




***Prevalence of Low Birth Weight and Preterm Birth and the  
Influential Factors in Zanjan, Iran (2014-2016)***

Kharaghani R<sup>1</sup>, Niroomand S<sup>2</sup>, Safaei Nezhad A<sup>3\*</sup>

<sup>1</sup>PhD. in Reproductive Health, Dept. of Midwifery, Assistant Professor, School of Nursing and Midwifery, Zanjan University of Medical Sciences, Zanjan, Iran

<sup>2</sup>MSc. Dept. of Midwifery, School of Nursing and Midwifery, Zanjan University of Medical Sciences, Zanjan, Iran

<sup>3</sup>MSc. Midwifery Counseling. Dept. of Midwifery, School of Nursing and Midwifery, Zanjan University of Medical Sciences, Zanjan, Iran

**\*Corresponding Author:** Dept. of Midwifery, School of Nursing and Midwifery, Zanjan University of Medical Sciences, Zanjan, Iran

**Email:** a.safaei20@yahoo.com

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## Abstract

**Background:** The prevalence of low birth weight (LBW) has been estimated at 15.5%, and approximately 15 million preterm births (PTB) occur across the world. These rates have been reported to be 9% and 9.2% in Iran, respectively.

**Objectives:** The present study aimed to assess the prevalence of LBW and PTB and compare their influential factors in Zanjan province, Iran during 2014-2016.

**Methods:** This descriptive-analytical study was conducted on 41,265 neonates (stillbirth and alive) in Zanjan province and suburbs. Data were collected using the registries of the midwives in charge of the maternal and neonatal registry system. Data analysis was performed in Excel and SPSS version 16 using descriptive and analytical tests, including the univariate and multivariate logistic regression models.

**Results:** The prevalence of LBW and PTB was 7.2% and 8.2%, respectively. Odds ratio of LBW was lower with increased parity (OR=0.736; P<0.001) and gestational age (OR=2.570; P<0.001), while it was higher in female neonates (OR=1.324; P<0.001) and infants with congenital malformations (OR=2.570; P=0.001). Odds ratio of PTB was higher with increased abortions (OR=1.206; P<0.001) and in male neonates (OR=1.440; P<0.001), while it was lower with increased birth weight (OR=0.996; P<0.001). Maternal underlying diseases and diabetes reduced the odds ratio of LBW (OR=0.633; P=0.019) and increased the odds ratio of PTB (OR=3.650; P<0.001). Moreover, preeclampsia and eclampsia increased the odds ratio of LBW (OR=3.140; P<0.001) and PTB (OR=1.489; P=0.005). In terms of social factors, maternal education level decreased the odds ratio of LBW (P<0.05). The prevalence of PTB increased by 22.8% in 2015 compared to the previous year (P=0.012).

**Conclusion:** According to the results, congenital malformations, gender, gestational age, birth weight, maternal education level, and maternal underlying diseases were significantly correlated with LBW and PTB. Therefore, improving maternal and neonatal health requires proper planning to control the influential factors in LBW and PTB.

**Keywords:** low birth weight, neonatal outcomes, preterm birth, risk factors, Zanjan, Iran

## Introduction

Birth before 37 weeks of gestation is defined as preterm birth (PTB), and birth weight of less than 2,500 grams is referred to as low birth weight

(LBW). PTB and LBW are important, indirect causes of neonatal mortality. LBW contributes to 60-80% of all neonatal deaths, and the global prevalence of LBW has been estimated at 15.5%

[1]. In Iran, the total prevalence of LBW has been reported to be 9% [2].

PTB is an important influential factor in neonatal mortality. Each year, approximately 15 million preterm newborns are born, accounting for 11% of the total live births across the world. While neonatal mortality due to PTB has declined in general, the rate has remained high and is directly correlated with gestational age at birth. The subsequent morbidity and disabilities are common in premature neonates [2]. The prevalence of PTB has been reported to be 9.2% in Iran [3].

One of the goals of the World Health Organization (WHO) is to reduce the prevalence of LBW by 30% by 2025 [4]. According to United Nations International Children's Emergency Fund (UNICEF), the global prevalence of LBW was 16% in 2014, while it was 14% in the least developed countries, 11% in Turkey, and 8% in Iran [5].

Zanjan province is located in the northwest of Iran. Zanjan has an area of more than 22,000 square kilometres and consists of seven counties, including Abhar, Eejrud, Khodabandeh, Khorramdarreh, Zanjan, Tarom, and Mahneshan. Previous studies have investigated the effects of various demographic and delivery factors, maternal underlying diseases, fetal factors, and socioeconomic factors on neonatal outcomes [6,7]. Some studies have proposed conflicting results regarding the influential factors in neonatal outcomes. For instance, there is controversy on the association between maternal age, parity, underlying diseases, and neonatal outcomes among these studies [6-8]. On the other hand, it seems that neonatal outcomes are associated with common risk factors.

