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Research article

The Relationship between Maternal Serum Zinc Concentration and the Size of Babies during Six Months after childbirth

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Abstract

Background: Zinc deficiency is a major public health problem in many developing countries including Morocco. However, its prevalence is still unknown in most populations, In Morocco, this is the first time a study evaluate the relationship between maternal serum zinc concentration and the size of the babies in terms of weight and height during six month after childbirth.

Methods: This study included 44 mother-baby pairs, 13 Healthy women with low birth weight baby (LBW) and 31 Healthy women with normal weight baby (NBW) were recruited by a pediatric, in the maternity of the children Hospital in Rabat, Morocco.

Results: Results showed in the first month there was a significant difference in zinc concentration in serum (p=0.013) between mothers with NBW babies and mothers with LBW babies. the correlations showed that there is a positive correlation between maternal serum zinc concentration during 6 months after birth and weight for NBW and LBW babies at 1, 3 and 6 month after birth, successively R2=0.015, R2=0.013 and R2=0.006. Also maternal serum zinc concentration and the height for NBW and LBW babies showed in graphic 1 a significant positive correlation successively R2=0.031, R2=0.025 and 0.010 at 1,3and 6 after birth.

Conclusion: The incidence of low birth weight babies in the mothers with low and normal zinc level were also not significant different during 6 month. Further studies are necessary to confirm the generalizability of our results.

Key words: Maternal zinc serum, LBW baby, weight and height.

Introduction

Zinc is an essential trace element with a key role in numerous basic cellular functions in humans. It is crucial to the normal function of the immune system (1) and is involved in DNA synthesis, cellular division, proliferation, and growth (2). Zinc is also required during pregnancy for optimal growth and development of the foetus and for maternal tissue expansion (3). Poor maternal zinc status has been associated with negative pregnancy outcomes (4,5), including spontaneous abortion, congenital malformation, low birth weight, and preterm delivery (6,7). A third of the world population lives in very exposed countries with the zinc deficiency (8); the most vulnerable groups are babies, the young children, the pregnant women and nursing, because of their needs high for this nutriment essential (9). However, there are few such in low-birth-weight infants (10,7). Very few investigations were carried out with an aim of directly determining the extent of the zinc deficiency. In Morocco, there is no data on the prevalence of the zinc deficiencies. To evaluate zinc status of a population, the only biochemical indicator recommended by WHO/UNICEF/ IAEA/IZiNCG is measurement of serum or plasma zinc concentration (11). Zinc status has been reported in small-for-date infants (12,13). In Morocco for 1,289 births, 10.3% have a LBW <2500g and 11% are premature (14). Our objective is to provide longitudinal data on zinc in serum in Moroccan breastfeeding mothers and we were interested in assessing the relationship between maternal serum zinc concentration and the size of the baby in terms of weight and height during 6 month, this is the first study in Morocco.

Type of study

Longitudinal study which was carried out, with a follow-up of the same couples mother-baby, in 1st, 3rd and 6th month after childbirth.

Subjects and study design

This study fits within the framework of the activities of “alliance international Zinc”. Including seven countries, one of them is Morocco, and controlled by the International Atomic Energy Agency (A.I.E.A-Vienna). After the purpose of the study was explained, mothers gave informed consent. 13 Healthy women with LBW (<2500 g) and 31 Healthy women with NBW (>2500 g) baby were recruited by a pediatric, in the maternity of the children Hospital in Rabat, Morocco, with a condition that mothers should breastfeed babies until 6 months. They had similar socioeconomic without a history of serious disease. They delivered a healthy full-term infant. Mother-baby

pairs visited the maternity 1 month after delivery, used a questionnaire we collected the data which enables to identify the pairs mother-baby; Weight and height of mother's and infants were measured, also we collect blood from mothers. Again we repeat these entire steps in 3 and 6 month after childbirth.

Materials and Methods

Anthropometric measurements

The length of the child was measured to the nearest ± 0.1 cm using a calibrated mobile baby measuring mat (Seca 210). The child was weighed to the nearest ± 0.01 kg using a paediatric scale (Seca 745). The body weight of the mothers was measured to the nearest ± 0.1 kg using a floor scale (Seca 761). The mothers' height was measured to the nearest ± 0.1 cm using a wall mounted measuring tape (Seca 206). These measurements were taken after childbirth in 1, 3 and 6 months postpartum. Body Mass Index (BMI, kg/m2) of the mothers was calculated at each time point.

