International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

Determination of Zinc Levels in Cord Blood and Its Possible Effects on the Fetus

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Abstract: ***This study was conducted in order to determine the zinc level in the cord blood of the pregnant women who applied for birth to Karabük Private Medikar Hospital and to examine the possible effects of zinc on the fetus. The sample of the study was made up with face-to-face questionnaire method of 50 pregnant women who applied to the hospital for giving birth, who did not have understanding and speaking problems, who could speak and understand Turkish and who accepted the study. The collection of cord blood samples for research; cord blood was obtained by umbilical cord clamping during the new-born intensive care unit (if there is no health problem of the new-born) by taking 5-10 ml of blood from the arterial part of the cord and slowly transferring it to trace element tubes (without EDTA). The level of zinc in cord blood was analyzed using Atomic Absorption Spectroscopy (AAS) Graphite System Method. Also, the relationship between cord blood zinc level and independent variables showed nonparametric distribution, therefore, the data obtained were evaluated with percentage, arithmetic mean, frequency distributions and Kruskal Wallis H Test and Mann Whitney U Test were used for comparisons. The mean age of the pregnant women was found to be 30.08. in this research. The mean zinc level of cord blood was found to be 97.71 µg/dl in our study. A moderate, positive way and statistically significant relationship was found between maternal age and zinc level (rs=0.34; p<0.05).Also, in the results of correlation analysis which was conducted for determine the relationships between the zinc levels in the cord blood and the baby's weight, height, head circumference, week of birth and Apgar values; there was no statistically significant correlation (p>0.05) among of baby's weight (p = 0.566), height (p = 0.554), head circumference (p = 0.767), birth week (p = 0.104), 1st minute apgar score (p = 0.166), 5th minute apgar score (p = 0.089).***

Keywords: Zinc, midwifery, trace element, pregnancy, cord blood, placenta

1. Introduction

It is determined that zinc level (Zn), which is one of the important trace elements, is deficient in 2 billion people in the world (Müller et al. 2005, Kutlubay et al. 2011). Because of the zinc plays a role in important events such as cell division and differentiation, DNA and RNA activation in the entire human organism, it has been suggested that 15 mg in the adult and 3 mg in the newborn daily should be taken (Arcasoy 2002, Güneş 2014). Zinc is an intracellular cation and is not stored in the body while it is localated in all tissues and fluids (Doğan 2009, Akarsu 2013). It contains 2-3 g of zinc in an adult human body, of which about 0.1% is regenerated daily.

Zinc plays a role in preventing the free radical formation and protecting against oxidative stress (Kasnak and Palamutoğlu 2014), is found in the structure of many proteins in the brain and also plays a role in the metabolism of the fatty acid and the amino acid. It affects the synaptic response in the hippocampus (Ülger and Coşkun 2003, Özmert 2005, Tarakçı and Küçüközer 2006, Akdeniz et al. 2016). It is thought that hyozincemia plays a role in the growth of thymus and lymphoid organs, the decrease in lymphocyte count, the deterioration of neutrophil function, and the decrease of antibody-antigen reaction (Karadağ 2006, Akdeniz et al. 2016). Thus, it has been determined that zinc played an important role in the growth and the system of the body by increasing protein synthesis, nucleic acid metabolism and growth hormone production.

It has been reported that zinc plays an important role in the healthy development and growth of maternal tissues, fetus and placenta during pregnancy (Uzdil and Özenoğlu 2015) and for the realization of the passage of substances from the placenta to the fetus by active transport (Kaya 2014). In addition, if there is a daily intake of less than the amount of zinc required for mother and fetus health during pregnancy, it has been suggested to occur as a variety of negative pathological problems such as growth and developmental disorders, spontaneous abortion, congenital malformations, intrauterine growth retardation (IUGR), low birth weight (LBW), preeclampsia, premature birth and neural tube defects (NTD) (Karimi et al. 2012).

It has been explained that during the embryo and fetal development, maternal zinc levels are affected by numerous environmental factors (Kaya 2014) and depending on these can have adverse effects on both the pregnant and intrauterine growth and development of the fetus (Genenş et al. 2009).

