Research paper

Maternal risk factors for low birth weight infants: A nested case-control study of rural areas in Kurdistan (western of Iran)

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Keywords

Low birth weight • Nested case control • Risk factors • Iran

Summary

Infant mortality is among the most important indicators of health and development in global communities. One of the causes of neonatal mortality is low birth weight. This study aims at evaluating the risk factors for LBW in infants. This study was carried out using a nested case-control study in rural areas of Kurdistan province in Western Iran in 2015. The selection of case and control groups was based on the nesting using the risk set sampling approach. In total, 182 and 364 subjects were selected for the case group and the control group respectively. Data analysis was performed using the Stata-12 software with the point and spatial estimation of OR using the conditional logistic regression method. The multivariate logistic regression analysis performed shows that the maternal gestational age, the mother's health history during pregnancy, any medication abuses by the mother, any mental stress during pregnancy, are LBW risk factors ($P < 0.05$). Prevention of LBW is possible by identifying effective factors and performing appropriate interventions in infants with low birth weight.

Introduction

Birth weight is one of the most important factors in the development, survival, and future of the baby; it is one of the main determinants of future physical and brain development of the child and also a valid sign of intrauterine growth [1, 2]. Low birth weight (LBW) is defined by the World Health Organization (WHO) as any weight less than 2,500 g regardless of the age of the baby [3]. Every year around 20 million newborns (17% of live births) weigh less than 2,500 g and more than 90% of them are born in developing countries [2, 4, 5].
According to WHO in 2015, the prevalence of LBW around the globe was 15%. It was 13% in developing countries, 9% in the US, 6% in East Asia and the Pacific, 13% in Sub-Saharan Africa, and 28% in South Asia [6].
LBW is closely related to infant mortality in the first days of life and even after infancy. It has been seen that the survival rate and survival chance of children who weigh less than 2,500 g after birth are much lower than other children [4, 7]. Generally, in these newborns the risk of neonatal mortality is 25-30 times more likely than those weighing more than 2,500 g, the lower the birth weight at birth, the greater the risk of neonatal mortality [5, 8]. It has been shown that LBW children who are alive with therapeutic interventions are two to three times more likely to suffer from short-term and long-term disabilities than other children [5, 9].

Many maternal and fetal factors are significantly associated with LBW [10-12]. Based on the results obtained from various studies, these factors include the mother's age, occupation, weight, number of pregnancies, history of smoking, length of pregnancy, previous births, reproductive multiplication, inappropriate nutritional status, socioeconomic inequalities, lack of attention to proper diet and consumption of supplements during pregnancy, birth season, number of pregnancy cares and anemia, and birth defects, along with pre-pregnancy conditions and the socioeconomic status of the family related to LBW [5, 11]. LBW birth outcomes are high, especially in developing countries and the third world. Those who survive with LBW have cognitive and neurologic disorders as well as increased risk of hypertension, pulmonary disease, blood cholesterol, kidney damage, acute watery diarrhea, and immune system disorders [4]. Moreover, LBW is one of the determinants of neurological disorders and evolution, including backwardness and mental disability in learning, and may cause disorders relating to chronic diseases in adulthood [13].
Since LBW causes the risk of mortality, disability, and many diseases in childhood and even in adulthood while causing immense economic costs to the healthcare system and communities, it is very important to identify the factors affecting underweight during birth and hospital release [14, 15]. Even though Iran has been

successful in reducing infant mortality over the past two decades, LBW is still recognized as one of the main causes of death and disability in this infant group. The purpose of this Study, which was conducted with a nested case-control study as a cost-effective [16] alternative to a cohort study, is to study the risk factors of LBW at present in a rural area of Iran.

Method

The nested case-control study was carried out in rural areas of Kurdistan province, Western Iran, for six months – from the beginning of December 2014 to the end of June 2015. In this study, the case and control groups were selected based on the design of the nest – i.e. with the risk set sampling approach.

Eligibility criteria

The infants who were born in the study area with the birth weight 2,500 g or more were in the control group and infants with the birth weight less than 2,500 g were in the study group. Therefore, the criterion was birth weight and there were no other restrictions for being in the case and control groups.

In this study, in order to reach appropriate sample size in the study time frame, two infants with the birth weight 2,500 and more were included in the study as controls for each case of infants with the birth weight less than 2,500.

