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REGULAR ARTICLE

CALCIUM AND MAGNESIUM CONCENTRATION OF BREAST MILK IN RELATION WITH AGE AND PARITY OF NURSING WOMEN

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ABSTRACT

The aim of this study was determination of the concentration of calcium and magnesium in human milk (n=150) taken from nursing women who lived permanently in Malopolska district (South Poland). Milk samples were classified into groups taking into account women' age and parity. According to the various age of the women milk samples were segregated into three groups: 20-25 years old, 26-31 years old and 32-37 years old. Included parity milk samples were spitted into two groups: the first group consisted of women who were primiparous (1 baby), the second group included women who were multiparous (≥2 babies). Milk samples were taken between the 7th and 14th day of the postpartum in each age group. The samples were taken by manual expression every morning. The analyses of metals were done by flame atomic absorption spectrophotometry (FAAS), after all samples had been collected. The mean concentration of cooper in milk taken from women of first age group (20-25 years old) was 209.44±15.10 mg/L, in second group (26-31 years old) was 238.65±13.34 mg/L and in the oldest group (32-37 years old) was 261.44±17.16 mg/L. The mean concentration of magnesium in the same group of age was 42.12±3.793 mg/L, 47.51±2.728 mg/L and 45.43±3.840 mg/L, respectively. The mean concentration of calcium in milk taken from primiparous was 223.17±10.50mg/L, in multiparous was 266.37±16.20 mg/L. Whereas, the mean concentration of magnesium in transitional milk taken from the same group was 44.12±2.58 mg/L and 47.412±3.16 mg/L, respectively. Statistical analyses

showed that there were statistically significant differences between calcium level in milk taken from the youngest group and the concentration of this metal in milk from the oldest group (p=0.032). Also, when comparing women's parity, significant differences were found in the concentration of calcium (p=0.022). However, the differences in magnesium levels between tested groups were no statistically significant. Additionally, r Pearson correlation coefficient showed positive correlation between analyzed metals (Mg/Ca: r^2=0.589; p=0.000). These observations suggest that mothers' age and parity have influence on calcium concentration in milk but did not impact on magnesium level in breast milk.

Keywords: breast milk, calcium, magnesium

INTRODUCTION

The nutritional benefits of exclusive breast feeding for growth and protection of infants ale well recognized. Human breast milk provides all of the vitamins and essential minerals and trace elements that are required by the infant, until wearing. Calcium and magnesium are the most abundant cations in the human body after sodium and potassium and most of them are deposited in bone. The adult skeleton stores about 99% of the total body calcium and almost 65% of the total body magnesium **(Civitelli *et al*., 1994).** During lactation, bone is mobilized and exerts influence on the availability of those macroelements to the mineral poll that supply the mammary gland. Due to an increase in bone turnover, the concentration of these metals elevated in serum, additionally less urinary Ca and Mg is excreted **(Klein *et al*., 1995)**. Possible shifts in internal pools of calcium, magnesium, and/or contributions from bone resorption during lactation are of particular interest because diets of lactating women are likely to fall short of the recommended dietary allowance (RDA) for these minerals (7).

Daily dietary calcium and magnesium intakes have been recommended in order to maintain an adequate Ca and Mg status, and the American Recommended Dietary Allowances (RDA) for infants, 0-0.5 years old is 360 mg for calcium and 50mg for magnesium **(WHO/IAEA, 1989).**

Human breast milk composition is dependent on many maternal and gestational factors such as stage of lactation, maternal age, nutritional status, diet, parity and gestational age **(Lawrence, 1985; Dorea, 1999; Dorea, 2000, Kinsara *et al*., 2006).** Longitudinal

changes in the nutrient composition of human milk during the course of lactation have been well documented **(Honda *et al*., 2003; Hunt *et al*., 2005; Yamawaki *et al*., 2005)**, but less is known about changes that may occur in milk samples descendent from women at different age and number of pregnancy.

The primary purpose of this study was to determine calcium and magnesium concentration in transitional milk samples taken from women live in south Poland. The secondary goal was to assess the potential effect of women's age and parity on Ca and Mg level in milk.

MATERIAL AND METHODS

Milk samples were taken from 150 healthy women from malopolska district in Poland who had given birth in two hospitals in Cracow. All mothers had been informed about the aim of the study and gave their permission for collecting milk. Milk samples were taken between the 7^{th} and 14^{th} day of lactation (transitional milk). The samples of transitional milk were divided into groups taking into account women' age and parity. According to the various age of the women milk samples were segregated into three groups: 20-25 years, 26-31 years and 32-37 years. Included parity milk samples were spitted into two groups: the first group consisted of women who were primiparous (1 baby), the second group included women who were multiparous (≥2 babies).

