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The Factors Affecting Newborn Birth Weight in Borujerd City: A Case-Control Study

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ABSTRACT

Background: Newborn birth weight is an important indicator for determining the health status of the human societies. Therefore, the current study aimed to investigate the critical factors affecting the newborn anthropometric indices in the health centers of Borujerd city, Iran. **Methods:** This case-control study was conducted from September 2016 to June 2017. The participants included 22 infants with low birth weight (LBW) and 44 with normal birth weight (NBW). The demographic questionnaire and food frequency questionnaire were applied to collect data. For statistical analysis, SPSS version 16 was run and the significance level was set at P-value < 0.05. For comparing the quantitative variables between the case and control groups, the independent *t-test* and *Chi-square* test were performed. **Results:** The results indicated that mothers older than 35 years, self-employed fathers, pre-pregnancy, mothers' body mass index of more than 25 kg/m^2, first pregnancy, pregnancy surveillance of less than four times, irregular consumption of folic acid, iron, and multi-vitamins during pregnancy, as well as inadequate consumption of meat, legumes, nuts, milk, dairy products, and vegetables during the pregnancy could increase the risk of LBW among infants significantly. **Conclusion:** Mothers' nutritional status before pregnancy, promotion of nutritional status by considering food sundry, nutritional balance, and care during pregnancy in the health centers can play a crucial role in improving the infants' anthropometric indices.

Keywords: *Newborn; Low birth weight; Birth weight; Anthropometric indices*

Introduction

Pregnancy is one of the most critical, sensitive, and crucial procedures among women, which affects their health and hygiene issues widely. Considering the changes of hormonal level, metabolic process, and physical activity in pregnant women and their nutritional requirements during pregnancy, mothers are highly susceptible to many environmental factors that cause metabolism exchange in their body (Rao *et al.*, 2001). Many studies have accurately suggested that infant's weight is a determinant marker in evaluating the sanitary status of human societies (Alexander *et al.*, 2007). According to the definition provided by world health organization (WHO), low birth weight (LBW) is considered as a weight of less than 2500 g for a healthy individual. In this regard, reducing the

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prevalence of LBW to 5% is a critical policy to keep the infant's health in the upcoming years (Hromi-Fiedler, 2007).

More than 21 million LBW babies are born every year all over the world in the developed or most developed countries. A remarkable correlation was reported between life expectancy and normal weight. Normal weight was also considered as a marker to estimate the rate of growth survival inside the uterus. This index can provide many useful information for public health centers (Akbari *et al.*, 2015). Similar to many other countries all over the world, statistics indicated that more than 7.7% of the LBW infants were born in Iran during 2010 (Rashidian *et al.*, 2014)

The prevalence of LBW were 8.6%, 5.2%, 8.8%, and 7.3% in Tehran, Gillan, Yazd, and Ahvaz cities, respectively (Golestan *et al.*, 2011, Tootoonchi, 2007). These studies showed that the LBW infants were 5 to 10 times more susceptible to death than normal cases in the first year of life. Therefore, these babies will face dangerous dilemmas during their life. In addition to the impact of this factor on infant's lifestyle, LBW children shared long-term consequences including evolutional disabilities and educational dysfunctions (Cogswell *et al.*, 1995). In such condition, the risk of mental and physical disorders can critically increase in their following years of life, which result in decreased quality of their life during their life (Robert-McComb *et al.*, 2014, Wu *et al.*, 2004).

Studies also suggested that gaining weight during pregnancy could directly affect the weight of newborn infants (Kabali and Werler, 2007). So, the mothers' nourishment status before and during pregnancy can determine the infant's weight. From this point of view, the current study aimed to investigate the effect of determining factors on the anthropometric indices of newborn infants in the health centers of Borujerd city for the first time.

Materials and Methods

Study design and participants: In this retrospective case-control study, the statistical population included 22 infants with LBW, as the case group and 44 infants with normal birth weight (NBW) as the control group. The study was conducted from September 2016 to February 2017 and data collection was performed from all health centers in Borujerd city.

Inclusion criteria were having no pre-historic diseases for mothers as well as no congenital diseases and full-term infants.

Measurements: The data were gathered based on the mothers and infants' documents available in health centers. All entities were carefully screened to find the relevant information in details for further analyses. A 147-item Food Frequency questionnaire (FFQ) was also completed by researchers through individual interviews with the participants about the mothers' nourishment status during the pregnancy. This questionnaire was previously used by Azadbakht et al. to determine food patterns (Azadbakht *et al.*, 2008).

