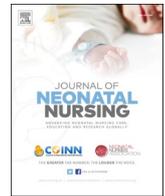




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Comparison of maternal and umbilical cord blood serum selenium levels in neonates with low and normal birth weight

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ABSTRACT

Background: Selenium is a vital and rare element for the body that the maximum time for its accumulation and storage in the fetal body is the last trimester of pregnancy. This study aimed to compare the selenium level in maternal and umbilical cord blood in neonates with low and normal weight.

Methods: This cross-sectional study was conducted on 112 pregnant women referred to a learning hospital, 2018. Case and control group, respectively, consisted of 56 women with neonates weighing less and more than 10 percentiles based on gestational age. After delivery, 5 cc blood was taken from mothers and neonates. After coagulation, it is centrifuged within a maximum of 1 h and its serum was frozen and sent to the laboratory. Then selenium were compared in two groups.

Results: The mean age and average gestational age of women was 26.66 ± 5.76 years and 38.68 ± 1.68 weeks, respectively. In the group of normal-weight neonates, a weak and direct correlation was observed between the weight and selenium of umbilical cord ($P = 0.02$).

Conclusion: Considering the low level of selenium in this study, it is suggested to conduct other studies with a larger sample size and in other populations to provide the possibility of examining the blood selenium of neonates.

1. Introduction

According to the World Health Organization report in 2017, 4.1 million deaths (75% of deaths in children under 5 years old) occurred in the first year of birth (World-Health-Organization, 2017), and every year in the world, nearly 45% of the deaths of children under 5 years old occur in the group of neonates under 28 days old (World-Health-Organization, 2014). Among the main causes of these deaths are complications from premature birth and low birth weight (LBW), respiratory infections, asphyxia, and birth trauma (World-Health-Organization, 2014). LBW is a birth weight of less than 2500 g, which is associated with a wide range of short and long-term consequences. It is estimated that 15–20% of all births (more than 20 million) each year are LBW, and more than 95% of these births occur in low and middle-income countries. It is also estimated that 6% of these births occurred in East Asia and

the Pacific, 13% in sub-Saharan Africa, and 28% in South Asia (World-Health-Organization, 2014). LBW can also be defined based on intrauterine growth restriction. This refers to a situation in which, based on a definition, the estimated weight of the fetus is less than the 10th percentile. This disease is a multi-causal complication whose prognosis and outcome are mostly influenced by the cause of its occurrence (Jahanian Sadatmahale, Ziaei, and Kazemnejad, 2011).

Three causal groups, factors related to the mother, placenta, and fetus, are involved in the occurrence of LBW or intrauterine growth restriction, and the state of the placenta plays the most important role. Pre-eclampsia, age, weight during pregnancy and maternal chronic diseases, smoking, drug and alcohol abuse, gestational age, fetal infections, and environmental pollution are among the main causes of this disorder (Heshmat, 2017). In addition, studies have shown that the nutritional status of the mother plays a key role in pregnancy, and the

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health of the mother and the fetus depends on it. Zinc, calcium, copper, and selenium are among the main micronutrients in the diet of pregnant women; the main cause of their deficiency is lack of intake through diet. Selenium has received more attention among the mentioned micronutrients (Berti et al., 2011; Goshtasebi et al., 2013; Fadakar Soogheh et al., 2012).

Various studies have investigated the level of selenium in pregnant women and neonates and showed that the level of selenium can be used as a tool to predict some diseases. Davaryari et al. showed that women with preeclampsia had lower blood selenium levels than normal pregnant women, and this difference was significant (Davaryari et al., 2011). Tsuzuki et al. study showed that the amount of selenium in the group of preterm children was significantly lower than in term children. However, no significant difference was observed between the two groups in terms of other trace elements such as iron, zinc, and copper (Tsuzuki et al., 2013). Another study showed that there was no significant difference in selenium levels in 3 groups of women with miscarriage, normal pregnant women and women who are not pregnant (Isa et al., 2004). In addition, Nazemi et al. concluded that there is no significant difference between maternal and umbilical cord blood selenium levels between the two groups. However, the umbilical cord blood selenium concentration had a positive relationship with the maternal blood selenium concentration (Nazemi, et al., 2015).

Considering that few studies have been conducted in the field of examining the amount of selenium and its effect on the condition of the fetus and neonate in the world and in Iran, they have different results, and the serum level of selenium is affected by spatial and temporal changes. This study aimed to compare maternal and umbilical cord selenium levels in LBW and normal birth weight neonates.

