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Risk Factors of Low Birth Weight Infants: A Population-Based Cross-Sectional Study

Hamid Reza Bahrami[1], Ehsan Musa Farkhani[2], Behnaz Beygi[3], Mahdi Gholian-Aval[4], Ali Taghipour[5], *Seyed Javad Hoseini[6]

[1]Associate Professor of Complementary and Chinese Medicine, Persian and Complementary Medicine Faculty, Mashhad University of Medical Sciences, Mashhad, Iran. [2]PhD Candidate in Epidemiology, Khorasan Razavi Province Health Center, Mashhad University of Medical Sciences, Mashhad, Iran. [3]Environmental Health Engineering, Khorasan Razavi Province Health Center, Mashhad University of Medical Sciences, Mashhad, Iran. [4]Department of Health Education and Health Promotion, Mashhad University of Medical Sciences, Mashhad, Iran. [5]Ph.D. in Epidemiology, Associate Professor, Social Determinants of Health Research Center, Mashhad University of Medical Sciences, Mashhad, Iran. [6]Department of Medical Biotechnology, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.

Abstract

Background: Complications caused by low birth weight (LBW) are among the most common causes of neonatal mortality and future problems during adulthood. This study aimed to identify the risk factors for LBW.

Materials and Methods: This cross-sectional study was conducted in Mashhad University of Medical Sciences from 2017 to 2018 on 7,382 LBW neonates and 36,911 healthy neonates. Data were collected from the SINA electronic health record system. Data analysis was performed in STATA version 12.0. Bivariate and multivariate logistic regression were applied to determine the association between independent variables and LBW.

Results: The prevalence of low birth weight was 5.88 infants per 100. In this study, the risk of LBW was increased in people living in rural areas, compared to urban areas, by 9% (95% CI: 1.01-1.18), in illiterate individuals by 4.60% (95% CI: 4.05-5.23), in employed individuals by 2.40% (95% CI: 2.20-2.62), in female newborns (95% CI: 1.04-1.16), in mothers with a history of miscarriage by 74% (95% CI: 1.09-2.75), in women with premature delivery by 34.09% (95% CI: 29.17-39.84), in women with a history of multiple gestations by 22.30% (95% CI: 18.71-26.59), in women with a history of drug consumption by 2.01% (95% CI: 1.83-2.21), in mothers not consuming folic acid and iron by 24% (95% CI: 1.10-1.39) and 9% (95% CI: 1.00-1.19). On the other hand, it decreased by lack of consumption of multivitamins and vitamin D by 1% (95% CI: 0.88-1.11), and 29% (95% CI: 0.61-0.82), respectively.

Conclusion: According to the results, educating mothers, increasing prenatal care, having an appropriate diet and taking supplements can play an important role in reducing the risk of LBW.

Key Words: Children, Distraction, Pain, Venipuncture, Video game play.

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Corresponding Author:

Behnaz Beygi, MSc. Khorasan Razavi Province Health Center, Mashhad University of Medical Sciences, Mashhad, Iran. Fax: +98 513 8415222

Email: b.beygi1990@gmail.com

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1- INTRODUCTION

Low birth weight (LBW) is one of the important indices for assessing the health of infants, which demonstrates the quality of fetal growth (1). According to the World Health Organization (WHO), LBW is defined as birth weight of less than 2.5 kg. Based on an international agreement, this weight is ideally measured within the first hours after birth, before significant postnatal weight loss has occurred (2). In addition, the WHO has reported that 15-20% of all births worldwide are LBW, representing approximately 20 million births a year (3). The prevalence rate of LBW in developing and developed countries has been estimated at 5-7% and 19%, respectively (2). According to the calculations of the United Nations Children's Fund (UNICEF), the highest prevalence rate of LBW is related to South Asia (28%). In this regard, the prevalence rate of this condition has been reported 5-12% in Iran (4). In this country, approximately two-thirds of neonatal deaths occur in the first 24 hours after the birth of LBW infants, which accounts for 56.11% of all births (5). The level of neonatal mortality in LBW infants is 20 times more than neonates with weights above 2.5 kg worldwide (6).

