors for preterm delivery in Fatemieh Hospital of Hamadan, Iran, 2019: A case-control study

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Abstract

Background: The present study aimed to evaluate maternal risk factors of preterm delivery in Fatemieh Hospital in Hamadan, Iran, 2019. **Methods:** In this case-control study, 7,478 hospital files of live-born neonates and their mothers in Hamadan Fatemieh Hospital in 2019 were examined. According to statistical estimates, 261 preterm deliveries and 736 term deliveries were studied. Information files of neonates and mothers were used to complete the study questionnaire. The data were compared in two separate groups and logistic regression was performed to estimate the crude relationship between demographic and clinical characteristics of term and preterm delivery. **Results:** The mean age of women was 27.89 ± 6.48 years. Analysis of data revealed that academic education (OR: 2.02, $P = 0.014$), age group 25-34 years (OR: 1.5, $P = 0.016$), age of 35 years and above (OR: 1.66, $P = 0.018$), previous history of preterm delivery (OR: 5.3, $P < 0.001$), history of abortion (OR: 1.67, $P = 0.004$), history of surgery (OR: 1.54, $P = 0.007$), history of infertility ($P = 0.016$), and a history of cesarean (OR: 2.11, $P < 0.001$) were potentially associated with a higher odds of preterm delivery ($P < 0.2$). **Conclusion:** Based on the results, it is important to identify potential risk factors of preterm delivery in mothers and corrective interventions in strengthening consultation and education of pregnant women during pregnancy. Such a measure helps select the type of delivery and strengthen prenatal care in identifying mothers in high-risk groups and performing timely interventions.

Keywords: Maternal, neonatal, preterm delivery, risk factor

Introduction

Approximately, 15 million neonates are born prematurely each year, accounting for more than 10% of all neonates around the world.[1] Preterm delivery is the second leading cause of death in children under 5 years of age.[2] The rate of neonatal mortality, as an important indicator for the general health of a community, is 1 per 1000 live births. In 2018, the neonatal mortality rate in the United States was 5.7 deaths per 1000 live births.[3,4] Premature or preterm delivery is a term used to describe neonates born prematurely. According to the WHO, this delivery is categorized into classes of relatively early (less than 28 weeks), very early (28 to 32 weeks), and moderate to late (32 to 37 weeks).[5]

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In 2018, in the United States, five major causes of neonatal mortality have been found. This statistic is similar to the most common causes of neonatal death in 2017, including congenital anomalies (21%), disorders related to gestational age and low birth weight (LBW) (17%), maternal complications (6%), sudden infant death syndrome (6%), and unpredictable injuries (5%).[3] Neonates born at or before week 25 of pregnancy have the highest mortality rate (approximately 50%) and the highest risk of severe disorders if they survive.[6] Among all preterm deliveries, 30-35% of cases are due to maternal indication, 40-45% of cases are due to spontaneous preterm labor, and 30-35% of cases are due to preterm rupture of the membranes. Multiple pregnancies and hydramnios increase the risk of preterm labor. Factors related to maternal lifestyle such as smoking, maternal underweight, use of the unauthorized drug also play a negative role. Other maternal factors involved in this area are maternal age, poverty, short stature, and vitamin C deficiency. Psychological factors such as depression, anxiety, and stress have also been reported in this regard. Genetic factors, periodontal disease, the interval between pregnancies, a history of preterm labor, and infections such as bacterial vaginosis are also considered among the major risk factors for preterm labor.[5]

About 15 million preterm neonates are born annually (before week 37 of gestation) and this figure is increasing each year. Preterm delivery complications are the leading cause of death in children aged below 5 years so that it accounts for approximately 1 million deaths in 2015. According to WHO, preterm delivery rates in 184 countries range from 5% to 18% of newborns. Approximately, 1 million children die annually due to complications of preterm delivery[7] and many survivors face disabilities such as learning disabilities as well as vision and hearing problems up to the rest of their lives. Moreover, almost in all countries with reliable data, the rate of preterm delivery is increasing. Survival rate inequality around the world is quite a serious issue. In low-income communities, half of the neonates born on week 32 or sooner die due to infections and respiratory problems caused by a lack of practical and cost-effective care such as heat, breastfeeding support, and basic care. In high-income countries, almost all of the neonates survive.[8]