Açkurt et al. examined the relationship between anemia and nutritional disorders in Turkish women in the prenatal and

postnatal period. Also depending on the data they obtained, it was determined that iron, zinc, calcium, vitamin B12, vitamin A, vitamin E, folate, total protein and albumin, vitamin B2 deficiencies and low ferritin levels in early-late gestational weeks and postpartum pregnancies and consequently it was found that anemia can occur due to this.

It was determined with literature studies that clinical and experimental studies were insufficient intended for determining the level of zinc in pregnancy and its possible effects on the fetus. This study is due to the environmental pollution in Karabük province which has important iron and steel industry of our country, it was conducted to determine the possible effects of Zn on the fetuses of pregnant women (n=50) who came to Karabük Private Medikar Hospital for childbirth and accepted to participate voluntarily in the study.

2. Material and Method

This descriptive and analytical study was designed by the Ethics Committee of Karabuk University, the permission of the Turkish Hospital Association and the coordinator of Karabuk University BAP. This study was carried out in order to determine the zinc levels and the factors affecting them in the blood sample taken from fetal cord of pregnant women who applied for delivery at Karabük Private Medikar Hospital between 01.09.2018- 01.09.2019.

Prior to the beginning to the research, the necessary ethics committee and institution permissions were obtained, and then the purpose and importance of the research were explained to each participant and their approval was obtained. The sample of our research consisted of 50 pregnant women who did not have problems speaking and understanding, who could speak and understand Turkish and who agreed to participate voluntarily in the research. In our research, while dependent variables are the possible effects of zinc on the fetus, independent variables were determined as sociodemographic and obstetric characteristics belonging to mother, characteristics belonging to place of life, feeding patterns, vital signs and haemoglobin value.

In the data collection section for the research, firstly it has been informed about the purpose and importance of the research to each participant and has been received a voluntary consent form. Later than, the data collection form developed by the researcher himself based on the literature was applied to the pregnant women who accepted the study by face-to-face interview technique. After the birth and the umbilical cord clamping, 5-10 ml blood samples were taken from the artery part of the cord during new-born intensive care unit. During the bloodletting from the cord, no patting procedure was applied to the cord. After the needle tip was removed, blood was slowly transferred to trace element tubes (which did not contain EDTA). The baby's name and surname (baby surname) and sampling number were written on the tube, and the same number was also used for the survey. After the blood samples taken were centrifuged at 3000 rpm within 30-45 minutes at the latest, 2 ml serum was taken and put into 2 ml eppendorf tubes. These serums were carried without waiting to Private Medicar Hospital Laboratory and stored at -20 degrees until all samples were completed and sent to the contracted private laboratories for analysis. After all the cord blood samples were sent to the contracted analysis centre, since the zinc in the samples was colored, it was given a pink colour under Br-PAPS (Zinc Colorimetric Assay Kit / 5-Br-PAPS Method) conditions and the change was calibrated with zinc sulphate at 548 nm absorbance and dissolved in deionized water and analysed by Colorimetric method (Rel Assay Diagnostics/TURKEY) (Baran Medical Ankara/TURKEY) (Homsher and Zak 1985).

In this study, the data were obtained by the researchers based on the literature by asking 49 questions structured to determine the sociodemographic characteristics of the pregnant women, their eating habits, their fertility characteristics, their medical history and the characteristics of the new-born.

The data we obtained from our research was first transferred to electronic media. Then Shapiro Wilk's was used, depending on the states and unit numbers of variables coming from the normal distribution. The study data showed a nonparametric distribution. Also, Kruskal Wallis and Mann Whitney U tests and correlation analysis were used for distributions of the percentage-frequency and for the comparison of the cord blood zinc levels according to the variables. On the interpreting of the results, 0.5 was used as a significance level; It was stated that if $p<0.05$, there was a significant relationship, and if $p>0.05$, there was no significant relationship.