In addition, the possibility of the emergence of several problems, including visual, auditory, neural, and mental disorders, is two-three times higher, compared to infants with birth weight of more than 2.5 kg. Moreover, there is a higher chance of congenital anomalies and respiratory problems in these children (7). Complications associated with low birth weight are not limited to this period. In fact, most adult diseases have fetal origins, in a way that LBW neonates are four times more at risk of hyperlipidemia in adulthood (8). Furthermore, there is a relationship between LBW and complications such as hypertension, reduced sensitivity to insulin, and the possibility of schizophrenia in adulthood (9, 10). Birth weight not only reflects neonates' survival and development, but also it indicates the health state, proper nutrition and maternal quality of life. According to the literature, genetic, biological, environmental, and socio-economic factors, mother's lifestyle (e.g., alcohol abuse, smoking, and pharmaceutical supplements), and any other factor that affects maternal health can also affect fetal growth (4, 11).

According to various studies, birth weight depends on different factors, each having a specific impact on the issue. On the other hand, birth weight can significantly affect the health of people in adulthood. The first step to achieve a proper birth weight is assessing the current condition and determining the effective factors. Despite several studies on this issue in Iran, the social and cultural factors of each region of the country are different than other parts. Therefore, this study aimed to evaluate the effect of supplementation on the birth of LBW neonates based on a case-control research on the population covered by Mashhad University of Medical Sciences, Mashhad, Iran, and to design the necessary strategies.

2- MATERIALS AND METHODS

2-1. Source of Information

Patient records documented in SINA electronic health record system (SinaEHR®) have been considered to present the medical files of patients for clinical and epidemiological purposes. In total, the medical files of approximately five million individuals have been recorded on this system, a total 98.6 percent of which account for the total population auspices of Mashhad University of Medical Sciences. The data recorded in medical files of patients included diagnosis, symptoms, and referral for secondary care, medication consumption, and variables such as body

mass index (BMI), blood pressure, smoking status, alcohol consumption and laboratory results.

2-2. Research Design

This cross-sectional study was performed to assess the effect of supplementation and other factors affecting LBW in the population auspices of Mashhad University of Medical Sciences. In addition, the effect of confounding factors, including age and gender, was considered in the study. The birth weight of an infant is said to be recorded the first weight until the first hours after birth so that if the weight is less than 2,500 grams, the infant will be considered as low birth weight (12).

2-3. Research Population

In order to select the research population, the medical files of women who delivered a neonate during the period January 4, 2017 to May 21, 2018 were assessed and all neonates with weights below 2,500 g were identified. All LBW infants were placed in the case group. After that, five healthy neonates with birth weight above 2,500 g were selected per each LBW infant from the same population and were randomly allocated to the control group. In total, 7,382 and 36,911 subjects were placed in the case and control groups, respectively. Exclusion criteria included non-Iranian mothers, stillbirth, and medical files with no specific information about the weight of the infant.

2-4. Study Variables

Most of the information was extracted from the Sina Electronic Health Record System (SinaEHR®, Iran). The data recorded in this system include the health records of each individual, reports of physicians and health care providers, prescribed drugs, laboratory results, procedures, diagnosis and other details of each patient's case. This system covers the data of over five million individuals in Khorasan-Razavi province, Iran. It is an integrated health system that is managed by the cooperation and coordination of all stakeholders including managers, physicians, midwives, health care providers, etc. In this system the demographic and anthropometric information along with the health information of the covered population is recorded electronically. For the first level, demographic characteristics, such as age, maternal education, job and place of residence were documented. For the second level, maternal clinical information, including diabetes (ICD code: E10 and E11), hypertension (ICD code: I10 and I11), hyperlipidemia and depression, was considered. For the third level, information related to the pregnancy of mothers, such as gender of the neonate, history of miscarriage, preterm delivery, history of multiple births, and medication consumption during pregnancy were recorded. Finally, for the fourth level, information related to supplementations during the recent pregnancy, such as intake of folic acid, multivitamin, iron and vitamin D was recorded.

2-5. Ethical consideration

This study was conducted after obtaining the research approval from the ethics committee of Mashhad University of Medical Sciences (IR.MUMS.REC.1397.247). Individual patient consent was often not required for anonymized data extracted from electronic health record.

2-6. Statistical Analysis

In order to select the research population, the medical files of women who delivered a neonate from January 4, 2017 to May 21, 2018 were assessed and all neonates with weights below 2,500 g were identified. All LBW infants were placed in the case group. After that, five healthy neonates with birth weight above 2,500 g were selected per each LBW infant from the

same population and were randomly allocated to the control group. In total, 7382 and 36911 subjects were placed in the case and control groups, respectively. Exclusion criteria included non-Iranian mothers, stillbirth, and medical files with no specific information about the weight of the infant. All statistical analyses were performed using a standard software package (Stata, version. 12.0; StataCorp).