Considering the discrepancies in the findings regarding the key influential factors in neonatal outcomes, the present study aimed to assess the prevalence of LBW and PTB and compare their influential factors in Zanjan province, Iran during 2014-2016.

### **Methods**

This cross-sectional, retrospective study was conducted on all the neonates (stillbirth and alive) with the gestational age of more than 22 weeks in Zanjan province during 21 March 2014-19 March

2016. The birth data were collected from the Iranian Maternal and Neonatal (IMAN) web system, which contains the birth data reported by private and government maternity hospitals. The Iranian Ministry of Health and Medical Education (MOHME) registers the birth data of the entire country in IMAN. The registration data sheets in this network include maternal and neonatal characteristics. Data were collected using the standard forms of the MOHME for the entire country, which are completed by trained midwives and often registered in the IMAN network by a trained midwife. The researchers obtained all the MOHME data in a professional excel format to be analyzed in SPSS version 16. The full coverage of the data was confirmed by matching the IMAN data with the provincial birth statistics as reported by the provincial civil registration office. To ensure the accuracy of the data, some of the data in SPSS were randomly controlled with the data recorded in the IMAN network.

In the present study, PTB was defined as birth before 37 weeks of gestation, and LBW was referred to the neonates with the birth weight of less than 2,500 grams. To analyze the data, the prevalence of neonatal outcomes and their influential factors were initially determined based on number, percentage, mean, and standard deviation (SD). Afterwards, univariate and multivariate logistic regression models were applied based on backward logistic regression in order to verify the influential factors in the neonatal outcomes. The first model was used to examine the influential factors in LBW, including maternal age, parity, number of abortions, gestational age, neonatal gender, chronic hypertension, preeclampsia/eclampsia, thyroid diseases, diabetes, and other diseases in the mother, neonatal malformations, maternal education level, consanguineous marriage, place of residence, insurance status, and year of entering the multiple logistic regression model.

In the second model, to examine the influential factors in PTB, variables such as maternal age, parity, number of abortions, birth weight of the infant, gender of the infant, chronic hypertension, preeclampsia/eclampsia, diabetes and other diseases, neonatal malformations, maternal education level, and insurance status were

analyzed using the multiple logistic regression model.

The study protocol was approved by the Ethics Committee of Zanjan University of Medical Sciences (code: ZUMS.REC.1395.56), and the required permit for the research was obtained from the related authorities. In all the statistical analyses, P-value of less than 0.05 was considered significant.

**Results**

During the study period, there were 41,265 recorded births at the gestational age of more than

22 weeks in Zanjan province and the suburbs. In total, 49% of these births were reported in 2015, and 51% were reported in 2016. In the present study, the independent variables predicted 50.3% of the LBW variable and 49.4% of the PTB variable. Almost all the mothers were Iranian with the mean age of 27.78 years, and 12.35% had diseases such as chronic hypertension, diabetes, preeclampsia / eclampsia, and other underlying diseases. The prevalence of LBW and PTB was estimated at 7.2% and 8.2%, respectively (Table 1).

**Table 1: Maternal Characteristics and Factors Related to Neonatal outcomes**

Variable	Number	Percent
<b>Year</b>		
2015	20236	49
2016	21029	51
Nationality of Mother (Non Iranian)	6	0.01
Maternal Age*	27.78	6.13
<b>Maternal Education Level</b>		
Illiterate	1274	3.1
Primary School	9149	22.2
Middle and High School	9609	23.3
High School Graduate	13380	32.4
Associate to Master’s	7521	18.2
PhD	80	0.2
Other	252	0.6
Place of Residence (rural)	16195	39.2
<b>Insurance</b>		
Urban Health Insurance	1934	4.7
Rural Health Insurance	7058	17.1
Social Security Insurance	11202	27.1
Others	2602	6.3
Imam Khomeini and No Insurance	1158	2.8
missing	17311	42
<b>Maternal Underlying Diseases</b>		
Chronic Hypertension	479	1.16
Preeclampsia or Eclampsia	1072	2.60
Diabetes	1038	2.52
Thyroid Disease	1373	3.33
Heart Disease	255	0.62
Anemia	198	0.48
HIV or VDRL Positive Test	9	0.02
Other	1099	2.66
Consanguineous Marriage (yes)	4702	11.4
Gravida*	2.03	1.09
Parity*	0.83	0.9
Abortion*	0.2	0.51
Newborn Gender (male)	21165	51.3