Date analysis: To analyze the data, SPSS version 16 and N4 were applied and P-value <0.05 was considered as the significant level. All data were checked carefully and no missing or erroneous records were observed. To evaluate the expected variables, mean and standard deviation were applied. For qualitative variables frequency and percentage were used. For comparing quantitative variables between case and control groups, the independent *t-test* and *Chi-square* test were conducted. The following formula was used to calculate the odds ratio, as an estimation of relative risk:

$$Odds\ Ratio = P_1 \times P_4 / P_2 \times P_3$$

Results

Totally, 22 infants participated in the case group and 44 infants took part in the control group. The *t-test* results unveiled significant difference between the case and control groups regarding the evaluated parameters including weight, height, and head circumference (**Table 1**). The two groups had no significant differences with regard to gender and birthdate seasons (**Table 2**).

As detailed in **Table 3**, odds ratio showed that the risk of giving birth to LBW infants was higher in mothers over 35 years of age, employed mothers, self-employed fathers, and mothers with body mass index of more than 25 before pregnancy, first

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pregnancy, less than 4 times of surveillance during pregnancy, irregular consumption of folic acid complements, iron, and other multi-vitamins during the pregnancy, as well as inadequate consumption (lower than the serving size per day in g/day) of meat, legumes, nuts, milks, other dairy products, and vegetables. In contrary, the risk of giving birth to LBW infants decreased in parents with less than bachelor's degree, in women with a history of abortion before pregnancy, in women who started caring in their first trimester of pregnancy, and in those with normal hemoglobin content in their last trimester.

Table 1. The mean and standard deviation of anthropometric indices of studied infants

Indices	Case (n = 22)	Control (n =44)	P-value[a]
	Mean ± SD	**Mean** ± SD	
Birth weight(g)	2116.8 ± 213.6	3349.2 ± 389.7	< 0.001
Birth height(cm)	44.2 ± 2.3	49.5 ± 1.8	< 0.001
Birth head circumference(cm)	32.6 ± 1.8	35.1 ± 1.1	< 0.001

[a]: Student *t-test*

Table 2. The percentage of case/control girls and boys born in different seasons

Variables	Case		Control		P-value[a]
	n	%	n	%	
Sex					
Boy	11	50	22	50	< 0.001
Girl	11	50	22	50	
Birthday					
Autumn	10	45.4	20	45.4	< 0.001
Winter	6	27.3	12	27.3	
Spring	6	27.3	12	27.3	

[a]: Chi-square test

Table 3. The LBW infants odds ratio for independent variables

Variables		Case	Control	Odds ratio
Mother's age (year)	≤ 35	5	7	1.6
	> 35	17	37	
Mother's education	≤ Bachelor's degree	9	23	0.3
	> Bachelor's degree	13	11	
Mother's occupation	Employed	5	2	6.2
	House hold	17	42	
Abortion before pregnancy	Yes	3	14	0.3
	No	19	30	
Father's age (year)	≤35	9	21	0.8
	>35	12	23	
Father's education	≤ Bachelor's degree	11	30	0.5
	> Bachelor's degree	11	14	

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Father's occupation				
	Employed	14	19	2.3
	Self-employed	8	25	
Mother's BMI (kg/m^2)				
	≤25	13	18	2.3
	>25	8	26	
Number of pregnancy				
	1	14	12	4.7
	1<	8	32	
Pregnancy surveillance				
	First-third months	14	35	0.6
	Last sixth months	6	9	
Number of surveillance during pregnancy	≤4	11	4	10
	>4	11	40	
Consumption of folic acid.				
	Irregular	11	8	6.2
	Regular	8	36	
Consumption of Iron				
	Irregular	4	4	3.1
	Regular	13	40	
Multi-vitamin consumption				
	Irregular	7	13	1.6
	Regular	10	30	
Weighing during pregnancy				
	Low and proportional	12	26	1.1
	overweight	6	14	
Hemoglobin: First assay				
	$12 g/dl \leq$	15	36	1
	$12 g/dl >$	3	7	
Hemoglobin: second assay				
	$12 g/dl \leq$	4	22	0.3
	$12 g/dl >$	8	15	
First fasting blood sugar assay				
	$92 mg/dl >$	18	33	1.3
	$92 mg/dl \leq$	0	10	
Second fasting blood sugar assay				
	$92 mg/dl >$	13	34	0.7
	$92 mg/dl \leq$	1	4	
Consumption of bread and cereals				
	Inadequate	0	0	—
	Adequate	22	44	
Meat, legumes and others				
	Inadequate	2	2	2.1
	Adequate	20	42	
Milk and other dairy products				
	Inadequate	14	11	5.3
	Adequate	8	33	
Fruits	Inadequate	2	0	0.9
	Adequate	20	44	
Vegetables				
	Inadequate	7	4	4.7
	Adequate	15	40	