3- RESULTS

From a total of 44,293 evaluated subjects, 7,382 (17%) participants were in the case group, whereas 36,911 (83%) samples were in the control group. Mean maternal age was 27.74±8.43 and 29.14±6.38 years in the case and control groups, respectively. From the whole evaluated population, most mothers in the case and control groups were residents of urban areas, literate and housewives. In terms of supplementation during pregnancy, there was 14.3%, 16.5%, 16.4% and 7.1% intake of folic acid, multivitamin, iron and vitamin D in the case group, respectively. Meanwhile, the mentioned supplements were taken at 9.0%, 11.0%, 12.8%, and 4.8% in the control group, respectively. At first, the single logistic regression was run to determine the effect of research variables on LBW. Afterwards, the variables with P-value below 0.05 were entered into multivariate analysis. The results were reported as a crude and adjusted odds ratio with a confidence interval of 95%. As observed in **Tables 1, 2**, the variables of age, place of residence, level of education, occupational status, hypertension, depression, gender of born infants, history of miscarriage, preterm delivery, multiple gestation, medication consumption during pregnancy, supplementation (folic acid, multivitamin, iron, and vitamin D) had P-values below 0.05, and were therefore entered into multivariate regression analysis. According to the results, after adjusting the effect of other variables, the odds ratio of LBW of an infant increased per each year of mother's age by two percent (with a 95% confidence interval of 1.02-1.03). The chance of birth of LBW infants in rural areas was 9% more than urban areas (with a confidence interval of 1.01-1.18), 4.60 times more in the illiterate individuals, compared to literate subjects (with a confidence interval of 4.05-5.23), and 2.4 times more in the employed individuals compared to housewives (with a confidence interval of 2.20-2.62). However, this chance decreased in those living in outskirts of cities by 16% (with the confidence interval of 0.78-0.90) and depressed mothers by 60% (0.24-0.65). After adjusting for the confounding effect of other variables, it was also determined that the chance of birth of LBW neonates was 10% higher in female infants, compared to male individuals (with a confidence interval of 1.04-1.16), 74% higher in mothers with a history of miscarriage (with a confidence interval of 1.09-2.75), 34.09 times higher in mothers with a history of preterm delivery (29.17-39.84), 22.30 times higher in mothers with a history of multiple gestations (with a confidence interval of 18.71-26.59), and 2.01 times higher in mothers with a history of medication consumption (with a confidence interval of 1.83-2.21), compared to mothers who had none of these histories. In addition, results indicated that the mothers who consumed folic acid and iron during pregnancy had an increased chance of LBW infant by 24% (with a confidence interval of 1.10-1.39), and 9% (with a confidence interval of 1.00-1.18), compared to those who did not use these supplements during pregnancy. In addition, the chance of LBW neonate decreased in mothers who consumed multivitamin and vitamin D by 1% (with a confidence interval of 0.88-1.11), and 29% (with a confidence interval of 0.61-0.82), compared to those who did not use these supplements during pregnancy.

Table-1: Maternal risk factors associated with low birth weight babies.

Variables	Groups	Case		Control		Unadjusted OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
		Number	%	Number	%				
Age	-	27.74	8.43	29.14	6.38	1.03(1.02-1.03)	0.000	1.02(1.02-1.03)	0.000
Place of Residence	Urban	3720	50.4	15188	41.1	1	-	1	-
	Suburban	1618	21.9	9788	26.5	0.67(0.63-0.71)	0.000	0.84(0.78-0.90)	0.000
	Rural	2044	27.7	11934	32.3	0.69(0.65-0.74)	0.000	1.09(1.01-1.18)	0.022
Level of Education	Illiterate	775	10.5	641	1.7	6.63(5.95-7.39)	0.000	4.60(4.05-5.23)	0.000
	Literate	6607	89.5	36269	98.3	1	-	1	-
Occupational Status	Employed	1398	18.9	2389	6.5	3.37(3.14-3.62)	0.000	2.40(2.20-2.62)	0.000
	Housewife	5984	81.1	34521	93.5	1	-	1	-
Diabetes	Yes	1269	17.2	6632	18.0	0.94(0.88-1.01)	0.111	-	-
	No	6113	82.2	30278	82.0	1	-	1	-
Hypertension	Yes	28	0.4	72	0.2	1.94(1.25-3.01)	0.003	1.58(0.94-2.66)	0.080
	No	7354	99.6	36838	99.8	1	-	1	-
Hyperlipidemia	Yes	13	0.2	48	0.1	1.35(0.73-2.50)	0.332	-	-
	No	7369	99.8	36862	99.9	1	-	1	-
Depression	Yes	23	0.3	207	0.6	0.55(0.36-0.85)	0.007	0.40(0.24-0.65)	0.000
	No	7359	99.7	36703	99.4	1	-	1	-