Milk samples were collected into 5 ml sterile polypropylene containers by manual expression, always in the morning hours between 9.00 am and 10.00 am. Samples were frozen at -20°C, and analyses were done after all samples had been collected. Concentrations of calcium and magnesium in milk samples was assayed by flame atomic absorption spectrophotometry (FAAS). The aliquots of milk (1 mL) were placed in a separate mineralization tubes, mixed with 2 mL of HNO_3-$HClO_4$ (4:1) and heating at 120°C for 240 minutes in a thermostat-controlled digestion block. After cooling the samples were filled to the volume of 5 mL with demineralized water. The concentrations of metals were expressed in miligrams per one liter of the milk.

Statistical analysis was performed using t-test. Correlation coefficients, between calcium and magnesium were calculated by r Pearson correlation test.

RESULTS AND DISCUSSION

In our study 150 milk samples were analyzed for the Ca and Mg concentration. The average concentration and standard error of nutritional elements in transitional milk taken from women from different age groups are presented in the Figures 1-2. The lowest levels of calcium and magnesium were observed in milk samples taken from the youngest group of women (20-25 years old). Whereas, the highest level of calcium was detected in transitional milk taken from the oldest group 932-35 years old) instead magnesium concentration in milk from women between 25-31 years old.

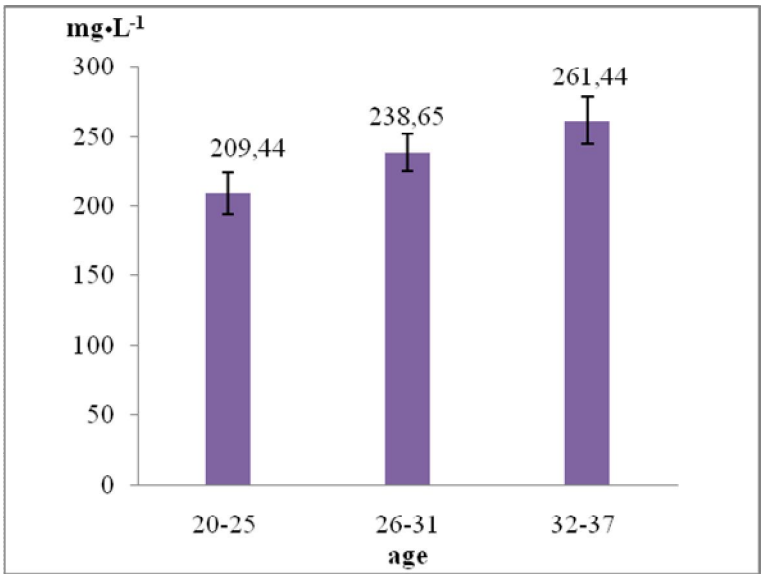

Figure 1 Mean concentration of Ca in transitonal milk from different age groups.

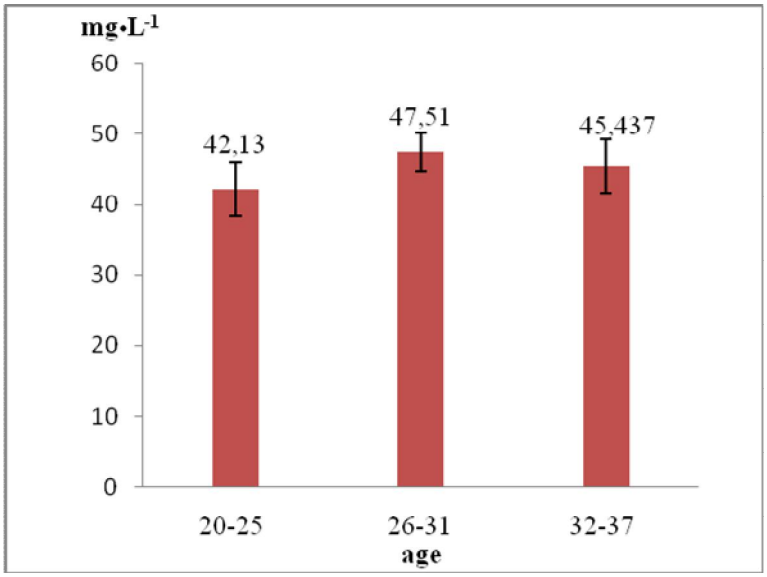

Figure 2 Mean concentration of Mg in transitonal milk from different age groups.

Statistical analyses showed that women's age was significant factor affecting Ca concentration in human milk. The mean concentration of Ca in milk form the youngest group of age was considerable lower than the mean level of this metal in milk from the oldest group of age (t=-2.170, p=0.032). The concentration of Mg in transitional milk slightly changed in relation with age, but the differences were statically insignificant.