Data collection tools comprised a researcher-made checklist, which included independent variables and risk factors including maternal age, the mother's education, maternal BMI, the number of pregnancies and previous births, newborn's sex, birth season, the history of smoking for the mother, whether the mother is a second-hand smoker, the use of pregnancy supplement pills, the history of specific diseases during pregnancy, the history of drug use during pregnancy, parental separation history, the mother's mental stress during pregnancy, baby birth rank, the number of pregnancy care, the kinship ratio of parents, the mother's blood group, and possibility of having anemia, whether it is a natural pregnancy or IVF, and Rh maternal and neonatal conditions .

The data analysis for this study was performed using the Stata-12 software with a point estimate and OR (and CI) spacing that deals with raw and adapted conditional logistic regression and an error rate of less than 5%.

Logistic regression analysis on nesting case data means that the design is not identical in data analysis. If the exposure is constant over time, the odds ratio estimates the consistency ratio.

The conditional logistic regression method makes it possible to compare the cases and controls in each pair in which the case and control groups are defined as the outcome [17, 18].

Findings

Mothers in the case and control groups had elementary education (49.8%), and about 90% of them were housewives. Most of the mothers did not have a kinship with their spouses, and more than 95% of them had no history of morbidity in their previous labors. The findings show that age, education, occupation, parents' separation history, and maternal birth history has no significant relationship with their neonates in both case and control groups ($P > 0.05$) (Tab. I).

Tab. I. Distribution of demographic variables and maternal history in case and control groups.

Variable	Case N = 182 (%)	Control N = 364 (%)	Chi²	P-value
Mother's age				
20-35 years	134 (74.1)	273 (74.16)		
< 19	15 (7.48)	29 (8.11)	0.12	**0.93**
> 35	33 (18.03)	62 (17.3)		
Maternal education				
College education	3 (1.64)	12 (3.31)		
Diploma	34 (18.58)	53 (14.6)		
Guidance	30 (15.92)	70 (19.16)	3.18	**0.52**
Elementary	88 (49.87)	180 (49.77)		
Illiterate	27 (14.75)	49 (13.50)		
Mother's occupation				
Housewife	164 (90.01)	322 (88.39)		
Employee	1 (0.55)	10 (2.75)		
Laborer	16 (8.74)	28 (7.71)	3.52	**0.31**
Other	1 (0.55)	4 (1.10)		
Parental relationship ratio				
No	164 (89.3)	334 (92.19)		
Yes	18 (10.7)	30 (7.81)	2.77	**0.56**
History of parents' separation (separation of living place)				
No	170 (93.44)	346 (95.04)	2.74	**0.43**
Yes	12 (6.56)	18 (4.96)		
History of stillbirth				
Yes	174 (95.63)	353 (96.97)	3.1	**0.54**
No	8 (4.37)	11 (3.03)		

Tab. II. Results of single-variable conditional logistic regression of newborns born in Kurdistan province (west of Iran).