Congenital Anomalies (yes)	305	0.7
Birth Weigh* (gram)	3144.7	531.5
Low Birth weight (<2500 gram)	2996	7.2
Gestational Age* (week)	38.4	2.1
Preterm Birth (<37week)	3393	8.2

\* mean ± Standard deviation

a: Armed Forces, Oil, and Bank employer-based Insurances

Univariate logistic regression indicated a statistically significant correlation between LBW and maternal age, parity, number of abortions, gestational age, maternal education level, consanguineous marriage, chronic hypertension, preeclampsia/eclampsia, diabetes, thyroid and other disorders, congenital malformations, rural residence, and having insurance (P<0.05).

Moreover, a statistically significant association was observed between PTB and maternal nationality, age, education level, parity, number of abortions, neonatal weight and gender, chronic hypertension, preeclampsia/eclampsia, diabetes and other diseases, congenital malformations, year, and having insurance (P<0.05) (Table 2).

**Table 2: Factors Associated with Neonatal Outcomes in Univariate Regression**

Variable	Low Birth Weight			Preterm Birth		
	9	%95 CI	P Value	OR*	%95 CI	P Value
<b>Year</b>						
2015	1			1		
2016	1.077	1.160,0.999	0.052	1.114	1.195, 1.038	0.003
Nationality of Mother(Non Iranian)	0	0	0.999	11.170	2.253-55.367	
Mothers Age*	1.010	1.016,1.004	0.002	1.022	1.028,1.017	<0.001
<b>Maternal Education Level</b>						
Illiterate	1			1		
Primary School	0.709	0.858,0.585	<0.001	0.753	0.906,0.0625	0.003
Middle and High School	0.652	0.790,0.538	<0.001	0.709	0.854,0.589	<0.001
High School Graduate	0.601	0.726,0.498	<0.001	0.621	0.746,0.517	<0.001
AssociatetoMaster's	0.555	0.677,0.455	<0.001	0.620	0.751,0.512	<0.001
Degree PHD	0.782	1.734,0.353	0.547	0.964	1.970,0.472	0.921
Others	0.372	0.699,0.198	0.002	0.447	0.787,0.254	0.005
Place of Residence (rural)	1.133	1.222,1.051	0.001	1.054	1.132,0.981	0.149
<b>Insurance</b>						
Urban Health Insurance	0.539	0.699,0.415	<0.001	0.639	0.639	<0.001
Rural Health Insurance	0.649	0.799,0.529	<0.001	0.652	0.652	<0.001
Social Security Insurance	0.539	0.658,0.441	<0.001	0.579	0.579	<0.001
Other	0.680	0.859,0.538	0.001	0.749	0.749	0.012
Imam Khomeini and No Insurance	1			1		
<b>Maternal Underlying Diseases</b>						
Chronic Hypertension	2.890	2.284, 3.656	<0.001	3.323	2.674, 4.130	<0.001
Preeclampsia or Eclampsia	6.024	5.256, 6.904	<0.001	5.290	4.621, 6.056	<0.001
Diabetes	1.582	1.297, 1.931	<0.001	2.590	2.204, 3.044	<0.001
Thyroid Disease	1.221	1.008, 1.479	0.041	1.174	0.977, 1.411	0.088
Heart Disease	0.854	0.514, 1.419	0.543	0.950	0.601, 1.501	0.825
Anemia	1.124	0.673, 1.876	0.656	1.1170	0.687, 1.815	0.656
HIV or VDRL Positive Test	0	0	0.999	1.685	0	0.999
Other	1.699	1.406, 2.051	<0.001		1.407, 2.017	<0.001
Consanguineous Marriage (yes)	1.140	1.276,1.019	0.021	1.072	1.194,0.962	0.207

Gravida	0.992	1.026,0.958	0.630	1.100	1.134,1.067	<0.001
Parity	0.909	0.949,0.871	<0.001	1.037	1.077,0.988	0.058
Abortion	1.236	1.315,1.161	<0.001	1.319	1.396,1.247	<0.001
Newborn Gender (male)	0.933	0.866, 1.005	0.069	1.125	1.049, 1.208	0.001
Congenital Anomalies (yes)	6.122	4.797, 7.814	<0.001	5.329	4.176, 6.798	<0.001
Gestational Age* (week)	0.385	0.396,0.374	<0.001	-	-	-
Birth Weight*	-	-	-	0.996	0.996,0.996	<0.001

#### Armed Forces, Oil, and Bank employer-based Insurances

The first multivariate logistic regression model was adjusted for the variables of maternal age, parity, number of abortions, chronic hypertension, thyroid and other disorders, consanguineous marriage, and place of residence. According to the findings, the odds ratio of LBW increased in line with gestational age, congenital malformations, maternal underlying diseases (e.g., preeclampsia/eclampsia), and presence of other underlying medical conditions in the mother. However, this odds ratio decreased in the case of male neonates, diabetic mothers, mothers with middle- and high-school education level, and urban health and social security insurance.