2. Methods

This descriptive-cross-sectional study was conducted on 112 pregnant women referred to a learning hospital in 2018. Based on comparing the average of the two groups' formulas, taking into account the error level of 5% and the power of 80%, the sample size was calculated to equal 112 cases. Fifty-six women who gave birth to neonates weighing less than the 10% percentile based on gestational age (natural or cesarean childbirth) were considered as the case group. They did not have a history of any underlying disease that affects the weight of the fetus. Another 56 women who had neonates weighing more than 10% based on gestational age were included in the control group.

The criteria for including the study were the age of mothers 17–40 years old with a singleton pregnancy, gestational age 37–41 weeks based on reliable last menstrual period (LMP) or ultrasound of the first trimester of pregnancy. Twins and multiples and all people who were suffering from pre-eclampsia and eclampsia, or suffering from diabetes and gestational diabetes, chronic blood pressure, hepatitis, heart, kidney, and other underlying diseases, or had a history of smoking and other drugs, and also mothers with hemoglobin anemia below 10, consuming supplements containing selenium, mothers with premature birth and congenital malformation of the neonate and neonates with a weight above the 90% percentile were excluded from the study.

Immediately after delivery, 5 cc of venous blood was taken from the mother and the baby's umbilical cord and stored in the clotting tube. After coagulation, it was centrifuged within a maximum of 1 h, and its serum was frozen and stored in a freezer for analysis and sent to the laboratory of origin. The sample taken was non-fasting. At least 8 h had passed since the last meal. All the received blood was sent to the laboratory to perform an atomic absorption furnace to measure the amount of selenium. Then, two groups were compared in terms of maternal and umbilical cord blood selenium levels after delivery. Also, to collect demographic information was used a checklist including age, number of pregnancies, gestational age, mother's weight before pregnancy and before delivery, mother's height, mother's body mass index (BMI), baby's sex, baby's weight, baby's height, baby's head circumference,

place of residence, level of education, occupation of the person.

Descriptive statistics, Chi-square and Fisher exact tests, T-test, Mann-Whitney U, Pearson and Spearman correlation coefficient, and SPSS version 23 software were used for data analysis. A significance level of $P < 0.05$ was considered.

The ethics committee of the Kerman University of Medical Sciences approved this study (code: IR.KMU.AH.REC.1397.036).

3. Results

The mean age of mothers was 26.66 ± 5.76 years old and the average gestational age was 38.68 ± 1.68 weeks. The average weight of pre-pregnancy, before delivery, and during pregnancy was 55.76 ± 11.34 , 67.24 ± 11.04 and 11.65 ± 4.15 kg, respectively. The average gravidity was 1.64 ± 2.46 . In comparing the demographic variables of mothers, there was a significant difference between the BMI of the mothers in the two groups ($P = 0.01$). So, the BMI of mothers with normal-weight neonates was more in the normal range than the other group, and mothers with low-weight neonates were more underweight. Although the average age, gestational age, and gestational age of mothers with normal-weight neonates were higher compared to mothers with low-weight neonates, this difference was not significant ($P < 0.05$). In addition, education level, place of residence, occupation, and husband's job in two groups were not significantly different ($P < 0.05$) (Table 1).

The majority of neonates were boys (60%). Their average weight was 2942.451 ± 82.51 g, and their average height and head circumference were 49.16 ± 3.23 and 34.26 ± 2.11 cm, respectively. More than half of the neonates were born by natural delivery (69.1%) (Table 2).

The average maternal blood selenium was 54.22 ± 46.51 mg/L, and only 22 mothers (20%) were in the normal range in terms of blood selenium. The average selenium in the umbilical cord was 35.76 ± 19.20 mg/L, and the amount of selenium in the umbilical cord was in the normal range in less than 50% of the neonates (43.6%). Although the average amount of blood selenium in the case group was higher than the control group, this difference was not significant. In addition, no significant difference was seen between the amounts of selenium in the umbilical cord between the two groups ($P < 0.05$) (Table 1).

No significant correlation was observed between the three indicators of head circumference, height, and weight of neonates in both groups with the amount of selenium in the umbilical cord and maternal blood ($P < 0.05$). However, after examining the two groups separately, a direct and weak correlation was observed between the weight in the group of neonates with normal weight and the amount of selenium in the umbilical cord ($r = 0.29$ and $P = 0.02$) (Table 3).