Variable	Cases N = 182 (%)	Control N = 364 (%)	Unadjusted OR (95% CI)	P-value
Mother's age years				
20-35	134 (74.1)	273 (74.16)	1	
< 19	15 (7.48)	29 (8.11)	1.05 (0.54-2.05)	0.88
> 35	33 (18.03)	62 (17.3)	1.07 (0.67-1.72)	0.75
Maternal education				
College education	3 (1.64)	12 (3.31)	1	
Diploma	34 (18.58)	53 (14.6)	2.56 (0.67-9.70)	0.16
Guidance Elementary	30 (15.92)	70 (19.16)	1.68 (0.44-6.33)	0.43
Elementary education	88 (49.87)	180 (49.77)	1.93 (0.53-6.93)	0.31
Illiterate	27 (14.75)	49 (13.50)	2.17 (0.57-8.22)	0.25
Father's education				
College education	5 (2.73)	17 (4.68)	1	
Diploma	34 (19.26)	85 (23.34)	1.45 (0.48-4.3)	0.50
Guidance Elementary	46 (25.14)	93 (25.63)	1.76 (0.59-5.24)	0.30
Elementary education	86 (46.99)	147 (40.50)	2.12 (0.72-6.20)	0.16
Illiterate	11 (6.01)	22 (6.06)	1.74 (0.49-6.10)	0.38
Mother's occupation				
Housewife	164 (90.01)	322 (88.39)	1	
Employee	1 (0.55)	10 (2.75)	0.2 (0.02-1.56)	0.12
Laborer	16 (8.74)	28 (7.71)	1.06 (0.57-1.98)	0.83
Other	1 (0.55)	4 (1.10)	0.5 (0.05-4.50)	0.53
Father's occupation				
Employee	8 (4.37)	19 (5.23)	1	
Worker	51 (27.87)	111 (30.58)	1.13 (0.43-3.93)	0.79
Self-employment	94 (51.01)	190 (52.02)	1.19 (0.48-3.95)	0.70
Unemployed	6 (3.28)	9 (2.48)	1.63 (0.48-6.39)	0.49
Other	23 (13.37)	35 (9.86)	1.64 (0.58-4.63)	0.43
Sex				
Girl	94 (51.6)	192 (52.75)	1	
Boy	88 (48.35)	172 (74.25)	1.04 (0.73-1.48)	0.79
Abortion history				
No	146 (79.78)	298 (82.09)	1	
Yes	36 (20.22)	66 (17.91)	1.12 (0.7-1.8)	0.61
Gestational weeks				
≤ 37	76 (41.76)	330 (90.91)	1	
> 37	106 (58.24)	33 (9.09)	18.2 (9.39-34.59)	0.000
Distance between pregnancy				
3 ≤ years	148 (81.32)	317 (78.09)	1	
3 >years	34 (18.68)	47 (12.91)	1.64 (0.97-2.7)	0.06
Pregnancy				
Pregnancy1	72 (39.34)	143 (39.39)	1	
Pregnancy2	54 (28.96)	115 (31.96)	0.94 (0.61-1.45)	0.79
2< Pregnancy	56 (31.96)	106 (28.65)	1.05 (0.67-1.62)	0.82
Childbirth				
1 delivery	90 (49.18)	167 (46.01)	1	
2 delivery	56 (30.05)	114 (31.68)	0.91 (0.61-1.63)	0.66
2 < delivery	36 (20.77)	83 (22.31)	0.79 (0.49-1.27)	0.34
Pregnancy with IVF				
No	178 (97.80)	362 (99.45)	1	
Yes	4 (2.20)	2 (0.55)	4 (0.73-21.83)	0.10
Multiple birth				
Singleton	136 (74.73)	359 (98.63)	1	
≤ Twain	46 (25.27)	5 (1.37)	4.45 (2.47-6.43)	0.000
Abortion history				
No	146 (79.78)	298 (82.09)	1	
Yes	36 (20.22)	66 (17.91)	1.12 (0.7-1.8)	0.61
Mother's disease history				
No	48 (26.52)	250 (68.68)	1	
Yes	133 (73.84)	114 (31.32)	6.11 (3.95-9.45)	0.000
History of stillbirth				
No	174 (95.63)	353 (96.97)	1	
Yes	8 (4.37)	11 (3.03)	1.45 (0.58-3.61)	0.42

Continues

Follows

Tab. II. Results of single-variable conditional logistic regression of newborns born in Kurdistan province (west of Iran).