LBW prevalence in Iran was reported to be 9.2% in 2015.[9] In a meta-analysis conducted by Shokri *et al.*[9] (2020), the prevalence of this complication in Iran in 62 studies with a sample size of 301,839 neonates was reported as 7.95%. Preterm delivery is a multifactorial complication of a set of individual, behavioral, psychological, and environmental factors, as well as medical conditions, infertility treatment, and biological and genetic factors.[10] Pregnancy in adolescence, low school years, and inadequate pregnancy care are also common causes of this problem.[11] Preterm neonates are at greater risk for damage to their brain, lungs, and liver. Also, neonates born before week 32 of gestation have a higher mortality and disability rate.[12] Complications of preterm delivery include intraventricular hemorrhage, increased cesarean, neurological problems, and high costs imposed on families. Preterm delivery also leads to other complications including fetal abnormalities and membrane infections that are side-effects of it. Given the complications of preterm delivery, assessing the epidemiological and environmental factors is essential in diagnosing at-risk women.[13]

Preterm neonates are at risk of delivery complications including infectious diseases, respiratory failure, intraventricular hemorrhage, neurological defects, and other organ system disorders.[14] Accordingly, the discovery of ways to prevent preterm delivery is crucial for higher quality in infants and children. Despite significant advances in identifying the underlying causes of preterm delivery, the rate of preterm deliveries and consequently neonatal mortality is increasing. The present study is an attempt to compare maternal and neonatal factors of preterm and term delivery mothers to identify preventable factors. Also, it tries to inhibit the birth of preterm neonates, shorten the length of hospital stay of neonates, and lower the costs imposed by the preterm neonatal ward.

Methods and Materials

Study design

In this case-control study, neonates born were examined in Hamadan city (2019) in Fatemieh Hospital as the only referral hospital of the city.

Sample size determination

All live births (7,478) were included in the study. According to Martius *et al.*[15] in which the percentage of previous preterm delivery in cases and controls were 1.4% and 5.8%, and considering the power of 80% of the study, 95% confidence interval and control to case ratio equals 2.8. The required sample size for the present study was obtained to be 997, of which 261 preterm deliveries were assigned to the case group and 736 term deliveries to the control group.

Inclusion and exclusion criteria

Term pregnancy with gestational age 37 to 42 weeks and preterm with under 37 weeks (24-37) were assessed. It is of note that gestational age was determined based on pregnancy ultrasound and EDC method based on the first day of the last menstrual period. In this way, 7 days were added to the date of the first day of the last menstrual period and three months were subtracted. The mothers in the study were matched for prenatal care. Another criterion for inclusion was the availability of maternal and infant files in the hospital. However, exclusion criteria were incomplete files without phone numbers and contact information, unknown pregnancy age, incomplete and distorted medical records, and history of trauma or surgery during pregnancy (e.g. pelvic and abdominal surgeries).

Instrument and data collection

This questionnaire included demographic information and midwifery history of the mother including maternal age, maternal education, gestational age, number of previous pregnancies, history of preterm delivery, history of abortion or stillbirth,

premature membrane rupture, history of infertility, history of previous cesarean section, type of delivery, underlying diseases, and a history of previous surgery. The information inserted in the medical records of infants and their mothers, as well as telephone calls, was used to complete a questionnaire developed following the objectives of the research. Participants in the study entered the study with full consent and they were ensured about the confidentiality of their information. Each medical record was coded and the women's first names and last names were kept confidential. A random sampling method was used in the study.

Statistical analysis

Descriptive statistics were reported as number (%) for categorical variables and mean (±SD) for continuous variables across the participant's backgrounds in case and control groups. Univariate logistic regression was conducted to estimate the crude association between demographic and clinical characteristics of pregnant women and preterm delivery. Those with *P* value <0.2 were considered as potential significant determinants of preterm delivery and were included in multivariable logistic regression. The results of the logistic regression model were presented with an odds ratio (OR) and 95% confidence interval (CI). All analyses were performed using Stata 14 software.