4. Discussion

Selenium is a rare and necessary element for the human body and plasma levels less than 30 mg/L are associated with disorders. The need for this element increases during pregnancy. The presence of selenium in the maternal blood prevents many toxins from entering the body of the fetus. In addition, the decrease and increase of selenium in the umbilical cord blood compared to the selenium in the maternal blood indicates the active transfer of selenium from the mother to the fetus. The normal amount of selenium in the maternal blood in the third trimester of pregnancy is between 130 and 240 ng/ml, and in the umbilical cord blood, between 70 and 100 ng/ml (Qazi et al., 2018).

In this study, maternal and umbilical cord blood selenium serum levels in low and normal-weight neonates were compared. According to the results, the average selenium in the maternal and umbilical cord blood of neonates was 54.46 ± 22.51 and 35.76 ± 19.20 mg/L, respectively only 20 and 43.6% of mothers and neonates were in the normal range in terms of blood selenium levels. These results showed that the maternal and umbilical cord blood selenium levels in neonates in our study are lower than in other studies. In addition, no significant difference was observed between the average selenium of the umbilical

Table 1
Mothers' demographic data.

Variables		N (%)	Case group N (%)	Control group N (%)	P-value
Place of residence	City	77 (70)	38 (70.4)	39 (69.6)	1
	Village	33 (30)	16 (29.6)	17 (30.4)	
Education	Illiterate	16 (14.5)	8 (14.8)	8 (14.3)	0.99
	High school	42 (38.2)	20 (37)	22 (39.3)	
	Diploma and postgraduate diploma	35 (31.8)	18 (33.3)	17 (30.4)	
	Bachelor's degree and higher	17 (15.5)	8 (14.8)	9 (16.1)	
BMI	Underweight	27 (24.5)	19 (37.3)	8 (14.8)	0.01
	Normal	59 (53.6)	22 (43.1)	37 (68.5)	
	Overweight	13 (11.8)	8 (15.7)	5 (9.3)	
Maternal job	Obese	6 (5.5)	2 (3.9)	4 (7.4)	1
	Housewife	105 (95.5)	52 (96.3)	53 (94.6)	
Husband's job	Employee	4 (3.6)	2 (3.7)	2 (3.6)	0.66
	Free	1 (0.9)	0	1 (1.8)	
Husband's job	Free	89 (80.9)	89 (82.4)	46 (85.2)	0.66
	Employee	8 (7.3)	8 (7.4)	3 (5.6)	
	Labor	7 (6.4)	7 (6.5)	4 (7.4)	
Husband's job	No job	4 (3.6)	3 (5.6)	1 (1.9)	0.66
		Mean±SD	Mean±SD	Mean±SD	
Maternal age (years)		26.5 ± 66.76	25.83 ± 5.97	27.46 ± 5.49	0.13
Gestational age		38.68 ± 1.68	38.60 ± 1.62	38.75 ± 1.76	0.34
Pregnancy weighing		11.65 ± 4.15	11.03 ± 3.81	11.80 ± 4.24	0.33
Gravidity		1.64 ± 2.46	2.39 ± 1.76	2.54 ± 1.52	0.38
Maternal blood Se (mg/liter)		54.46 ± 22.51	55.07 ± 23.64	53.87 ± 21.56	0.83
Umbilical cord Se (mg/liter)		35.76 ± 19.20	36.96 ± 23.59	34.64 ± 13.82	0.80

*Se: selenium; BMI: Body mass index.

Table 2
Neonates' demographic data.

Variables		N (%)	Case group N (%)	Control group N (%)
Sex	Male	66 (60)	29 (54.7)	37 (67.3)
	Female	46 (40)	24 (45.3)	18 (32.7)
Type of delivery section	Natural	76 (69.1)	33 (64.7)	43 (78.2)
	Cesarean	36 (30.9)	18 (35.3)	12 (21.8)
Weight	Mean±SD	2942.82 ± 451.51	2587.78 ± 263.79	3298.93 ± 290.34
	Height	49.3 ± 16.23	47.72 ± 3.57	50.52 ± 2.14
	Head circumference	34.2 ± 26.11	34.01 ± 2.73	34.50 ± 1.26

Table 3
Correlation between maternal and umbilical cord blood selenium and neonatal indices in two groups of mothers with normal and low weight neonates.