Variable	Cases N = 182 (%)	Control N = 364 (%)	Unadjusted OR (95% CI)	P-value
History of bleeding				
No	154 (84.62)	355 (97.53)	1	
Yes	28 (15.38)	9 (2.47)	7.59 (3.30-17.44)	0.000
Birthday rating				
First birthday	77 (42.31)	147 (40.38)	1	
Second birthday	62 (34.07)	126 (34.62)	0.94 (0.36-1.41)	0.78
≤ third birthday	43 (23.63)	91 (25)	0.9 (0.57-1.41)	0.65
Longing				
No	114 (62.64)	255 (70.05)	1	0.07
Yes	68 (37.36)	109 (29.95)	1.43 (0.96-2.13)	
blood group				
A	58 (31.87)	123 (33.79)	1	
B	52 (28.57)	80 (21.98)	1.36 (0.86-2.15)	0.18
AB	16 (8.79)	30 (8.24)	1.12 (0.58-2.19)	0.71
O	56 (30.77)	131 (35.99)	0.9 (0.57-1.40)	0.64
Smoking				
No	173 (95.05)	361 (99.18)	1	
Yes	9 (4.95)	3 (0.82)	8.29 (1.77-38.69)	0.007
The number of cares by the physician				
3 ≤ care	43 (23.62)	75 (20.6)	1	
2 care	28 (15.38)	77 (21.15)	0.93 (0.56-1.51)	0.77
1 care	111 (60.99)	212 (58.24)	0.63 (0.35-1.13)	0.12
The number of care by midwives				
10 ≤	6 (3.30)	9 (2.20)	1	
9-5 care	57 (31.32)	129 (35.54)	0.55 (0.17-1.74)	0.31
5 > care	119 (65.38)	226 (62.29)	0.72 (0.23-2.24)	0.57
The number of care by health care				
≤ 10	5 (2.75)	6 (1.38)	1	
9-5 care	81 (44.51)	256 (70.52)	0.37 (0.1-1.31)	0.79
< 5 care	96 (52.75)	102 (28.10)	1.19 (0.32-4.33)	0.12
Exposed to second smoke				
No	108 (59.34)	293 (80.49)	1	
Yes	74 (40.66)	71 (19.51)	2.95 (1.94-4.48)	0.000
Drug abuse				
No	142 (78.02)	361 (99.18)		
Yes	40 (21.98)	3 (0.82)	39.25 (9.48-162.51)	0.000
Drug use under medical supervision				
No	112 (61.54)	325 (89.29)	1	
Yes	70 (38.46)	39 (10.71)	4.99 (3.12-7.99)	0.000
Parental kinship relations				
No	164 (89.3)	334 (92.19)	1	
Yes	18 (10.7)	30 (7.81)	1.19 (0.65-2.19)	0.56
Separation of parent's place of residence				
No	170 (93.44)	364 (95.04)	1	
Yes	12 (6.55)	18 (4.96)	1.34 (0.64-2.82)	0.43
History of physical, mental, and psychological stress in pregnancy				
No	106 (58.24)	337 (92.58)	1	
Yes	76 (41.76)	27 (7.42)	8.52 (4.95-14.67)	0.000
RH				
Rh+	174 (95.6)	335 (92.03)	1	
Rh-	8 (4.40)	29 (7.97)	0.53 (0.24-1.19)	0.12
Mother's, BMI				
> 18.4	13 (7.14)	16 (4.41)	1	
24.9-18.5	69 (37.91)	133 (36.64)	0.63 (0.28-1.41)	0.27
29.9-25	64 (35.16)	141 (38.84)	0.55 (0.25-1.22)	0.14
≤ 30	36 (19.78)	74 (20.11)	0.59 (0.25-1.39)	0.23

The results of single-variable analysis indicate that the newborn's sex and the history of abortion with the placement of the infant in the case and control groups did not have the required conditions for being in the multi-variable model (P > 0.2), while the gestational age, multiple pregnancy, maternal disease, history of

Tab. III. Results of multivariate conditional logistic regression of newborns born in Kurdistan province (west of Iran).

		Adjusted OR (95% CI)	P-value
Gestational weeks	≤ 37	1	0.0001
	> 37	6.94 (3.11-15.50)	
Distance between pregnancy	≤ 3 years	1	0.54
	> 3 years	1.40 (0.46-4.22)	
Pregnancy with IVF	No	1	0.12
	Yes	15.35 (0.45-512.7)	
Multiple birth	Singleton	1	0.0001
	≤ twain	85.81 (5.74-128.08)	
Mother's disease history	No	1	0.002
	Yes	3.66 (1.79-7.46)	
History of bleeding	No	1	0.1
	Yes	2.81 (0.80-9.75)	
Longing	No	1	0.82
	Yes	0.91 (0.39-2.08)	
Smoking	No	1	0.27
	Yes	5.32 (0.13-205.80)	
Exposed to second smoke	No	1	0.2
	Yes	1.69 (0.74-3.83)	
Drug abuse	No	1	0.006
	Yes	2.23 (17.31-134.16)	
Drug use under medical supervision	No	1	0.39
	Yes	1.48 (0.59-3.68)	
History of physical, mental, and psychological stress in pregnancy	No	1	0.0001
	Yes	6.59 (2.52-17.18)	

hemorrhage, obsession, smoking, secondhand smoking, drug abuse, drug use under the supervision of the doctor, mental stress, and placement of the baby are required to be included in a multivariate model ($P < 0.2$) (Tab. II).