Results

A total of 997 were included in the study. The mean age of the investigated population was 27.89 ± 6.48 years. A full comparison of demographic and clinical variables was performed between case and control groups. The results of univariate logistic regression analyses associated with preterm delivery are presented in Table 1.

In univariate analysis, academic education (OR: 2.02, $P = 0.014$), age groups 25-34 years (OR: 1.5, $P = 0.016$), age of 35 and higher (OR: 1.66, $P = 0.018$), history of preterm delivery (OR: 5.3, $P < 0.001$), history of abortion (OR: 1.67, $P = 0.004$), history of surgery (OR: 1.54, $P = 0.007$), history of infertility (OR: 1.92, $P = 0.016$), and history of cesarean (OR: 2.11, $P < 0.001$) were potentially associated with higher odds of preterm delivery ($P < 0.2$).

Table 2 and Figure 1 show the results of the multivariate logistic regression. After adjusting other variables, women with academic education showed 2.05-fold higher odds of preterm ([OR = 2.05, 95% CI: 1.13, 3.67)], $P = 0.017$). History of previous preterm delivery and a cesarean was associated with 4.13 and 2.09-fold increases in odds of preterm delivery ($P < 0.001$). History of previous abortion ([OR = 1.49, 95% CI: 1.03, 2.15)], $P = 0.03$) and history of infertility ([OR = 2.1, 95% CI: 1.21, 3.64)], $P = 0.008$) were other predictors of preterm delivery.

Discussion

In the present study, 997 women were studied. According to the results, the odds ratio of preterm delivery in people with

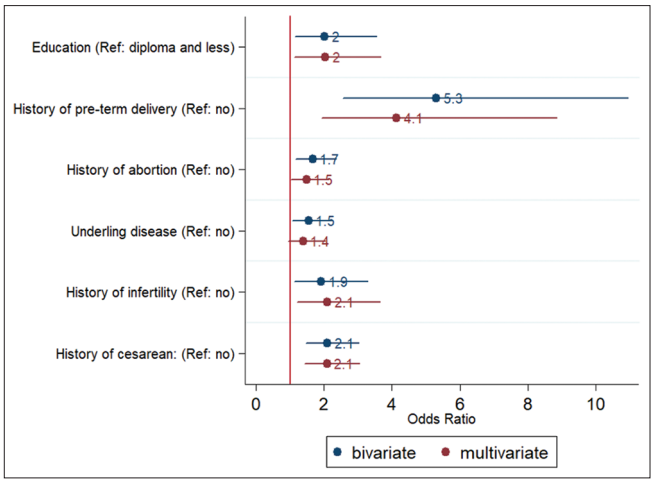

Figure 1: Graphical presentation of Multivariable analysis

academic education is 2.05-folds. Also, the odds ratio of preterm delivery in women with a history of previous preterm delivery and previous cesarean delivery increased by 4.13 and 2.09 folds, respectively. Preterm delivery was associated with a 1.49-fold increase in the history of abortion and a 2.10-fold increase in the history of infertility. In a similar study conducted by Silvestrin *et al.*[16] (2020), a statistically significant difference was observed between and maternal LBW education. Neonates born from mothers with higher education were underweight. Herein, the preterm deliveries were also effective in the observed trends in weight at birth. In contrast to the results of the present study, Taha *et al.*[17] (2020) extracted a statistically significant relationship between a low level of parental education and preterm delivery under 37 weeks. Also, Ruiz *et al.*[18] (2015) found that maternal education was significantly associated with a significant risk of preterm delivery and small gestational age (SGA) in 12 European countries. In another study, social factors such as maternal education level and psychosocial mediating factors (maternal anxiety and stress during pregnancy), behavioral factors, and lack of prenatal care were directly associated with preterm delivery.[19] The effect of maternal education on preterm delivery can be explained in two different ways. First, in line with the results of this study, highly educated mothers due to using new technologies such as *in vitro* fertilization, elective cesarean section, and ultrasound experience low mean birth weight with or without preterm delivery in the relevant processes.[16] Second, mothers with lower levels of education, similar to other studies reported above, suffer preterm delivery and its complications due to lower social and economic levels, receiving less prenatal care, and an insufficient number of prenatal visits.[20] These results indicate the importance of parental education level in preterm delivery and its complications. In the studied population, it is necessary to examine the causes and factors and perform corrective interventions. Results of this study revealed a relationship between the type of delivery and the occurrence of preterm delivery, which was similar to the study conducted by Taha *et al.*[17] (2020). These researchers observed a significant relationship between recurrent cesarean section and the occurrence of preterm delivery under 37 weeks.