Determination of serum in zinc

Serum samples, transport and storage

Samples of blood are taken among nursing women before breakfast. For each participating woman being studied, two tubes (All specimen tubes are zinc-free) of 4 ml filled with blood were taken at 1st, 3rd and 6th month after childbirth. The samples are placed in a kept refrigerator with approximately -4°C and are transported to the laboratory. Blood is centrifuged 30trs/5 min. using a micropipette; serum is recovered in coded tubes eppendorf then stored with the freezer with -20°C until the moment of the analysis. This preparation must be carried out within 30 minute and we used acid-washed Pasteur pipettes provided to decant serum and transfer to trace-metal-free eppendorf tubes.

Determination the serum zinc concentration

1- The samples preparation:

a. Thaw and vortex serum samples.
b. Place 200 µl of serum into an Eppendorf.
c. Add 800 µl distilled H20 (room temp) to sample.
d. Record samples on analysis line-up sheet.
e. Always include serum pool and/or ortho-normal control prepared as above in assay.

2- Then one prepares a calibration curve:

a. Auto zero with 5% glycerol
b. 75 as Standard 1 (15 µg.dl Std)
c. 100 as Standard 2 (20 µg/dl Std)
d. 150 as Standard 3 (30 µg/dl Std)
e. Concentration will vary, we adjust standard calibration accordingly.

Standards must be run both prior to and immediately following samples. After each 5 samples, check for possible machine drift by measuring zero standard and auto zero, if necessary.

Analyzes

The serum zinc content is determined by the technique of analyses per atomic emission: Inductively coupled plasma mass spectrometry «ICP-MS», after Quality control process for zinc analysis by in expert for University of Chalmers (Sweden).

Statistical Analyze

Data were analyzed using the SPSS software for Windows (version 20.0). ANOVA, for the comparisons of serum zinc concentration at the 3 different time points. MedCalc 11.5.1. Software. Independent two sample t-tests were used assess the significance of the difference between means. Significance ($p < 0.05$) was determined at the ninety five per cent confidence level.

Result

Anthropometric characteristics for mothers and babies at one, three, and six months postpartum

There was no significant change in BMI for mothers with NBW babies and mothers with LBW babies during the six months of the study (Table 1). Based in questionnaire collect, the level of education is very poor: from 44 women, 14 who have an educational level, 3 of them paired with LBW babies. Only 12 women who work 2 of them paired with LBW babies. In table 2, babies' anthropometric data showed normal growth during the six months after birth. The comparison of babies' weight shows that there is no significant difference between the two groups of babies, also LBW babies recovered normal weight quickly from the first month.

Zinc concentration (mg/l) in serum for mothers with NBW and LBW babies

Zinc concentration (mg/l) in serum for mothers are presented in Table 3, in the first month there was a significant positive difference in zinc concentration in serum ($p=0.013$) between mothers with NBW babies (0.70±0.30mg/l) and mothers with LBW babies (0.47±0.15), however, there was no significant difference between the two groups in 3 and 6 month after birth.

For mothers with NBW babies the zinc concentration in serum was 0.70±0.30mg/l, 0.64±0.29mg/l and 0.48±0.13mg/l successively in 1, 3 and 6 month after birth, p-value showed a significant positive difference between the zinc concentration in serum in the 1 and 6 month ($p=0.001$) and between 3 and 6 month after birth ($p=0.000$). Regarding the mothers with LBW babies the zinc concentration in serum was 0.47±0.15mg/l, 0.54±0.15mg/l and 0.45±0.08mg/l successively in 1, 3 and 6 month after birth, p-value showed a significant positive difference between the zinc concentration in serum between 3 and 6 month after birth ($p=0.046$).

Correlations coefficients for maternal serum zinc concentration and babies' (Height and weight) size

The correlation coefficient for maternal serum zinc concentration and NBW babies size (weight and height) was between r=0.00 and r=0.50 (Table 4) therefore, there is a significantly positive correlation between maternal serum zinc concentration in the 1 month and weight for LBW babies (r=0.665) at 3 month after birth also between maternal serum zinc concentration in the 3 month and the height for LBW babies (r=-0.624) at 6 month after birth. For more details the graphically presentation is necessary (graphic 1), the correlations showed that there is a positive correlation between maternal serum zinc concentration during 6 months after birth and weight for NBW and LBW babies at 1, 3 and 6 month after birth, successively R2=0.015, R2=0.013 and R2=0.006. Also maternal serum zinc concentration and the height for NBW and LBW babies showed in graphic 1 a significant positive correlation successively R2=0.031, R2=0.025 and 0.010 at 1,3and 6 after birth.

