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MATERNAL BIOMINERAL STATUS AND NEWBORN DATA

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Abstract. The study aimed to investigate some bioelement levels of pregnant women as well as the relationship of these levels with the newborn data. The studied group consisted of 211 fullterm pregnant women who were hospitalized for delivery in "Cuza –Vodă" Maternity from Iaşi city. Calcium, magnesium, iron and zinc levels were measured. The recorded data of newborns were: duration of gestation, sex, length, weight, 5 min Apgar score and head circumference. Low levels of zinc and magnesium have been found in pregnant women. Mean newborn parameters were in normal range. Serum and erythrocyte zinc and magnesium showed positive correlations with newborn length and weight and erythrocyte magnesium showed negative correlations with duration of gestation and positive correlation with head circumference. Our study draws the attention to the necessity of improvement, by nutrition or therapy, of these especial important maternal bioelements focusing on the highly vulnerable foetus.
Key words: pregnancy, iron, zinc, calcium, magnesium, newborn data

Rezumat. Studiul a avut drept scop investigarea nivelelor unor bioelemente la femeia însărcinată şi a relației dintre aceste nivele şi datele nou-născutului. Grupul studiat a cuprins 211 femei gravide la termen, internate în vederea naşterii la Maternitatea "Cuza-Vodă" din Iaşi. S-au determinat nivelurile de calciu, magneziu, fer şi zinc din ser. După naştere au fost înregistrate datele nou-născutului: durata gestației, sexul, talia, greutatea, scorul Apgar la 5 minute şi circumferința capului. Femeile gravide investigate au avut niveluri medii de zinc şi magneziu sub limita normală. Parametrii medii ai nou-născuților au fost în domeniul normal. Zincul seric şi eritrocitar s-au corelat pozitiv cu lungimea şi greutatea nou-născutului iar magneziul eritrocitar s-a corelat negativ cu perioada de gestație şi pozitiv cu circumferința capului nou-născutului. Studiul nostru atrage atenția asupra necesității îmbunătățirii prin nutriție sau terapie a nivelelor materne de biominerale ce sunt reflectate în primul rând de sănătatea fătului extrem de vulnerabil.
Cuvinte cheie: sarcină, fer, zinc, calciu, magneziu, parametrii nou-născutului

INTRODUCTION

Mineral status of the women is affected by pregnancy like as biochemical or hematological parameters. Numerous studies emphasized deficits of calcium, iron, magnesium and zinc in pregnant women.

Iron is constituent of haemoglobin, myoglobin and a number of enzymes. The requirement for iron is greatest when there is expansion of tissues and red cell mass such as pregnancy. The recommended daily allowance for iron doubles during pregnancy and assumes a mixed diet (animal and vegetable sources of iron).

Low dietary iron is associated with increased premature delivery rates and decreased birth weight (1).

Zinc is a vital component of enzymes involved in most major metabolic pathways. The recommended daily allowance for zinc during pregnancy is of 25 percent over the nonpregnant value. Zinc may influence pregnant women, foetus and newborn health. It is suggested that in pregnancy there is a zinc deficiency syndrome including increased maternal morbidity, taste dysfunctions, abnormally short or prolonged gestation, inefficient labor, atonic bleeding and increased risks for foetus: intrauterine growth delay, prematurity, postmaturity, malformations, perinatal death (2).

Calcium requirements during pregnancy increase by 50 percent over nonpregnant levels. It is essential for the process of skeletal formation and maintenance, as well as a factor in nerve conduction, muscle contraction, blood clotting and membrane permeability. Calcium accretion during pregnancy totals approximately 30 mg, mostly in the foetal skeleton and deposited during the last trimester. Although calcium absorption increases and excretion decreases, additional dietary requirements are still needed to meet the demands of pregnancy. Calcium deficient diets during gestation are associated with decreased bone density in the newborn infant (1).