In the multivariate regression analysis, the variables that had been significant in the single-variable analysis stage were included in the multivariate model. At this stage, the variables with a significant level of 0.2 and less were introduced to the model. The results of this model analysis show that there is a significant relationship between maternal gestational age, history of illness, medication abuse during pregnancy, mental stress during pregnancy, and multiple birth with LBW in the case and control groups ($P < 0.05$) (Tab. III).

Discussion

The prevalence of LBW is one of the most important health indicators and an indicator of the survival of the baby at the moment of birth. By recognizing the risk factors associated with LBW, it is possible to prevent LBW very significantly in newborns [1]. The results of this study show that there is a statistically significant relationship between LBW and maternal gestational age, mother's disease history, medication abuse during pregnancy, psychological stress during pregnancy, and multiple pregnancies in the case and control groups ($P < 0.05$).

In Iran, the birth of LBW infants is a major cause of neonatal mortality (IMR). LBW has a direct relation with the duration of pregnancy: When the number of weeks of pregnancy is less than normal, the birth weight of the baby will be less than the normal weight due to insufficient growth of the foetus [15]

According to our study, premature infants (less than 37 weeks) had lower birth weight. The results of this study are consistent with the studies of Feresu et al. [19], Badshah et al. [20], and Muchemi et al.[21].

The results of various studies show that prematurity in developed countries and Iran is a common cause of LBW [15]. It is possible to detect different causes associated with underweight newborns – such as maternal diseases, genetic problems, and midwifery problems – to prevent the birth of a LBW baby. Moreover, the prevention measures also include teaching health promotion behaviors, pregnancy care, vaccination of pregnant women, proper education of health behaviors in fertility, improving economic, cultural, and social conditions, avoiding risky behaviors like smoking; in fact, with these measures, infants could be born with ideal weight [22]. In developing countries, this is one of the most important risk factors for birth weight and thus it is necessary to adopt methods to lessen this risk factor. Prenatal diseases and repeated infections in pregnancy are among the most effective factors relating to LBW [23, 24].

The results of this study show that mothers with a history of illness are three times more likely to have babies with LBW compared those who do not have a history of illness.

Rubari et al. in their stud represented that the prevalence of underweight in infants of mothers with a history of

disease is higher than that of mothers without a history of disease [25].
Also, findings of Batist et al. study reported that mothers with a history of disease are more likely to have infants with low birth weight. These results were consistent with the results of our study [26].
However,, these results are not consistent with the research of Sharma et al. in Nepal [27] as well as the studies of Feresu et al. [19] and Badshah et al.[20] which declare that there is no significant relationship between the history of mothers and the birth of children with LBW in the case and control groups. The need to pay attention to pregnant mothers with other illnesses should be taken more into consideration.
Pregnancy bleeding can be caused by pregnancy diseases including vaginal infections, chlamydia, gonorrhea, and swelling and inflammation of the uterus. In the second and third trimesters of pregnancy, bleeding or spotting can indicate a dangerous condition, such as sudden detachment of the foetus from the uterus, that is likely to cause abortion or preterm delivery leading to premature infants [28, 29]. Which might be a reason for their LBW. The results of this study show that the history of bleeding points to the chance of having an underweight baby more than two times, which is statistically significant. These results are consistent with the results of Moradi et al. [2] and Eshraghian et al. [30] in Iran which found the relationship between bleeding during pregnancy and LBW risk in the case and control groups to be statistically significant. This risk factor in mothers should be taken into consideration in developing countries and the intervention design to reduce this risk factor.
Drugs used during pregnancy can affect the foetus. In fact, they may affect maternal and fetal health in the coming years or cause trichoderma to the foetus. The placenta allows the passage of many medications and dietary items. Pregnant women should be trained in other non-pharmacological methods to cope with stress, pain, and discomfort as well as other illnesses, and drug must be used only when it is necessary [22, 31, 32].
According to the results of the present study, arbitrary drug use increases the probability of giving birth to an underweight infant.
This relationship is in line with the results of Huang et al. [32]. Public health and maternity care programs should pay close attention to this risk factor.
Violence during pregnancy affects the birth weight of newborns. Since it can physically and mentally affect pregnant women, widespread planning is essential to reduce violence, especially physical violence, and convince the families about its subsequent consequences [19, 33]. Violence and mental stress during pregnancy can affect the birth weight of newborns. According to the results of our study, mental stress is strongly associated with LBW infants and increases the chance of having a LBW about six times this relationship is statistically significant. The results of this study are consistent with the results of Ansari et al. [29, 34].
The studies of Johnson et al. in Canada and Kedy et al. in Uganda to investigate the relationship between mental stress and adverse outcomes of pregnancy show that there is a significant relationship between LBW and mental stress during pregnancy. These results are consistent with the results of our study [35, 36]. The results of Leung et al. do not show a statistically significant relationship between violence during pregnancy and low risk of LBW [37]. Thus, violence is a risk factor that affects women in a way that needs to be addressed and included in care plans. Since most violence comes from husbands and takes place in neighborhoods where people of low socioeconomic status live, it seems important to arrange awareness classes at times and places suitable for husbands. To reduce this risk factor, interventions targeting pregnant women should be considered.
The restriction of intrauterine growth is three times more common in twin pregnancies than in single pregnancies, the limitation of intrauterine growth is asymmetric in multiform pregnancies. The relative immaturity in placenta and competition of twins on nutrients are the most likely causes of LBW [27]. The results of this study show that twin pregnancies increase the chance of LBW infants. These results are consistent with the results of Ansari et al. [34]. In other studies, it has been shown that a twin pregnancy is somewhat related to LBW for newborns [38, 39]. Multiple pregnancies in developing countries and in societies like Iran require more care during pregnancy and delivery.
This study was conducted in rural areas of one of the Iranian provinces and may have limitations in terms of generalizing its results in respect to the whole country. Therefore, it is suggested that given the presence of potential groups in countries like Iran, researchers would have to place the nesting control case nationally on their own agendas.