OR: Odds ratio; CI: Confidence interval.

Table-2: Obstetrics and behavioral related factors associated with low birth weight babies.

Variables	Group	Case		Control		Unadjusted OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
		Number	%	Number	%				
Gender of the neonate	Boy	3971	53.8	19084	51.7	1	-	1	-
	Girl	3411	46.2	17826	48.3	0.92(0.87-0.96)	0.000	1.10(1.04-1.16)	0.000
History of miscarriage	Yes	29	0.4	87	0.2	1.66(1.09-2.54)	0.017	1.74(1.09-2.75)	0.018
	No	7353	99.6	36823	99.8	1	-	1	-
History of preterm delivery	Yes	1112	15.1	191	0.5	34.09(29.17-39.84)	0.000	25.34(21.50-29.86)	0.000
	No	6270	84.9	36719	99.5	1	-	1	-
History of multiple birth	Yes	646	8.8	158	0.4	22.30(18.71-26.59)	0.000	8.10(6.56-10.01)	0.000
	No	6736	91.2	36752	99.6	1	-	1	-
Medication consumption during pregnancy	Yes	657	8.9	1703	4.6	2.02(1.83-2.21)	0.000	1.49(1.31-1.70)	0.000
	No	6725	91.1	35207	95.4	1	-	1	-
Intake of folic acid	Yes	1058	14.3	3327	9.0	1.68(1.56-1.81)	0.000	1.24(1.10-1.39)	0.000
	No	6324	85.7	33583	91.0	1	-	1	-
Intake of multivitamin	Yes	1220	16.5	4049	11.0	1.60(1.49-1.72)	0.000	0.99(0.88-1.11)	0.000
	No	6162	83.5	32861	89.0	1	-	1	-
Intake of iron	Yes	1212	16.4	4717	12.8	1.34(1.25-1.43)	0.000	1.09(1.00-1.18)	0.000
	No	6170	83.6	32193	87.2	1	-	1	-
Intake of vitamin D	Yes	523	7.1	1779	4.8	1.50(1.36-1.66)	0.000	0.71(0.61-0.82)	0.000
	No	6859	92.9	35131	95.2	1	-	1	-

OR: Odds ratio; CI: Confidence interval.

Table.3 shows the chance of LBW infants in relation to the number of days of supplementation by mothers. As observed, the chance of LBW in mothers who consumed folic acid, multivitamin, iron, and vitamin D during 1-90 days increased by 68% (with a 95% confidence interval of 1.56-1.82), 63% (with a confidence interval of 1.49-1.79), 35% (with a confidence interval of 1.25-1.47), and 63% (with a confidence interval of 1.33-1.85), respectively, compared to those who did not use supplements. The mentioned amounts were 69% (with a confidence interval of 1.33-2.16), 56% (with a confidence interval of 1.41-1.72), 30% (with a confidence interval of 1.16-1.46), and 31% (with a confidence interval of 1.11-1.55), respectively, in mother who consumed supplements for more than 90 days.

Table3: Chance of LBW infants in relation to the number of days of supplementation by mothers.

Variables	Number of days to use the pill	Odds ratio	95% CI	P-value
Folic acid	0	1	-	-
	1-90	1.68	1.56-1.82	0.000
	>90	1.69	1.33-2.16	0.000
Multivitamin	0	1	-	-
	1-90	1.63	1.49-1.79	0.000
	>90	1.56	1.41-1.72	0.000
Iron	0	1	-	-
	1-90	1.35	1.25-1.47	0.000
	>90	1.30	1.16-1.46	0.000
Vitamin D	0	1	-	-
	1-90	1.63	1.44-1.85	0.000
	>90	1.31	1.11-1.55	0.000

CI: Confidence interval; LBW: Low birth weight.