Magnesium is essential for all biosynthetic processes, glycolysis, formation of cyclic adenosine monophosphate and energy-dependent membrane transport. During pregnancy the recommended daily allowance increases with about 14 percent. Precarious status of this element is associated in newborn with a neuro-muscle syndrome (3), prematurity and mortality (4).

The study aimed to investigate iron, zinc, calcium and magnesium levels of a pregnant women and the relationship of these levels with newborn data.

SUBJECTS AND METHODS

The characteristic of pregnant women and the newborn data were shown elsewhere (5). There were determined serum levels of iron by Ferrene method (package NobiFlow Eisen-FS, Nobis, Labordiagnostica GmbH), serum magnesium by colourimetric method with xylidyl blue (6) and serum calcium by photometric dosing in the flame emission (7). Serum and erythrocyte zinc levels were assessed by flame atomic absorption spectrophotometry after adequate dilution with 0.1 N HCl and bidistilated H_2O respectively. This method has been used too for erythrocyte magnesium levels assessment (8). The deficit frequencies were calculated and, in order to appreciate the proportion of marginal deficits, we diminished the lower limits with 10 %. Statistical processing of the data was performed as we already showed (5).

RESULTS

Of the investigated biominerals, serum zinc, serum magnesium and erythrocyte magnesium had mean values under normal cut-off points and close of them (Table 1).

Table 2 shows the proportion of marginal deficits and severe deficits.

Table 1 . Blood elements

Element	No of subject	Mean values (95% CI)	Normal values Range
Serum iron (µmol/L)	201	12.7 (12.1 – 13.3)	8.8 – 27.0*
Serum zinc (µmol/L)	202	8.4 (8.2 – 8.6)	8.5 – 18.5 (9)
Erythrocyte zinc (µmol/L)	206	181.7 (178.6 – 184.8)	154.0–215.6 (10)
Serum magnesium (mmol/L)	204	0.76 (0.75 – 0.77)	0.78 – 1.07 (6)
Erythrocyte magnesium (mmol/L)	185	1.84 (1.37 – 2.37)	1.97 – 2.66 (8)
Serum calcium (mmol/L)	203	2.31 (2.29 – 2.33)	2.25 – 2.75 (7)

* by Ferrene method (package NobiFlow Eisen-FS, Nobis, Labordiagnostica GmbH)

Table 2. Deficit frequencies of blood elements

Element	Marginal deficiency (%)	Severe deficiency (%)
Serum iron (µmol / L)	8.0 ÷ 8.8 (7.6)	<8.0 (12.4)
Serum zinc (µmol / L)	7.6 ÷ 8.5 (29.7)	<7.6 (25.7)
Erythrocyte zinc (µmol / L)	138.6 ÷ 154.0 (12.7)	<138.6 (1.9)
Serum magnesium (mmol / L)	0.70 ÷ 0.78 (43.7)	<0.70 (12.7)
Erythrocyte magnesium (mmol/L)	1.76 ÷ 1.97 (33.5)	<1.76 (36.2)
Serum calcium (mmol / L)	2.02 ÷ 2.25 (21.7)	<2.02 (4.4)

The newborns mean anthropometric indicators which were in normal range have been published (5).

Among the assessed parameters of pregnant women, the following ones were correlated significantly with the newborn data (Table 3) :

- serum zinc positively correlated with length ($p<0.005$) and weight ($p<0.001$),
- erythrocyte zinc positively correlated with length ($p<0.05$) and weight ($p<0.05$),
- erythrocite magnesium positively correlated with head circumference ($p<0.05$) and negatively with gestational age ($p<0.05$).

We mention that the number of freedom degrees of correlations of any investigated parameters was lower than 211 because of the missing values.