Discussion

The current study aimed to determine effective factors on anthropometric indices of infants including weight, height, and head size in their first days of life. The evaluated indices were investigated in comparison to the control group and the results showed significant differences between the two studied groups. In this context, previous studies conducted based on the UNICEF standards reported that LBW infants had smaller heights and head size in comparison to other NBW ones (Panter-Brick, 1998). To show the effect of different factors, we controlled for the confounding factors of birth season and gender (Rafiei, 2007) and found no significant differences between the case and control groups. However, this query indicated that LBW infants had different anthropometric indices in comparison to other groups and their mothers should carefully check their nutrition pattern during pregnancy period. Many studies indicated that having a good and balanced diet could help mothers to fortify the quality of their life. In this way, they can follow specific patterns for nourishment of their body during different stages of their life (Rasouli *et al.*, 2018).

In this study, all full-term infants were LBW and they were born during nine months after pregnancy. The frequency of LBW was significantly low in the targeted studied society. Therefore, the odds ratio of LBW infants was qualitatively determined for both groups (Brownson and Petitti, 1998). Furthermore, mothers were divided into two age groups and we found that the risk of LBW infants was 1.6 times higher in mothers over 34 years of age. Borders et al. suggested that LBW infants' mothers were in their middle ages compared with mothers who had infants with normal weights (Borders *et al.*, 2007). In another encouraging study, Geronimus reported that the prevalence of LBW was four times higher among aged African mothers, while such condition was not observed among the white race mothers (Geronimus, 1996). This discrepancy can be attributed to genetic and social-cultural factors.

In the current study, the risk of LBW infants was six times higher in employed than the housekeeper mothers. This relationship can be interpreted based on the mother's work environment and their high levels of pressures. Geronimus et al. showed that LBW infants were about 3.1 times more common among unemployed women than the employed mothers (Geronimus, 1996). The possible reason for this is the cultural-social differences between families of different countries. However, each country has unique patterns for cultural behaviors and such condition can change the quality of life-dependent factors.

Among the studied groups, having a history of abortion before pregnancy decreased the odds of giving birth to LBW infants. This reduction is due to the mothers' frequent visits to health centers to avoid another abortion. On the contrary, Badshah et al. studied Pakistani mothers and showed that having a history of abortion before pregnancy could lead to LBW infants, since the history induced anemia among mothers that causes LBW (Badshah *et al.*, 2008). In our study, more than 83% of the case group mothers had similar hemoglobin contents in the first assays. However, it can be said that in Badshah study, apparently, mothers with the history of abortion and anemia entered the experimental procedure and therefore results have reported to born LBW infants.

Based on the results, fathers' age had no effect on infants' weights. Similarly, Kolivand et al. found no significant correlation between infants' weight and fathers' age (Kolivand *et al.*, 2014). Relying on other investigations, it can be said that the infants' weight is directly correlated with mothers' weight during the pregnancy period. Lekea-Karanika et al. indicated that LBW infants were 2 to 3 times more frequent among illiterate fathers or those with low educations (Lekea-Karanika *et al.*, 1999). This can be justified by the cat that educated fathers had better information about supporting their women for food and nutrition during pregnancy. In contrast, we observed that parents with less than bachelor's degree had decreased odds of LBW babies. This was mainly due to the fact that less-educated fathers paid less attention to the nutritional status of their family and wife. However, to confirm this result, further critical studies should be conducted in order to gain useful related data.

Regarding the relationship between fathers' occupation and LBW infants, the odds of having LBW infants was higher in self-employed fathers. Assefa et al. reported that the odds of LBW infants were two times higher in families with worker fathers (Assefa *et al.*, 2012). According to Rodriguez et al., the risk of having LBW infants was 26% higher in families with worker fathers. Since the burden of financial issues is on fathers, their occupation has an important role in the birth of LBW infants.

The mothers' body mass index of ≥ 25 before pregnancy increased the odds of having LBW infants by two times. Many reasons can justify this finding, but accumulation of fats in body (especially around mother's stomach) can be highlighted as the main reason. With significant disagreement with our results, McDonald et al. reported that the risks of giving birth to LBW infants was lower among obese women and this decrease was more significant in the developing countries than the developed nations (McDonald *et al.*, 2010). This is due to the fact that lower weights before pregnancy in the developing countries is directly correlated with malnutrition and mother's body nutrient requirements. In this regard, we should state that the mothers' anthropometric indices were normal or meta-normal before pregnancy. In addition, the mothers' age, pregnancy surveillance, and other demographic characteristics, such as genetics, age, nutrition, prenatal care, and smoking could cause. The complex interaction between these factors in different human populations can cause significant variance in the birth of LBW infants. The health centers should attentively consider these factors when mothers (especially pregnant mothers) visit them for receiving critical counseling advices for their nourishment plans.