3. Results

The results of this descriptive and analytical study to investigate possible factors affecting the fetus and also measurement of zinc levels in blood samples taken from the cord of newborn babies of women who applied to Karabük Private Medikar Hospital 01 August 2019 to 01 September 2019:

1) Socio-demographic, fertility, lifestyle of pregnant women and findings belonging to newborn
2) The findings related to the comparison of zinc levels in cord blood with socio-demographic, fertility, lifestyle, nutritional consumption and newborn variables.The findings are presented under two headings.

3.1 Results of socio-demographic, medical history, fertility, risk factors of pregnant women

Pregnant women who agreed to the study in this section, age, height, weight, education and income status, chronic disease, and drug use, smoking, alcohol consumption, haemoglobin levels, and blood pressure, birth, miscarriage, abortion, stillbirth, and total number of pregnancies, assessment of risk/risk factors related to previous and current pregnancies and babies, during pregnancy in the mouth or anywhere part of the body aft-like scar formation, eating habits and characteristics regarding the new-born have been given.

Sociodemographically; it was found to be 30.08 ± 4.53 as the mean age of the pregnant women in the study. It is

determined that 98% were married and 2% were single on the examination of the pregnant women's marital statuses. It was determined the rate of primary school graduates was 4%, secondary school graduates were 6%, high school graduates were 10%, and university and higher graduates were 35% on the evaluation of the pregnant women in terms of education. Also, It was found that 4% of pregnant women have lower income than outgoings, 72% have equal income to outgoings, and 24% have a higher income than outgoings on the examination of the pregnant women's family income levels. In addition, it was found that 70% of the pregnant women resided in Karabük province, 28% lived in the districts of Karabük, and 2% lived in the village on the examination of pregnant women's distribution according to the regions (Table 1).

Table 1: Socio-demographic characteristics of pregnant women

Characteristics		Mean	SD
Age		30,08	4,53
		n	**%**
Marital Status	Married	49	98
	Unmarried	1	2
	Divorced /widowed	0	0
Education status	Primary school	2	4
	Middle school	3	6
	High school	10	20
	University and above	35	70
Income	Income lower than expense	2	4
	Income equivalent to expense	36	72
	More than revenue	12	24
Permanent Residence	Village	1	2
	Districh	14	28
	County/town	35	70
Family type	Nuclear family	48	96
	Extended Family	2	4
Total		50	100

Table 2: Variables related to medical history of pregnant women

Variables		**Mean**	**SD**
Blood pressure	Systolic blood pressure	113,52	11,31
	Diastolic blood pressure	64,26	7,88
Haemoglobin Value		11,95	1,33
Pulse		90,04	12,07
		n	**%**
Presence of Chronic Disease*	Yes	7	14
	No	43	86
Regularly used drug/drug group	Yes	13	26
	No	37	74
Zinc supplement during pregnancy	Yes	24	48
	No	26	52
Zinc-rich food consumption during pregnancy **	Yes	42	85,7
	No	7	13,4
Smoking (during pregnancy)	Yes	4	8
	No	46	92
Smoking per day	3-4	4	8
Smoking (before pregnancy)	Yes	5	10
	No	45	90
Smoking period	Less than 5 years	1	2
	More than 5 years	4	8
Drink (before pregnancy)	Yes	1	2
	No	49	98
Drink (in pregnancy)	Yes	0	0
	No	50	100

*Diabetes, Blood Pressure, Thyroid disease, **Meat, seafood, milk and derivatives, eggs

As medical history; it was defined that the mean systolic blood pressure was 113.52 ±11.31 and the mean diastolic blood pressure was 64.26 ±7.88 on the examination of the pregnant women's blood pressure values. The hemoglobin level of the pregnant women was found to be 11.95 ± 1.33 and the pulse values to be 90.04 ± 12.07. Also, it was determined the majority of pregnant women (86%) did not have a chronic disease, only 14% had a chronic disease (diabetes, blood pressure, thyroid disease). In addition to these, when regular drug use was examined during pregnancy, 26% of women stated that they used regular medication and 74% did not. On the other hand, 48% of women received zinc supplements (fish pills, zinc preparations) during pregnancy and 52% did not. Also, it has been stated that 85.7% of the pregnant women who participated in the study consumed zinc-rich foods (such as meat, seafood, milk and derivatives, eggs), but 14.3% did not consume zinc-containing foods. Otherwise, it was determined that 8% of pregnant women smoked during their pregnancies and all smokers smoked 3-4 cigarettes a day. Also, it was found that 10% of them smoked during the pre-pregnancy period, 2% of them smoked less than 5 years, and 8% smoked more than 5 years. It was also stated that the majority of pregnant women (98%) did not use alcohol before pregnancy, 2% used alcohol before pregnancy, but none of them preferred to use alcohol during pregnancy (Table 2).