4- DISCUSSION

Low birth weight can be influenced by various factors that occur prior to and during pregnancy. This study showed that educating mothers, increasing prenatal care, having an appropriate diet and taking supplements can play an important role in reducing the risk of LBW. Among the studies conducted in Iran to determine the factors affecting LBW neonates, little attention has been paid to the impact of supplementation. In the current case-control research, we evaluated the effect of supplements and other different factors that affect LBW infants. According to the results, the most effective factors included maternal age, place of residence, level of education, occupational status, and the gender of born infants, history of miscarriage, preterm delivery, multiple gestations, supplementation and consumption of medications during pregnancy. One of the factors affecting the validity of the results was the large volume of data and taking into account all LBW infants born with a weight below 2500 g during the study period in the case group. On the other hand, calculation and report of the risk ratio for each effective factor in a model were among the advantages of the research. As the most important finding, the multivariate analysis showed that consumption of folic acid and iron supplements during pregnancy had negative impacts on birth weight of infants, whereas multivitamin and vitamin D had positive effects in this regard. In a research by Zarei et al., the chance of LBW infant increased by consumption of iron and folic acid, which is in agreement

with our findings (12). However, Mirza Rahimi et al. and Bhaskar et al. have marked conflicting results (2, 13) regarding the consumption of vitamin D. In the studies by Baker et al. and Carmago et al., no significant relationship was found between vitamin D consumption and LBW infants (14, 15). Meanwhile, several studies have reported the positive impacts of vitamin D during pregnancy on the birth of LBW neonates (16, 17). Vitamin D is a necessary compound with an important role in calcium metabolism, which confirms its positive effect. In terms of multivitamin consumption, some studies have confirmed the positive effect of these supplements on LBW, which is consistent with our findings (18, 19). This positive effect was more observed in individuals living in low-income and developing countries with poor diets. One of the factors affecting LBW infants is maternal demographic characteristics. In the present study, the chance of LBW infants increased by 2% per each year of maternal age, which is in line with the results of other studies (20). In 2017, Kheirouri et al. reported that the chance of birth of LBW was 3.8 times higher in mothers aged 35 years in Tabriz, Iran, compared to those above 35 years (21). In 2014, Mohammad et al. affirmed that the chance of birth of LBW neonates increased per each year increase in maternal age (22). On the other hand, higher pregnancy age might increase the possibility of unwanted pregnancy complications (e.g., diabetes or hypertension), which also affect fetal growth and weight (23). This issue required more attention in healthcare systems, and the birth of LBW infants must be minimized by proper education of mothers and the prevention of pregnancy at high ages. In terms of the variable of the gender of born infants in the present study, there was a higher rate of female LBW neonates, which confirmed the effect of gender on the birth rate of LBW infants (7, 24, 25). According to the results of the current research, a significant correlation was detected between place of residence (living in villages) (26), level of education (26-28), and being employed (29, 30), and the birth of LBW infants, which is in accordance with some other studies (31, 32). For instance, Rahimi Mirzaei et al. found no significant relationship between LBW infants and variables of place of residence and level of education (13). However, more attention must be paid to the level of maternal education and their awareness regarding health care and proper education in cities and villages. Problems related to pregnancy and delivery are among the major risk factors for LBW. In the current research, the impact of the history of miscarriage, preterm delivery (32), multiple gestations (31), and medication consumption during pregnancy on LBW was significant. In this regard, Rahimi Mirzaei et al. demonstrated a significant relationship between birth of LBW infants and preterm delivery, multiple gestations, and consumption of medications (13).

4-1. Limitations of the study

The current study has several limitations. First, the risk factors of LBW were assessed retrospectively. A longer recall period in maternal factor could have resulted in an underestimation of the odds of LBW. Secondly, some of the risk factor of LBW were derived from self-report, which could have led to misclassification.

5- CONCLUSION

According to the results of the current study, targeted interventional choices, such as maternal demographic characteristics (e.g., age), improved maternal awareness, and increased care during pregnancy, proper nutrition, and supplementation consumption can prevent LBW. It is recommended that more comprehensive studies be conducted to assess the effect of supplementation during pregnancy on LBW.

6- CONFLICT OF INTEREST: None.

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