Discussion

Breast milk is the only source of zinc for babies in the first 6 months (15) that mean that mothers must be in a good health and must be eat adequately the give the zinc necessary to her babies, unfortunately the mothers BMI showed that there was no significant change for mothers with NBW babies and mothers with LBW babies during the six months of the study. The importance of zinc for babies, the young children, the pregnant women and nursing, is well documented (3,4,5,9). In Our study the results showed that zinc level decreased with increasing babies age, zinc concentrations in the serum of mothers who delivered LBW and NBW babies are slightly low relative to other studies (16,17,18) and there is a significant difference in serum zinc concentration between mothers with LBW and mothers with NBW babies in the first month (p=0.013). This finding is also consistent with author studies (19,20,21). Although serum zinc concentration is commonly used as an indicator of zinc status, interpretation of the measurement is difficult because serum zinc concentration decreased with infection, vigorous exercise, and food intake (21). Many studies showed that, when mothers receive zinc supplementation during pregnancy, zinc concentration in the blood plays a role in determining the birth weight of term and preterm infants, but birth weight depends on many factors such as gender of the neonate, maternal age, race, BMI, maternal weight gain during gestation, and smoking. Multiple regression analyses should be performed to control for all of these variables before blaming zinc deficiency for the presence of LBW (20,21,22).

In the present study, there is a positive correlation between maternal serum zinc concentration during 6 months after birth and weight for NBW and LBW babies at 1, 3 and 6 month after birth, successively R2=0.015, R2=0.013 and R2=0.006. Also maternal serum zinc concentration and the height for NBW and LBW babies showed in graphic 1 a significant positive correlation successively R2=0.031, R2=0.025 and 0.010 at 1,3and 6 after birth.

To our knowledge, no study has demonstrated an association between serum Zinc concentration and birth weight. However, Khadam et al. and Widagdoa et all. reported that a maternal Zinc concentration was negatively associated with birth weight (20,21). Clearly, further studies are necessary to examine the effects, of this trace element on birth weight and height of babies during 6 month.

Conclusion

Zinc concentrations in the serum of mothers who delivered LBW and NBW babies are slightly low. There is a significantly positive correlation between maternal serum zinc concentration and weight and height for LBW and NBW babies during 6 month after birth. The further study in the broader scope could be suggested to find the definitive and valuable result to share in improving of the perinatal life.

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Table 1: Maternal (Mothers with NBW babies and mothers with LBW babies) anthropometric characteristics at one, three, and six months postpartum (n=44)

	All mothers (n=44)	Mothers with NBW babies(n=31)	Mothers with LBW babies(n=13)	p-value
Age (year)	27.27±6.16	27.97±5.93	25.62±6.61	0.252
Length (m)	1.58±0.05	1.58±0.05	1.57±0.05	0.469
Weight (Kg)				
1 month	65.57±11.01	65.29±11.21	66.23±10.93	0.799
3 month	62.64±10.79	62.19±10.75	63.69±11.24	0.679
6 month	63.16±9.02	63.54±7.89	63.54±7.89	0.859
BMI (Kg/m²)				
1 month	26.35±4.22	26.82±3.36	26.16±4.49	0.641
3 month	25.17±4.13	25.80±4.00	24.90±4.22	0.518
6 month	25.40±3.56	25.77±2.63	25.25±3.91	0.661
Level of education				
None	30	20	10	
Primary	9	7	2	
Secondary	5	4	1	
Work	12	10	2	

Table 2: Babies (Babies with NBW and babies with LBW) anthropometric characteristics by age (n=44)

	All Infant (n=44)	Babies with NBW (n=31)	Babies with LBW (n=13)	p-value
Weight (kg)				
1 month	3.86±0.51	3.97±0.38	3.60±0.70	0.090
3 month	5.89±0.79	5.95±0.65	5.74±1.08	0.532
6 month	7.70±1.03	7.86±0.78	7.34±1.45	0.131
Height (cm)				
1 month	51.43±2.62	51.81±2.54	50.54±2.70	0.145
3 month	59.74±2.37	60.00±2.13	59.12±2.87	0.264
6 month	67.73±6.18	68.00±5.41	67.08±7.93	0.656
Sex ratio (Male / Female)	13/31	10/21	3/10	

Table 3: Zinc concentration (mg/l) in serum for mothers with NBW and LBW babies (n=44)