As fertility characteristics; it was determined that 4% had their first pregnancies, 10% second pregnancies, 12% third pregnancies, and 34% fourth pregnancies on the examination of the pregnant women's fertility characteristics. Also, it was determined that 8% of pregnants had an abortion and 92% did not have an abortion on the examination of the pregnant women's presence of abortions. It was stated that 10% miscarried once, 4% miscarried twice and 86% in total miscarried on the determining of pregnant women's miscarriage statuses. On the other hand, it was stated that 2% gave stillbirths once and 98% did not give stillbirth on the determining of pregnant women's stillbirth status. In addition, 68% said yes and 34% no on the determination that whether there were risk factors in the current pregnancy or not. Finally, the mean gestational weeks of women were determined to be 37.86 ± 1.4 (Table 3).

Table 3: Fertility characteristics of pregnant women

Variables		n	%
Number of Pregnancy	1	22	44
	2	17	34
	3	6	12
	4	5	10
Total Pregnancy Number	1	22	44
	2	17	34
	3	6	12
	4	5	10
Total live births	0	27	54
	1	17	34
	2	6	12
Presence of curettage	Yes	4	8
	No	46	92

Presence of abortion	1	5	10
	2	2	4
	No	43	86
Presence of stillbirth	Yes	1	2
	No	49	98
Risk / Risk Factors Related to Your Current Pregnancy	Yes	34	68
	No	16	32
		mean	S.D
Pregnancy week		37,86	1,4
Total		50	100

As risk/risk factors; On the examination of the risk/risk factors in the current pregnancies of the pregnant women who participated in the study, it was found that 23.5% had an advanced maternal age and 76.5% did not and 26.5% had a preterm birth threat and 73.5% had no, on the other side, 2.9% experienced tension and preeclampsia during pregnancies and 97.1% had no problems. Also, they said that none of the pregnant women (100%) experienced a large infant and short pregnancy interval in their current pregnancies. On the other hand, it was stated that 29.4% of pregnant women experienced anaemia in the last three months of their pregnancies and 70.6% did not. However, in women's pregnancies, 2.9% of them were determined to experience polyhydramnios and detachment placenta conditions and the majority (97.1%) did not, in addition, oligohydroamniosis risk factor was found to be in 11.8% in pregnancies and not in 88.2%. Lastly, women were asked whether they had risk factors such as tube baby and pregnancy cholestasis. 2.9% of women answered as yes and 97.1% said no.On the other hand, it was determined that 5.9% had such a problem and 94.1% had no such problem on the evaluation of the nutritional health problem and diabetes during pregnancy (Table 4).

Table 4: Evaluation of pregnant women with risk/risk factors in their current pregnancy

Variables		n	%
Advanced Age Pregnancy	Yes	8	23,5
	No	26	76,5
Premature Threat Status	Yes	9	26,5
	No	25	73,5
High Blood Pressure	Yes	1	2,9
	No	33	97,1
Preeclampsia	Yes	1	2,9
	No	33	97,1
Short Pregnancy Interval	No	34	100
Birth of More Than Four	No	34	100
Large Baby	Yes	2	5,9
	No	32	94,1
Glycosuria	Yes	2	5,9
	No	32	94,1
Anaemia in the Last Three Months of Pregnancy	Yes	10	29,4
	No	24	70,6
Oligohydramnios	Yes	4	11,8
	No	30	88,2
Polyhydramnios	Yes	1	2,9
	No	33	97,1
Early Membrane Rupture	Yes	2	5,9
	No	32	94,1
Placental Detachment	Yes	1	2,9
	No	33	97,1
Test-tube Baby	Yes	1	2,9
	No	33	97,1
Pregnancy Cholestasis	Yes	1	2,9
	No	33	97,1
Health Problem Due to Nutrition	Yes	2	5,9
	No	32	94,1
Total		50	100