Conclusions

Birth weight in infants depends on several causes, not a single cause. Drug Abuse, the interval between pregnancies, and the history of bleeding are among the most preventable factors associated with LBW. In addition, other risk factors during pregnancy should be identified and nullified to reduce the number of LBW babies.

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Conflicts of interest statement

The authors declare no conflict of interest.

Authors' contributions

This study was done by ZKH and GM participated in the design of the study. Data collection was done by ZKH and MZ. ZKH, GM and EG performed the statistical analysis. ZKH, GM and EG performed the coordination and helped with the drafting of the manuscript. The authors read and approved the final version of the manuscript.

References

[1] Alexander G, Wingate M, Mor J, Boulet S. Birth outcomes of Asian-Indian-Americans. Int J Gynaecol Obstet 2007;97:215-20. https://doi.org/10.1016/j.ijgo.2007.02.017

[2] Moradi G, Khazaei Z, Esmailnasab N, Roshani D, Zokaii M, Ghaderi E, Nouri B. The relationship between maternal diseases during pregnancy and low birth weight: a nested case-control study in rural areas of Kurdistan Province (west of Iran). Int J Pediatr 2017;5:5501-14. https://doi.org/10.22038/IJP.2017.22666.1894

[3] Zhang Y, Lin L, Cao Y, Chen B, Zheng L, Ge R-S. Phthalate levels and low birth weight: a nested case-control study of Chinese newborns. J Pediatr 2009;155:500-4. https://doi.org/10.1016/j.jpeds.2009.04.007

[4] Demelash H, Motbainor A, Nigatu D, Gashaw K, Melese A. Risk factors for low birth weight in Bale zone hospitals, South-East Ethiopia: a case-control study. BMC Pregnancy Childbirth 2015;15:264. https://doi.org/10.1186/s12884-015-0677-y

[5] Moraes ABd, Zanini RR, Riboldi J, Giugliani ERJ. Risk factors for low birth weight in Rio Grande do Sul State, Brazil: classical and multilevel analysis. Cad Saude Publica 2012;28:2293-305.