In the current study, the odds of LBW infants was five times higher in mothers who were experiencing their first pregnancy. This can be justified by mothers' lack of awareness about the hormonal, metabolic, and physical changes during their pregnancies. In other words, they do not know about their nutritional requirements. This finding was also supported by another study in reporting that the most observed underweight infants were related to first pregnancies (Safari *et al.*, 2016). We also found that the odds of LBW was lower in women who started caring in their first trimester of pregnancy. These results showed that using accurate mother caring policies in the first months of pregnancy and helping the mothers with appropriate educational programs can support them to have a normal weight baby. Roudbari et al. showed a significant correlation between LBW and less than 4 visits for surveillance (Roudbari *et al.*, 2007), which is supported by our outcomes. Other authors also reported that inadequate surveillance during pregnancy can increase the odds of LBW about 1.36 times (Roudbari *et al.*, 2007).

According to our findings, irregular intake of folic acid during pregnancy can increase the risks of having LBW infants up to six times. In the same vein, other studies reported that administration of folic acid before pregnancy could increase the weights of infant and placenta up to 68 g and 13 g, respectively. Therefore, it can be concluded that administration of folic acid can decline the risks to have LBW infants (Bellinger *et al.*, 1987). The administration of folic acid before and during pregnancy decreases the risk of LBW infants significantly. Similar condition was observed for the administration of amino acids and multi-vitamins. The irregular administration of multi-vitamins during pregnancy can trigger the risks to have LBW infants up to 1.6 times. Fdakar-Soghe et al. reported that the probability of having LBW infants among mothers who did not use iron, multi-vitamin, and folic acid complements increased up to 13.16 times (Fadakar-Soogheh *et al.*, 2012). Intake of supplementary complements by low-income populations can obviously prevent from the birth of LBW infants, because supporting mothers' nutritional requirements has a crucial role in the growth of fetus in uterus. In addition, the portion of hemoglobin normality content is another factor

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that critically improves the health quality of infants. Therefore, the rate of hemoglobin in the last trimester of pregnancy decreased the odds of LBW infants by half. Based on the results, the average weights of infants were significantly higher in mothers with abnormal rates of hematocrit in the first and third trimesters of pregnancy. Therefore, the rate of hemoglobin, especially in the first trimester of pregnancy, has a significant correlation with LBW infants, which is supported by the fetus requirements for reaching oxygen through blood circulation.

Finally, our results unveiled that the irregular or inadequate consumption of meat, legumes, nuts, milk, and other dairy products; vegetables; and fruits during the pregnancy could increase the odds of LBW infants by 2.1, 5.3, and 4.7 times, respectively. The inadequate consumption of bread and other cereal groups and fruits had no significant effect on the infants' weights. Other researchers reported a correlation between mothers' nourishment status during the pregnancy and the infants' anemia. The odds of LBW infants was 2.57 to 3.75 times higher in mothers who did not consume fruits or dairy products regularly (Ramazanali *et al.*, 2006).

The major limitation of the current study was its small number of participants that may have spoil the significant results and the power of the current study. Some critical data about mothers and their infants were not recorded in their files at the health centers; therefore, accuracy of the recorded data was not confirmed comprehensively. Moreover, the study findings can be considered for Burojerd City and further studies should be conducted so that the findings can be compared.

Conclusion

The outcomes indicated that the nourishment status of mothers before/during pregnancy could affect the infants' weight significantly. Therefore, by promoting a profitable and appropriate strategy for supporting mothers regarding their body nutritional requirements and by performing sanitary activities during pregnancy in the health centers, the anthropometric indices of newborn infants can be improved. Many mothers do not have access to appropriate foods in their families, which increases the odds of giving birth to LBW infants. Reception of regular counseling from nutritionists in the local health centers and consumption of the micro-nutritional complements can help all mothers to improve their pregnancy to have a healthy baby.

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Authors' contributions

Siassi F and Jazayery A contributed to conception, design, and writing the manuscript draft. Niknejad N participated to data collection, statistical analyses, data interpretation and manuscript draftin All authors approved the final version of the manuscript and agreed upon all aspects of the work.

Conflict of interest

There is not any conflict of interest.

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