3.2. Results of the comparison of zinc levels in cord blood with variables related to socio-demographic, fertility, lifestyle and newborn

Cord blood zinc levels and pregnant women's socio-demographic characteristics, smoking statuses, medical histories, fertility histories, health information about previous pregnancies, nutritional histories, aphtha-wound formations in present pregnancies, the characteristics of newborns are compared in this section.

The mean cord blood zinc level in research was found to be 97.71±19.82 µg/dl in the comparison of the relationship between sociodemographic characteristics and zinc (Table 5). A positively, reasonably and statistically significant relationship was found between age and zinc levels on the examination of the relationship between socio-demographic characteristics and cord blood zinc levels of pregnant women ($rs=0.34$; $p<0.05$). Height, weight, marital status, education level, family income level, place of residence and family type did not have a statistically significant relationship with zinc levels ($p>0.05$). The mean blood zinc levels were also determined to be 99.88±6.72 µg/dl for primary school graduates, 105.29 ±20.68 µg/dl for secondary school graduates, 91.22±10.31 µg/dl for high school graduates, and 1.49±0.7 µg/dl for bachelor's degree/master degree graduates on the examination of pregnant women's blood zinc levels according to the educational status. The difference was not statistically significant ($p>0.05$).The mean zinc level was found to be 114.08±13.34 µg/dl for women whose income is lower than outgoings, 96.39±21.68 µg/dl for women whose income equals to outgoings, and 98.96±13.46 µg/dl for women whose income is higher than outgoings on the evaluation of pregnant women's cord blood zinc levels and family income levels.There was no significant difference between cord blood zinc level and family income ($p>0.05$) (Table 5).

On the other side, blood zinc levels were determined as 96.51 ±22.28 µg/dl for pregnant women living in the city center, 101.18 ±12.71 µg/dl for pregnant women living in the county seat, and 91.16 µg/dl for pregnant women living in the village. There was no statistically significant difference between these groups ($p>0.05$). Consequently, the mean zinc level was determined as 97.59 ±20.19 µg/dl for individuals with the nuclear family and 100.62 ±7.76 µg/dl for individuals with the extended family on the evaluation of the cord zinc level in terms of family type. The difference was not statistically significant ($p>0.05$). The mean cord blood zinc levels were found to be 97.82 ±21.3972 µg/dl for the pregnant women who participated in the study and consumed zinc-rich foods (meat, seafood, milk and derivatives, eggs) during pregnancy and 95.52 ±7.3872 µg/dl for pregnant women who did not consume. There was no statistically significant relationship between the groups ($p>0.05$) (Table 5).

Table 5: Evaluation of socio-demographic characteristics, smoking and feeding habits and cord blood zinc values of pregnant women

		n	Mean ±S.D	Min-Max	Analysis
Zinc Level (Cord Blood) (µg/dl)		50	97,71 ± 19,82	32,66 - 125,47	
Socio-demographic characteristics		n	r*	p	
Age		50	0,34	**0,016**	
Size		50	-0,152	0,293	
Weight		50	0,236	0,098	
		n	**Mean ±S.D**	**SıraOrt.**	
Marital Status	Married	49	97,57 ± 19,99	25,43	Z***=-0,243; p=0,808
	Unmarried	1	104,98	29	
	Divorced /widowed	0	-	-	
Education status	Primary school	2	99,88 ± 6,72	25	H**=4,127; p=0,248
	Middle school	3	105,29 ± 20,68	30,33	
	High school	10	91,22 ± 10,31	17,3	
	University and above	35	98,8 ± 22,19	27,46	
Income	Income lower than expense	2	114,08 ± 13,34	37,5	H=1,425; p=0.49
	Income equivalent to expense	36	96,39 ± 21,68	24,86	
	More than revenue	12	98,96 ± 13,46	25,42	
Permanent Residence	Village	1	91,16	17	H=0,476; p=0,788
	Districh	14	101,18 ± 12,71	26,86	
	County/town	35	96,51 ± 22,28	25,2	
Family type	Nuclear family	48	97,59 ± 20,19	25,44	z=-0,149; p=0,901
	Extended Family	2	100,62 ± 7,76	27	
Smoking (during pregnancy)	Yes	4	105,09 ± 12,72	31	z=-0,787; p=0,431
	No	46	97,07 ± 20,29	25,02	
Zinc-rich food consumption *	Yes	42	97,82 ± 21,39	25,71	z*=-0,857; p=0,391
	No	7	95,52 ± 7,38	20,71	