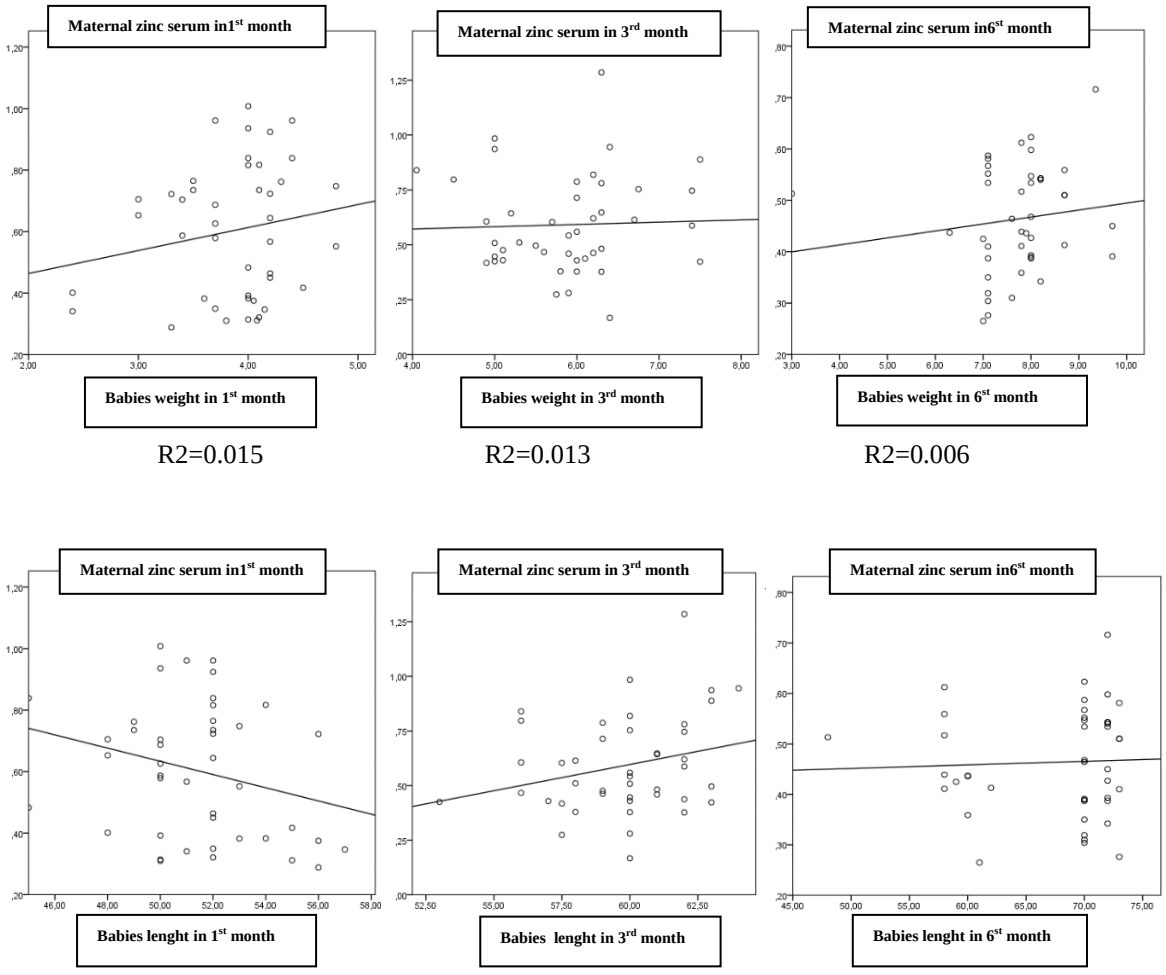
Zinc concentration in serum (mg/l)	All mothers (n=44)	Mothers with NBW babies(n=31)	Mothers with LBW babies(n=13)	P-value
1 month	0.63±0.28	0.70±0.30	0.47±0.15	0.013*
3 month	0.61±0.26	0.64±0.29	0.54±0.15	0.220
6 month	0.47±0.12	0.48±0.13	0.45±0.08	0.402
P-value	(1-3): 0.701 (1-6): 0.001* (3-6): 0.000*	(1-3): 0.410 (1-6): 0.000* (3-6): 0.002*	(1-3): 0.211 (1-6): 0.672 (3-6): 0.046*	

*significantly different ($p < 0.05$)

Table 4: Correlations coefficients for maternal serum zinc Concentration and babies' (Height and weight) size

Groups	Babies Size		Maternal zinc concentration in serum (mg/l)		
		Months	1	3	6
NBW (n=31)	Weight (Kg)	1	-0.088	0.051	-0.358
		3	-0.115	0.265	-0.027
		6	0.233	-0.012	0.155
	Height (cm)	1	-0.319	-0.207	-0.146
		3	0.477	0.277	0.005
		6	0.405	0.198	0.225
LBW (n=13)	Weight (Kg)	1	0.242	-0.243	-0.303
		3	0.665*	-0.337	-0.131
		6	-0.325	-0.365	-0.148
	Height (cm)	1	-0.204	-0.434	-0.010
		3	0.455	-0.334	0.068
		6	-0.292	-0.624*	-0.145

*significantly correlation



Graphic 1 : Correlations coefficients for maternal serum zinc concentration and babies' (Height and weight) size