[6] Organization WHO. Global nutrition targets 2025: wasting policy brief. 2014, pp.123-18. e3

[7] Rahmani K, Zokaei M, Bidarpoor F, Babahajiani S, Nessaei P, Moradi G. Children mortality rate trend in kurdistan province during 2007 to 2011. Iran J Epidemiology 2014;10:65-72. http://irje.tums.ac.ir/article-1-5208-en.html

[8] Namvaran Germi K, Moradi A, Farzad V, Zahrakar K. Identifying the dimensions of marital adjustment in Iranian couples: a qualitative study. J Health Care 2017;19:182-94. http://hcjournal.arums.ac.ir/article-1-825-en.html

[9] Xia W, Zhou Y, Zheng T, Zhang B, Bassig BA, Li Y, Wise J, Zhou A, Wan Y, Wang Y, Xiong Ch, Zhao J, Li Z, Yao Y, Hu J, Pan X, Xu Sh. Maternal urinary manganese and risk of low birth weight: a case-control study. BMC Public Health 2016;16:142. https://doi.org/10.1186/s12889-016-2816-4

[10] Teklehaimanot N, Hailu T, Assefa H. Prevalence and factors associated with low birth weight in Axum and Laelay Maichew districts, North Ethiopia: a comparative cross sectional study. Int J Nutr Food Sci 2014;3:560-6. https://doi.org/10.11648/j.ijnfs.20140306.21

[11] Khazaei S, Mansori K, Khazaei Z, Sani M, Ayubi E. Infant and young child feeding status in Iran compared the different United Nation Regions. Int J Pediatr 2016;4:3639-41. http://eprints.umsha.ac.ir/id/eprint/2433

[12] Goodarzi E, Ghaderi E, Khazaei S, Alikhani A, Ghavi S, Mansori K, Ayubi E, Gholamaliee B,Beiranvand R, Dehghani SL, Ghotbi N, Nili S. The prevalence of transient and permanent congenital hypothyroidism in infants of Kurdistan Province, Iran (2006-2014). Int J Pediatr 2017;5:4309-18. http://eprints.mums.ac.ir/id/eprint/3736

[13] Derakhshi B, Esmailnasab N, Ghaderi E, Hemmatpour S. Risk factor of preterm labor in the west of iran: a case-control study. IJPH 2014;43:499.

[14] Khanal V, Sauer K, Karkee R, Zhao Y. Factors associated with small size at birth in Nepal: further analysis of Nepal Demographic and Health Survey 2011. BMC Pregnancy Childbirth 2014;14:32. https://doi.org/10.1186/1471-2393-14-32

[15] Lim JW, Chung S-H, Kang DR, Kim C-R. Risk factors for cause-specific mortality of very-low-birth-weight infants in the Korean neonatal network. J Korean Med Sci 2015;30:S35-S44. https://doi.org/10.3346/ jkms.2015.30.S1.S35

[16] Holakouie Naieni K, Mansournia M, Panahi M, Elduma A, Nematollahi S. Nested-case control versus case-cohort studies: a narrative review on methodological considerations. Iran J Epidemiology 2016;12:64-72. http://irje.tums.ac.ir/article-1-5541-en.html

[17] Wacholder S, Silverman DT, McLaughlin JK, Mandel JS. Selection of controls in case-control studies: II. Types of controls. Am J Epidemiol 1992;135:1029-41.

[18] Holakouie Naieni K, Ostovar A, Danesh A, Sadjedinejad S, Ghalichee L, Moradi G, Mansournia MA, Hashemi Nazari SS. Comparison of nested case-control and cohort analysis methodologies using a district TB registry data. Iran J Epidemiology 2010;6:1-6. http://irje.tums.ac.ir/article-1-79-en.html

[19] Feresu SA, Harlow SD, Woelk GB. Risk factors for low birthweight in Zimbabwean women: a secondary data analysis. PloS One 2015;10:e0129705.

[20] Badshah S, Mason L, McKelvie K, Payne R, Lisboa PJ. Risk factors for low birthweight in the public-hospitals at Peshawar, NWFP-Pakistan. BMC Public Health 2008;8:197. https://doi.org/10.1186/1471-2458-8-197

[21] Muchemi OM, Echoka E, Makokha A. Factors associated with low birth weight among neonates born at Olkalou District Hospital, Central Region, Kenya. Pan Afr Med J 2015;20. https://doi.org/10.11604/pamj.2015.20.108.4831

[22] Rezaeian M, Goujani R, Sheikh Fathollahi M, Vaziri Nejad R, Manshori A, Razi S. A comparative study on prevalence of preterm birth and low birth weight in Iranians and Afghans races in Rafsanjan Nik-nafs hospital in 2011-2012. J Rafsanjan Univ Med Sci 2014;13:67-82. http://journal.rums.ac.ir/article-1-2012-en.html