In the comparison of pregnant women's fertility characteristics and cord blood zinc values; The mean zinc levels were found to be 92.53 ±22.53 µg/dl for the women were first-time pregnant, 104.36 ±16.24 µg/dl for the pregnants gave birth once and 104.36 ±16.24 µg/dl for the pregnant women gave birth twice and more. The difference was not statistically significant (p>0.05). In addition, the mean cord blood zinc value was determined as 100.69 ±10.77 µg/dl for women who had miscarried once, 104.66 ±15.49 µg/dl for women who had miscarried twice, and 97.04 ±20.92 µg/dl for women who had never miscarried. There was no statistically significant relationship between the groups (p>0.05) (Table 6). The mean cord blood zinc value was found to be 107.45 µg/dl for pregnant women with stillbirth history and 97.51 ±19.97 µg/dl for pregnant women without stillbirth history. There was no statistically significant relationship between the groups (p>0.05) (Table 6).

Table 6: Evaluation of Fertility characteristics and cord blood zinc values of pregnant women

		Zinc Level (Cord Blood) (µg/dl)			
Variables		n	Mean ±S.D	Mean rank	Statistical analysis
Number of Births	First pregnancy	27	92,53±22,53	22,22	H**=3,04; p=0,219
	1	17	104,36±16,24	29,82	
	2 and more	6	102,20±6,73	28	
Abortion	No	43	97,04±20,92	25,14	H=0,29; p=0,865
	1	5	100,69±10,77	26,6	
	2	2	104,66±15,49	30,5	
Stillbirth	Yes	1	107,45	35	z***=-0,658; p=0,51
	No	49	97,51±19,97	25,31	
Pregnancy	1	22	89,22±22,98	19,86	H=5,98; p=0,113
	2	17	105,21±15,87	30,65	
	3	6	103,12±13,63	28,67	
	4	5	103,15±8,97	29	
Risk status for your current pregnancy	Risk/Yes	34	98,91±18,09	226,18	z=-0,478; p=0,632
	Risk/No	16	95,18±23,51	24,06	

In the comparison of the information about the newborn with cord blood zinc values; The mean cord blood zinc level in the study was found to be 98.64 ±18.28 µg/L for female infants and 96.98 ±21.25 µg/L for male infants. The difference was not statistically significant (p>0.05). According to the results of the correlation analysis performed for determining the relationship between cord blood zinc levels with baby's weight, height, head circumference, birth week, Apgar values, there was no statistically significant relationship between cord blood zinc level with baby's weight (p = 0.566), height (p = 0.554), head circumference (p = 0.767), week of birth (p = 0.104), 1st minute Apgar score (p = 0.166) and 5th minute Apgar score (p = 0.089) (p>0.05) (Tablo 6). Lastly, the mean cord

blood zinc level was found to be 105.19 ±18.53 µg/l for normal vaginal births and 96.07 ±19.92 µg/l for cesarean births. The difference was not statistically significant (p> 0.05) (Table 7).