Table 1: Comparison of demographic and clinical variables between case and control groups and the results of univariate logistic regression

Variable	Case group *n* (%)	Control group *n* (%)	Crude model	
			OR (95% CI)	*P*
Education				0.014
Diploma and less	239 (91.57)	704 (95.65)	References	
Academic	22 (8.43)	32 (4.35)	2.02 (1.15, 3.55)	
Age group (Year)				
15-24	69 (26.44)	262 (35.60)	References	
25-34	140 (53.64)	355 (48.23)	1.50 (1.08, 2.08)	0.016
35+	52 (19.92)	119 (16.17)	1.66 (1.09, 2.53)	0.018
Gravidity				
1	82 (31.42)	286 (38.86)	References	
2	88 (33.72)	238 (32.34)	1.30 (0.91, 1.82)	0.15
3	53 (20.31)	141 (19.16)	1.31 (0.88, 1.96)	0.19
4 and more	38 (14.56)	71 (9.65)	1.87 (1.17, 2.97)	0.008
Parity				
0	106 (40.61)	318 (43.20)	References	
1	88 (33.72)	249 (33.83)	1.06 (0.76, 1.47)	0.74
2 and more	67 (25.67)	169 (22.97)	1.19 (0.83, 1.70)	0.35
History of preterm delivery				<0.001
No	238 (91.19)	723 (98.23)	References	
Yes	23 (8.81)	12 (1.77)	5.30 (2.57, 10.94)	
History of abortion				0.004
No	199 (76.25)	622 (84.51)	References	
Yes	62 (23.75)	114 (15.49)	1.67 (1.18, 2.36)	
Underlying disease				0.02
No	205 (78.93)	630 (85.59)	References	
Yes	55 (21.07)	105 (14.41)	1.55 (1.07, 2.23)	
History of surgery				0.007
No	179 (68.58)	568 (77.17)	References	
Yes	82 (31.42)	168 (22.83)	1.54 (1.13, 2.11)	
History of infertility				0.016
No	235 (90.04)	699 (94.97)	References	
Yes	26 (9.96)	37 (5.03)	1.92 (1.13, 3.28)	
History of cesarean				<0.001
No	200 (76.62)	641 (87.09)	References	
Yes	61 (23.38)	95 (12.91)	2.11 (1.47, 3.02)	

*Underlying diseases include Diabetes Mellitus, Hypertension, Kidney failure, Heart diseases, and cancers

Temu *et al.*[21] (2016) studied several factors associated with preterm delivery, including cesarean delivery. They showed that the planned cesarean section increases the risk of preterm delivery and has several maternal complications. Cesarean section in preterm deliveries involves high uncertainty in terms of surgical procedure since the lower part of the infant may not be formed and a vertical incision may be done in the upper part of the uterus. In this condition, other complications such as increased blood loss and increased risk of uterine rupture in subsequent pregnancies may occur.[22] Kaplanoglu *et al.*[23] (2014) showed that recurrent cesarean section was associated with preterm delivery. The gestational week at birth ($P < 0.001$), birth weight ($P < 0.001$), and Apgar score ($P < 0.001$) in the group with the third cesarean section were statistically significantly lower than the second cesarean section. This result is in line with the evaluated data on possible maternal and fetal complications in recurrent cesarean section. Given the similar evidence in this study, the need for accurate prenatal follow-up in pregnancies of adolescents and nulliparous women, guiding patients as much as possible to normal vaginal delivery, and encouraging normal vaginal delivery to prevent undesirable outcomes is inevitable.[18] A statistically significant relationship was observed between previous preterm delivery and the occurrence of preterm delivery in the present study. In similar studies, the history of preterm delivery was reported as a major cause of recurrence of preterm delivery.[20,22] In a study conducted by van den Broek *et al.*[24] (2014), the main reason for an increase in the rate of preterm delivery was reported to be an increase in the number of previous preterm deliveries. At Parkland Hospital, the risk of recurrent preterm delivery in women whose first pregnancy was preterm increased threefold compared to women who had a history of term previous. Based on the studies, the risk of spontaneous preterm delivery is influenced by previous preterm deliveries, gestational age, and order of previous preterm deliveries.[5]