The second multiple logistic regression model was adjusted for the variables of parity, number of abortions, congenital malformations, maternal education level, and birth weight. According to the findings, the odds ratio of PTB increased in 2016 compared to the previous year. Moreover, the odds ratio of PTB increased in the case of abortion, male neonates, and maternal underlying diseases (e.g., preeclampsia/eclampsia, diabetes, and chronic hypertension). The reduced odds ratio of PTB also increased birth weight, rural health insurance, and social security insurance (Table 3).

**Table 3: Factors Related to Neonatal Outcomes on Multiple Logistic Regression**

Variable	Low Birth Weigh			Preterm Birth		
	OR*	%95 CI	P Value	OR*	%95 CI	P Value
<b>Year</b>						
2015				1		
2016				1.228	1.441,1.046	0.012
Mothers Age				1.012	1.025,1.000	0.056
<b>Maternal Education Level</b>						
Illiterate				1		
Primary School	0.789	1.135,0.548	0.202			
Middle and High School	0.681	0.987,0.469	0.043			
High School Graduate	0.669	0.973,0.460	0.036			
Associate to Master's Degree	0.480	0.720,0.320	<0.001			
PhD	0.406	1.550,0.106	0.187			
Others	0.276	1.103,0.069	0.069			
<b>Insurance</b>						
Urban Health Insurance	0.684	0.981,0.477	0.039	0.853	1.187,0.614	0.345
Rural Health Insurance	0.884	1.184,0.661	0.409	0.741	0.977,0.562	0.033
Social Security Insurance	0.656	0.872,0.493	0.004	0.725	0.950,0.553	0.02
Other	0.755	1.053,0.541	0.098	0.864	1.178,0.633	0.355
Imam Khomeini and No Insurance	1			1		
<b>Maternal Underlying Diseases</b>						
Hypertension				1.700	2.683,1.077	0.023
Preeclampsia or eclampsia	3.140	4.046,2.437	<0.001	1.489	1.970,1.125	0.005
Diabetes	0.633	0.929,0.432	0.019	3.650	4.886,2.727	<0.001
Other	1.441	2.044,1.016	0.040	1.386	1.911,1.006	0.046

Parity	0.736	0.677,0.799	<0.001			
Abortion				1.207	1.089,1.339	<0.001
Newborn Gender (male)	0.755	0.885,0.679	<0.001	1.440	1.628,1.274	<0.001
Congenital Anomalies (yes)	2.570	4.569,1.446	0.001			
Gestational Age (week)	0.394	0.410,0.379	<0.001			
Birth Weight (gram)				0.996	0.996,0.996	<0.001

\*Low birth weight adjusted for year, mothers age, para, abortion, Chronic hypertension, Thyroid , others illness, consanguineous marriage , Place of residence.

\*\* Preterm birth for para, abortion, Congenital anomalies, Mothers education, Birth weight.

a: Armed Forces, Oil, and Bank employer-based Insurances

### Discussion

According to the results of the present study, the prevalence of LBW was 7.2% in Zanjan province during 2015-2016 (7% in 2015 and 7.5% in 2016). The odds ratio of LBW decreased with increased parity and gestational age in female neonates and those with congenital malformations. With regard to maternal underlying diseases, diabetes reduced the odds ratio of LBW, while preeclampsia/eclampsia and other underlying diseases increased the odds ratio. As for social factors, middle- and high-school education level, high school graduation, having associate to master's degree, and having urban health insurance and social security insurance reduced the odds ratio of LBW.

In the current research, the prevalence of PTB was 8.2%. The odds ratio of PTB was higher with the increased number of abortions and decreased birth weight. In male neonates, the odds ratio of PTB was higher compared to female neonates. In terms of maternal underlying diseases, diabetes, preeclampsia/eclampsia, chronic hypertension, and other underlying conditions increased the odds ratio of PTB. In addition, social factors (e.g., rural health insurance and social security insurance) decreased the odds ratio of PTB. In 2016, the prevalence of PTB (8.5%) increased by 22.8% compared to 2015 (7.8%).