[23] Rosa MId, Pires PDS, Medeiros LR, Edelweiss MI, Martínez-Mesa J. Periodontal disease treatment and risk of preterm birth: a systematic review and meta-analysis. Cad Saude Publica 2012;28:1823-33. https://doi.org/10.1590/S0102-311X2012001000002

[24] Ghavi A, Fadakar Sogheh K, Niknami M, Kazemnejad Leili E. Survey associated maternal factors with low-weight infants in women referred to health centers in Rasht. J Holist Nurs Midwifery 2011;21:35-9. http://hnmj.gums.ac.ir/article-1-185-en.html

[25] Roudbari M, Yaghmaei M, Soheili M. Prevalence and risk factors of low-birth-weight infants in Zahedan, Islamic Republic of Iran. East Mediterr Health J 2007;13:838-45.

[26] Batist ES. A case-control study of risk factors for low birth weight in the Western Cape. Winelands/West Coast region: University of the Western Cape 2003, pp. 120-32. e3. http://hdl.handle.net/11394/175

[27] Sharma SR, Giri S,Timalsina U, Bhandari SS, Basyal B, Wagle K, Shrestha L. Low birth weight at term and its determinants in a tertiary hospital of Nepal: a case-control study. PloS One 2015;10:e0123962.

[28] Smith GC, Pell JP, Dobbie R. Interpregnancy interval and risk of preterm birth and neonatal death: retrospective cohort study. Bmj 2003;327:313.

[29] Rahmani E, Ahmadi S, Motamed N, Khormoji NN. The relation between vaginal bleeding during pregnancy and preterm birth in patients admitted to martyrs hospital in Persian Gulf. Int. J Women's Health Reprod Sci 2016;4:171-5. https://doi.org/10.15296/ijwhr.2016.38

[30] Eshraghian M, Abou AJ, Ghafari Z, Rajaei S. The effects of riskfactor of pregnancy period on infant's weight. The Journal of Qazvin Univ of Med Sci 2008;11:4. http://journal.qums.ac.ir/article-1-17-en.html

[31] Ghahfarokhi SG, Sadeghifar J, Mozafari M. A model to predict low birth weight infants and affecting factors using data mining techniques. J Bas Res Med Sci 2018;5:1-8. http://jbrms.medilam.ac.ir/article-1-351-en.html

[32] Huang H, Coleman S, Bridge JA, Yonkers K, Katon W. A meta-analysis of the relationship between antidepressant use in pregnancy and the risk of preterm birth and low birth weight. Gen Hosp Psychiatry 2014;36:13-8. https://doi.org/10.1016/j.genhosppsych.2013.08.002

[33] Karimi A, Daliri S, Sayeh Miri K. The relationship between violence during pregnancy and low birth weight: a meta-analysis study. Hayat 2016;22:216-28. http://hayat.tums.ac.ir/article-1-1524-en.html

[34] Ansari H, Parisai Z, Rahimi E, Rakhshani F. Relationship between violence exposure pregnancy and neonatal low birth weight: a case-control study. Journal of Jahrom Uni Med Sci 2008;6:17-26. http://jmj.jums.ac.ir/article-1-785-en.html

[35] Janssen PA, Holt VL, Sugg NK, Emanuel I, Critchlow CM, Henderson AD. Intimate partner violence and adverse pregnancy outcomes: a population-based study. Am J Obstet Gynecol 2003;188:1341-7. https://doi.org/10.1067/mob.2003.274

[36] El Kady D, Gilbert WM, Xing G, Smith LH. Maternal and neonatal outcomes of assaults during pregnancy. Obstet Gynecol 2005;105:357-63. https://doi.org/10.1097/01.AOG.0000151109.46641.03

[37] Leung W-C, Wong Y, Leung T, Ho P. Pregnancy outcome following domestic violence in a Chinese community. Int J Gynaecol Obstet 2001;72:79-80. http://pascal-francis.inist.fr/vibad/index.php?action=getRecordDetail&idt=859077

[38] Fang J, Madhavan S, Alderman M. The influence of maternal hypertension on low birth weight: differences among ethnic populations. Ethn Dis 1999;9:369-76.

[39] Kelly TF. Maternal medical disorders of fetal significance. Avery's diseases of the newborn (Tenth Edition). Elsevier 2018, pp. 104-18.e3. https://doi.org/10.1016/B978-0-323-40139-5.00011-5

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