Table 2: Multivariable analysis of demographic and clinical variables associated with preterm delivery

Variable	Multivariable model	
	OR (95% CI)	*P*
Education		0.017
Diploma and less	References	
Academic	2.05 (1.13, 3.67)	
History of preterm delivery		<0.001
No	References	
Yes	4.13 (1.93, 8.85)	
History of abortion		0.03
No	References	
Yes	1.49 (1.03, 2.15)	
Underlying disease		0.09
No	References	
Yes	1.39 (0.94, 2.04)	
History of infertility		0.008
No	References	
Yes	2.10 (1.21, 3.64)	
History of cesarean		<0.001
No	References	
Yes	2.09 (1.44, 3.04)	

*Underlying diseases include Diabetes Mellitus, Hypertension, Kidney failure, Heart diseases, and cancers

These results highlight the necessity of evaluating women at risk of preterm delivery daily by physicians and other healthcare providers during prenatal care to prevent recurrent preterm delivery and its unfavorable consequences. According to the results of this study, a history of abortion and a history of infertility were reported as factors related to preterm delivery. In another study, the history of abortion, lack of adequate training and low visits, heavy physical activity during pregnancy, and placental abruption were reported as relevant causes.[21] Moreover, a retrospective study conducted in 2018 on Chinese women showed that women with a history of previous abortion were not at risk of preterm birth or LBW in subsequent pregnancies.[25] There are conflicting data in this area. According to scientific sources, the threat of abortion in early pregnancy is associated with the occurrence of subsequent unfavorable outcomes such as preterm delivery.[5] However, due to several conflicting studies in this area, to implement timely interventions, further investigations and evaluation of pregnant women with these symptoms are needed. Also, in similar studies, a significant relationship was observed between birth weight loss and the occurrence of preterm delivery in infertile women.[26]

The increase in preterm labor after infertility may be due to more monitoring of infertility mothers on their pregnancy status and detecting related complications, increasing age and underlying problems (e.g., diabetes and hypertension), an increasing number of fetuses, and changes in delivery methods (e.g., preterm cesarean section).[27,28] The risk factors of preterm delivery identified in this study are consistent with those of previous studies. Physicians and other healthcare providers should routinely assess women at risk of preterm delivery during prenatal care, especially in adolescent pregnancies, to prevent preterm delivery and adverse pregnancy outcomes and to improve quality. Healthcare provided to women can reduce the rate of preterm delivery. Thus, corrective interventions in strengthening counseling and education of pregnant women during pregnancy are necessary to help select the type of delivery and also to strengthen prenatal care in identifying mothers with a history of preterm delivery in high-risk groups and to perform timely interventions. Furthermore, the high rate of preterm delivery in this study in women with a history of abortion, a history of infertility, a history of surgery, women in the age group of 24-35 years, and women with academic education highlights the need for risk assessment in health centers in this group of mothers.

Conclusions

Based on the above results, identifying potential risk factors for preterm delivery in mothers is essential. The present study indicated a significant relationship between cesarean section and preterm delivery. Given that previous preterm delivery is one of the main reasons for the recurrence of this complication, corrective interventions are needed to strengthen the counseling and education of pregnant women during pregnancy. Accordingly, it is possible to help select the type of delivery and to strengthen prenatal care in identifying mothers with a history of preterm delivery in high-risk groups and timely interventions. Moreover, factors such as the high rate of preterm delivery in this study in women with a history of abortion, a history of infertility, a history of surgery, women in the age group of 24-35 years, and women with academic education highlight the need for risk assessment in health centers in this group of mothers.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request and with appropriate approvals.

Ethics approval

This research was approved by the Ethics Committee of Hamadan University of Medical Sciences under code (IR.UMSHA.REC.1399.021) and project NO 990209654.

Declaration of patient consent

All participants provided written informed consent.

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Conflicts of interest

There are no conflicts of interest.

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