Table 3. Correlations between maternal biominerals and newborn data (r)

Maternal parameters	Newborn parameters				
	Duration of gestation	Lenght	Weight	Apgar score	Head circumference
Serum iron	+0.06 (201)	+0.12 (201)	-0.05 (201)	+0.02 (196)	+0.10 (201)
Serum zinc	+0.07 (202)	**+0.21 (202)**[b]	**+0.23 (202)**[c]	+0.05 (197)	+0.13 (202)
Erythrocyte zinc	+0.06 (206)	**+0.16 (206)**[a]	**+0.14 (206)**[a]	-0.04 (201)	0.10 (206)
Serum magnesium	-0.03 (204)	-0.05 (204)	-0.08 (204)	+0.07 (200)	-0.11 (204)
Eryth. magnesium	**-0.16 (185)**[a]	+0.10 (185)	-0.01 (185)	+0.05 (182)	**+0.17 (185)**[a]
Serum calcium	-0.07 (203)	-0.13 (203)	-0.04 (203)	-0.14 (198)	-0.06 (203)

( ): No of subjects ; Significance levels : a= $p<0.05$; b=$p<0.005$; c= $p<0,001$

DISCUSSION

Mean serum iron and calcium values (Table 1) were in normal range the calcium one being very close to the lower limit.

While the erythrocyte zinc (more stable) was in normal range, the serum one (easily influenced by factors such nutrition, stress, physical activity, etc.) was under the lower normal limit but very close to it. So, the most serum zinc values were marginal.

Low zinc status of pregnant women could be explained by a reduced intake of food with a high easily bioavailable zinc (red meat, organs, eggs) and enhanced intake of vegetable food (especially cereals) which brakes zinc absorption. Otherwise, experimental studies found that marginal deficiency of dietary zinc can produce serious immunohaematological dysfunctions during pregnancy (11). Other conditions that may alter maternal zinc concentrations include smoking, alcohol abuse, acute stress (12).

About mean magnesium level, both the erythrocyte and serum ones were under the normal limits and close by them. Low magnesium levels could be due to a reduced intake of green, leafy vegetables and a increased intake of high-purified products.

Table 2 shows that excepting serum iron and erythrocyte magnesium, the most deficits were marginal.

Mean serum iron was in normal range, deficit frequency was low and was no correlation with newborn data (Table 3). This happened probably because the pregnant women were at term and apparently healthy. Otherwise, the literature indicates that iron deficiency in pregnancy is a risk factor for preterm delivery, subsequent low birthweight and possibly for inferior neonatale health (13).

As we showed, serum and erythrocyte zinc level positively correlated with length and weight of the newborn that prove the importance of the trace element in pregnancy and in foetal development. This occurred because zinc has a complex role in reproduction: it is involved in expression of certain genes, in nucleic acid and protein synthesis, in bone metabolism, in the growth hormone activity beginning in foetal stage (14). This trace element has also a role in oestrogen and progestative hormone and in prostaglandines metabolism (15). Our results are in concordance with the conclusions of many other authors, like Bahl & al. (11) and Kirksey & al.(12) who found that serum zinc level positively correlated with birth weight of newborn. This relationship was confirmed by the benefic effect of zinc supplementation during pregnancy on birth weight and head circumference (18).

Positive correlation of erythrocyte magnesium with head circumference is in agreement with the conclusions of Doyle & al. (19) who found, that maternal magnesium intake positively correlated with birth weight, head circumference, length and duration of gestation. We found negative correlation of erythrocyte magnesium level with duration of gestation; it may be due to the diminish of the erythrocyte magnesium level, a storage form of element, according as pregnancy advancement. As literature shows, pregnancy leads to magnesium depletion because of increased need and renal losses (20). Hence, magnesium intake will be largely decisive in determining whether or not a magnesium deficit develops. We found less correlations probably because of the smaller number of subjects. Our study draws the attention to the improvement, by nutrition and other means, of some especial important parameters (zinc and magnesium) focusing on the highly vulnerable foetus as a prime indicator of maternal nutritional status.

CONCLUSIONS

Some biomineral levels of maternal blood were positively correlated with anthropometric newborn characteristics:

- serum and erythrocyte zinc positively correlated with length and weight,
- erythrocyte magnesium positively correlated with head circumferences and negatively with gestational age.

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