Variables		Umbilical cord Se		Maternal blood Se	
		P-Value	r	P-Value	r
Head circumference	Neonates with NWs	0.10	0.22	0.67	0.05
	Neonates with LW	0.11	-0.21	0.93	-0.01
	In two groups	0.18	-0.12	0.76	-0.02
Height	Neonates with NW	0.43	0.10	0.09	0.22
	Neonates with LW	0.76	0.04	0.33	-0.13
	In two groups	0.78	0.02	0.82	-0.02
Weight	Neonates with NW	0.02	0.29	0.59	0.03
	Neonates with LW	0.10	-0.22	0.22	-0.16
	In two groups	0.54	-0.05	0.59	-0.05
Umbilical cord Se (mg/liter)	Neonates with NW	-	-	0.76	-0.04
	Neonates with LW	-	-	0.24	0.16
	In two groups	-	-	0.35	0.08

*Se: selenium; NW: normal weight; LW: low weight.

cord and maternal blood between the two groups of LBW and normal birth weight neonates in this study. The reason for this result could be the very small difference in the averages, and on the other hand, the average selenium in the maternal and umbilical cord blood was higher in the LBW group than in the other group. In Alipour et al. study in Kermanshah, the average selenium in cord blood of mature and premature neonates was 70.11 ± 11.6 and 63.86 ± 13.93 mg/L, respectively, which is much higher than the values in the present study. Also, the average selenium of umbilical cord blood and maternal serum in the group of full-term neonates was significantly higher than the group of premature neonates, which was not consistent with the present study (Alipour et al., 2014). In the Nazemi et al. study, the average selenium in maternal and umbilical cord blood in neonates was higher than our study (80.69 ± 28 and 77.32 ± 26.12, respectively) (Nazemi, et al., 2015). These differences can be due to the difference in the region and the feeding style of the studied populations.

Based on the results of the present study, there was a direct and weak correlation between the weight and selenium level of the umbilical cord in the group of neonates with normal weight. However, in both groups, no significant correlation was observed between the three indicators of head circumference, height, and weight of neonates with the amount of selenium in the umbilical cord and maternal blood. Also, although the average maternal blood selenium of low-weight neonates was higher than the group of mothers of normal-weight neonates, this difference was not significant, and there was no significant difference between the average amount of selenium in the umbilical cord of the mothers in the two groups. Nazemi et al. in Tehran also achieved similar results, which showed that there was no significant difference between selenium in maternal and umbilical cord blood between two groups of mothers of normal-weight and underweight neonates (Nazemi et al., 2015). The results of Dobrzynski et al. study in Poland also showed that there is no significant relationship between birth weight and serum and umbilical cord selenium levels (Dobrzynski et al., 1998). In contrast, Tsuzuki et al. in Japan showed that the maternal blood selenium level can significantly affect the weight of the neonate at birth (Tsuzuki et al., 2013). Also, the results of Giménez et al. study in Spain showed that the blood

selenium of neonates with LBW was significantly lower than neonates with normal weight (Giménez et al., 2003). These differences can be caused by the low amount of selenium in the maternal and umbilical cord blood of neonates in the present study.

In our study, there was a significant difference in the BMI of the mothers in the two groups, so the BMI of the mothers of neonates with normal weight was more in the normal range than the other group, and the mothers of neonates with low weight were more underweight. Fadakar Soukeh et al. study in Rasht also showed that there was a significant relationship between the mother's BMI, the neonates' birth weight, and the percentage of underweight neonates was higher in thin mothers (Fadakar Soogheh et al., 2012). These results were consistent with the results of the present study.

The results of the present study showed that there was no significant difference between the mother's age, gestational age, education level, and mother's occupation between mothers with normal-weight neonates and mothers with LBW neonates. Meanwhile, the Eghbalian study showed that LBW had a significant relationship with the mother's age, gestational age, and the mother's education level (Eghbalian, 2007). This difference, in addition to the significant difference in the sample size and the large distance between the investigated geographical points, can be due to the fact that in the current study, the average age of the mother and the gestational age in both groups were very close to each other, and also, most of the mothers in both groups were housewives and had undergraduate education.

5. Conclusions

Considering the maternal and umbilical cord blood selenium levels in neonates in the present study and the necessity of this vital element, it is necessary to educate and improve the nutritional style of the population under study. In addition, the umbilical cord and maternal blood selenium level showed a significant relationship with weight and height, respectively, in the group of neonates with normal weight, which shows the need to pay attention to the intake of this micronutrient. However, since there was no significant relationship between maternal and umbilical cord blood selenium with birth weight in both groups and considering the selenium low level in the present study, it is suggested other studies should be conducted with a larger sample size and other populations to provide the possibility of examining the blood selenium

in neonates.

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