Table 7: Evaluation of new-born information and comparison with cord blood zinc values

		Zinc Level (Cord Blood) (µg/dl)			
Variables		n	Mean ±S.D	Mean rank	Statistical analysis
Gender of Baby	Female	22	98,64 ± 18,28	25,82	z**=-0,137; p=0,891
	Male	28	96,98 ± 21,25	25,25	
		n	r*	p	
Baby's Weight		50	0,083	0,566	
Baby's Height		50	-0,086	0,554	
Baby Head Circumference		50	-0,043	0,767	
Apgar Reviews	1.min	50	-0,199	0,166	
	5. min	50	-0,243	0,089	
		n	**Mean ±S.D**	**Mean rank**	
Birth Type	Normal	9	105,19 ± 18,53	30,56	z=-1,149; p=0,251
	Caesarean	41	96,07 ± 19,92	24,39	
		n	**r**	**p**	
Birth Week		50	-0,232	0,104	

4. Discussion

It was determined that zinc played an important role in the healthy development and growth of maternal tissues, fetus, and placenta during pregnancy (Uzdil and Özenoğlu 2015). Addedly, it was found that zinc also played an important role in the transfer of substances from the placenta to the fetus by active transport (Kaya 2014). In addition, if the amount of zinc taken during pregnancy is less than the daily amount required for mother and fetus health (3 mg for a newborn), the situations such as growth retardation, spontaneous abortion, congenital malformations, intrauterine growth retardation (IUGR), low birth weight (LBW), preeclampsia, preterm labor (EDT) and neural tube defects (NTD) may adversely affect the health of pregnancy and fetus. There are studies in the literature showing that such situations occur (Velie et al. 1999, Arcasoy 2002, Karimi et al. 2012, Güneş 2014, Durmuşoğlu et al. 2018). On the other hand, it has been determined that there was a zinc transfer from mother to fetus according to the research results. It has been asserted that the decrease in the amount of zinc in the mother, which started as a result of this transfer, continued until birth (Türkmen et al. 2003, Köroğlu 2007).

In this study, the mean cord blood zinc level was found to be 97.71 ±19.82 µg/dl (Table 5). In the study of Dirik et al. (1986), zinc levels in the cord blood of 20 infants born via the normal vaginal route in Izmir were evaluated. As a result of this evaluation, the mean level was found to be 1.01 ±0.39 mg/L. Çavdar et al. (1991) worked on 12 healthy newborns in Ankara. In this study, the mean serum zinc level was found to be 68.7±10.9 µg/dl and the mean hair zinc level was found to be 193.3±39.2 µg/g. Anal et al. (1995) worked on 10 healthy normal infants in İzmir. According to the evaluation results, the mean serum zinc level was found to be 78.3±15.1 µg/dl. According to the results of all these studies, the findings in this study are in line with the results of the studies performed in the country.

In addition to these studies, there are studies comparing the maternal blood zinc levels and cord blood zinc levels. There is a weak but positive relationship between these two parameters (Genenş et al. 2009).This relation is contradicting with some studies in the literature, while it is consistent with some other studies. According to the studies of Ette and Ibeziako (1985) there was no difference between the mother and the cord blood zinc values. According to the studies of Ong et al. (1993) and Srivastava et al (2002), the cord blood zinc values were lower than maternal blood. In contrast, Okonofua et al. 1990 and Iqbal et al. 2001 found that cord blood zinc value was higher than maternal blood.

In many studies, it is emphasized that zinc alone is not effective and that many possible activities occur in the mother and newborn together with other trace elements. In the study of Turkmen et al. (2003), the relationship between maternal age and birth weight of infants was examined in terms of serum zinc and copper levels in mother and infant blood. As a result of this study, the mean serum zinc levels of the infants (79.5±18.3 µg/dl) were found significantly higher than the mean serum zinc levels of the maternal (64.3±13.5 µg/dl) (p=0.001). However, the mean serum copper levels of the infants (130.6±69.9 µg/dl) were found significantly lower than the mean serum copper levels of the maternal (245.3±83.2 mg/dl) (p<0.001). In addition to this, there was no relation between maternal age and zinc-copper levels of infants.