The estimated prevalence rate of LBW in the present study is consistent with the results of a systematic review in this regard [9], as well as the report of UNICEF (2014) [5]. The prevalence of PTB in Zanjan (Iran) was 22.8% higher in 2016 compared to the previous year. Further research is required to determine the causes and influential factors in PTB. It seems that the increased age of pregnant women and the subsequent maternal

underlying diseases could increase the prevalence of PTB in Zanjan province.

According to the current research, maternal age was associated with PTB, while it had no correlation with LBW. This is in congruence with the previous studies in this regard [10,11]. The increased rate of PTB with increased maternal age could be associated with the increased risk of various diseases and multiple pregnancies, reduced ovum quality, and factors associated with low fertility in older women [12].

In the present study, neonatal outcomes were associated with the gender of the neonates as the odds ratio of LBW was higher in female infants, whereas the odds ratio of PTB was higher in male infants. These findings are consistent with the results of the previous studies in this regard [6,13]. Moreover, male newborns were observed to be more susceptible to environmental factors compared to female newborns, while they were also more frequently affected by environmental stressors than females. Therefore, male neonates were at a higher risk of PTB, neonatal macrosomia, and other adverse consequences [13].

In the current research, the odds ratio of LBW increased with higher parity and lower gestational age, and the odds ratio of PTB increased with the higher number of abortions and decreased with higher birth weight. In other words, lower gestational age was associated with the higher risk of LBW, whereas higher gestational age was associated with the lower risk of LBW. On the other hand, decreased LBW has been reported to be associated with increased parity in the previous studies in this regard [6]. Maternal nutritional depletion or the abnormal reconstruction of endometrial blood vessels due to the inadequate interval between pregnancies could lead to LBW

[14]. However, consistent with the present study, Hinkle et al. denoted a non-linear association between parity and birth weight, so that birth weight resulted in the four-fold increase of parity [15]. The correlation between PTB and abortion could be resulted from cervical or uterus damage after induced, spontaneous or incomplete abortions [16].

According to the results of the present study, maternal underlying diseases played a key role in neonatal outcomes, so that maternal diabetes decreased the odds ratio of LBW and increased the odds ratio of PTB. Furthermore, preeclampsia/eclampsia and other underlying diseases increased the odds ratios of both LBW and PTB. Chronic hypertension also increased the odds ratio of PTB. The relationship between PTB and LBW with gestational diabetes or Type II diabetes was also observed in previous studies [17,18]. This could be attributed to the abnormal maternal-placental perfusion in diabetic women, which leads to macrosomia and adverse pregnancy outcomes [19]. The association between chronic hypertension and PTB, as well as preeclampsia, and PTB and LBW, has been confirmed in previous studies [18,20]. Since the prevalence of preeclampsia and eclampsia has been reported to be on the rise in Iran [21], their early diagnosis and management could remarkably improve maternal and neonatal outcomes.

According to the current research, social factors as having some types of insurances reduced the odds ratios of LBW and PTB. Similarly, maternal education level (middle school to master's degree) reduced the odds ratio of LBW compared to the infants of illiterate mothers, which is in line with the results of the previous studies in this regard [22,23]. Low-income individuals are unable to afford insurance costs, and LBW was observed to be correlated with poor socioeconomic status. In line with our findings, the results of a meta-analysis by Silvestine et al. indicated that high maternal education level could protect newborns against the risk of LBW at the rate of 33% [24]. Education level is influenced by the socioeconomic status of mothers, and under traumatic circumstances, uneducated individuals do not have access to adequate information, which

delays referrals to healthcare professionals, leading to insufficient prenatal consultation during pregnancy [24]. In this regard, an electronic surveillance system with links to health and treatment areas could help identify the factors associated with the increased risk of maternal and neonatal health [25].

Although our findings regarding the prevalence of LBW and PTB were consistent with the other studies conducted in Iran, the prevalence of PTB has been reported to increase by 22.8%, which requires the special attention of healthcare authorities and planners. On the other hand, an association was denoted between neonatal outcomes and several factors, such as demographic characteristics, reproductive factors, maternal underlying diseases, and socioeconomic status. Among various influential factors, congenital malformations, gender of neonates, gestational age, birth weight, maternal education level, and maternal underlying diseases were significantly correlated with LBW and PTB. Therefore, it could be concluded that the improvement of maternal and neonatal health requires proper planning to control the main influential factors in LBW and PTB. Furthermore, neonatal outcomes could be enhanced through the careful consideration of their dimensions and associations with other factors, and it is essential to plan each of these factors in accordance with the functional program of the WHO.

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