The mucosal structure and function of the intestine directly or indirectly change due to the mother's smoking. This change affects the absorption of zinc in the intestine and consequently causes a decrease in zinc which may be harmful to the fetus and newborn (Taneli 2005). Contrary to these data, the mean zinc level for smokers was found to be 429.50 ±161.31 µg/dl, and 678 ±334.21 µg/dl for non-smokers in the study of Srivastava et al. (2001). A significant difference was found between these two groups.

It was determined that there was no statistically significant difference in the comparison of cord blood zinc levels in terms of the number of births of pregnant women (p>0.05) (Table 6). The results of this study are different in the literature. According to some researchers, the number of births and the zinc values of maternal blood and cord blood did not change, while some researchers found that the number of births and the zinc values of maternal blood and cord blood changed (Mbofung et al. 1986, Wasowicz et al. 1993,Srivastava and Mehratra 2002, Genenş 2009).

Some researchers have suggested that the high rate of preeclampsia in developing countries in the etiology of preeclampsia might be related to nutrition, and especially trace elements might be important in the etiology of preeclampsia. In the study in which serum zinc, erythrocyte zinc concentration, and leukocyte alkaline phosphatase levels were compared for normal and preeclamptic pregnant women, plasma zinc and leukocyte alkaline phosphate activity scores were found to decrease in preeclamptic

women (Durmuşoğlu vd. 2018). 44 preeclamptic women, 23 eclamptic women, and 27 healthy pregnant women were evaluated in a study performed in 2013 to determine the levels of trace elements in preeclampsia and eclampsia.Serum zinc and copper levels were compared between these groups.Copper and zinc concentrations obtained in the study were found to be higher in eclampsia, and in preeclampsia compared to healthy pregnancies.This condition is thought to be important for eclampsia but not significant in terms of control (Durmuşoğlu 2014).

Some studies of supplementation of zinc have shown that fetal development due to zinc uptake during pregnancy improves the immune system.It has also shown that it reduced the incidence of low-weight birth and pregnancy-induced hypertension (Güneş 2014).

On the examination of pregnant women's blood pressure values who participated in this study, the mean systolic blood pressure value was determined as 113.52±11.31 and the mean diastolic blood pressure was 64.26±7.88. In order to explain the relationship between preeclampsia and cord blood zinc level, more clear and comprehensive research results are needed.

Studies evaluating trace elements in maternal and cord blood in terms of birth weight or anthropometric measurements of newborns are within many researchers' area of interest. Besides, in the study comparing the anthropometric measurements of newborns with cord blood and maternal blood zinc values, a low relation was observed between maternal and cord blood zinc values with head circumference and height of infants. In the study of Taneli et al. (1995), a significant relationship was found between maternal serum zinc and infant cord blood zinc with the birth weight of the infant. In conclusion, this finding is similar to the study of Goldenberg et al. (1995) but contradicts with the study of Rosa et al (1999). In this study, there was no significant relationship between the cord blood zinc level and the baby's weight, height, head circumference, birth week and Apgar values ($p>0.05$) (Table 7).

On the other hand, when the cord blood zinc level was examined in terms of delivery mode, the difference was not statistically significant in our study. This finding is similar to the study conducted by Genenş (2009). Besides, cesarean birthsare predominant in our hospital, reflecting the rate of delivery mode of the hospital, and this situation suggests that it has the disadvantage of being a private hospital.

In conclusion, the presence of zinc in cord blood and its possible effects on the fetus are related to many factors such as the mother's nutritional habit, place of residence, socioeconomic status, education, and personal habits. Studies on mothers' education should be increased in order to comprise of growth-development and neurodevelopmental changes healthier in the longtime effects of zinc levels. We believe this will contribute to the development of healthier generations.

5. Acknowledgement

This study is a part of the project that has been supported by Scientific Research Projects Coordination Unit of Karabük University. Project Number: KBÜ-BAP-TYL-2019-2033 ("Thiswork was supported by Scientific Research Projects Coordination Unit of Karabük University. Project Number: KBÜ-BAP-TYL-2019-2033"). Also, this wok is cofirmed by non-interventional ethics commitee of Karabuk universitry (ethic commitee number: 77192459-050.99-E.29111).

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