The mean and standard error of calcium and magnesium concentration in transitional milk in relation with parity are presented in Figure 3. Transitional milk taken from primiparous characterized lower concentration of analyzed metals than milk from multiparous.

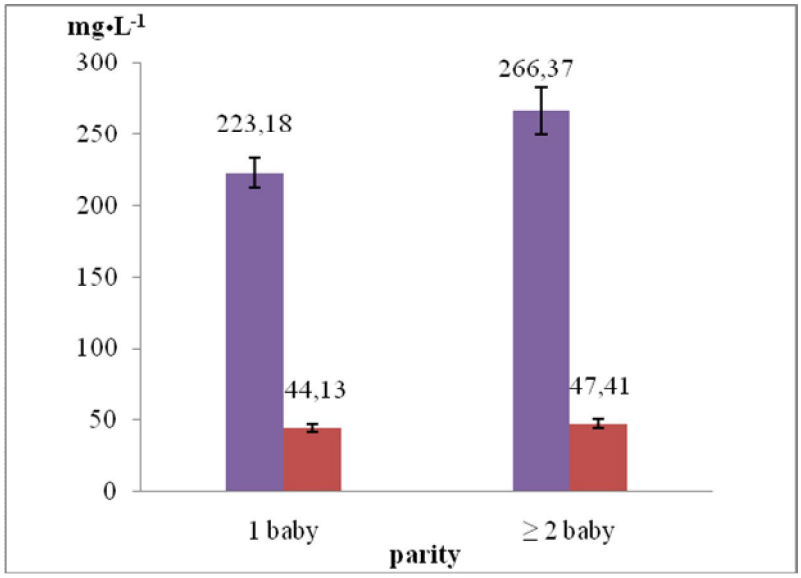

Figure 3 Mean concentration of Ca and Mg in transitonal milk in relation with parity

When comparing women's parity, significant differences were found in the concentration of calcium (t=-2.304, p=0.022). However, the differences in magnesium levels between primiparous and multiparous were no statistically significant. Additionally, r Pearson correlation coefficient showed significant correlation between Ca vs Mg in transitional milk (Mg/Ca: r^2=0.589; p=0.000).

The purpose of the present analysis was to quantify calcium and magnesium concentration in transitional milk from healthy Polish women. Obtain results were generally in agreement with the results of another investigations reported in the past **(Feeley *et al.*, 1983; Tanzer *et al.*, 1999).**

Our data indicate that the concentration of milk calcium varied according to the women's age; level of this metal in breast milk from older women (32-37 years old) was higher than in breast milk from the youngest (20-25 years old). Some authors like Piotrowska-**Depta *et al.* (2007)** who analyzed breast milk from women lived in northern Poland (Podlasie) did not confirmed our results. They suggested that calcium level in milk is independent of women' and its level depended only on supplies and diet. However, **Vitolo *et al.* (2004)** suggested that calcium concentration was much lower in milk from young women from poor families that in breast milk from older women without regard for their material status, thereby without regard for their diet. Similarly **Stawarz *et al.* (2007)** in their study on breast milk from Polish women observed increasing concentration of calcium in milk from older women in relation with younger. Our results are confirmation of previous data presented by **Lipsman *et al.* (1985)** who also noted that young women (under 20 years old) had lower level of this element in comparison with older women (between 20-36 years old). Results of this author concerned also concentration of magnesium in breast milk. Compared to the magnesium content of milk samples from adult women, milk of teenage mothers was significantly lower in this metal. In our study as well as in study presented by **Vitolo *et al.* (2004)** concentration of magnesium in milk did not show significant differences between samples from young and old women. The mechanisms that control nutrient level in the mammary gland are not known. Most of authors suggest that organisms of young women show higher need on calcium due to growth of bones and mineral changes in skeleton. Together with ageing of organism follows gradual loss of calcium from bones, above 30 years old mechanisms bone loss dominate above bone creation. Together with ageing accrues level of parathormone, which increases release of calcium from bones. It is proved that during lactation calcium is dredged from bones what is apparent in lower bone density of lactating women **(Sower, 1993)**. It is possible that observed higher level of calcium in breast milk from older women is caused by changes in skeleton.

There are very few data focus on influence of parity on Ca and Mg level in breast milk because the main factors point by some authors are period of lactation **(Allen *et al.*, 1991; Yamawaki *et al.*, 2005)**. However, the influences of number of pregnancies on these elements concentration in breast milk are controversial. In these study breast milk samples from primiparous women characterized lower calcium concentration in comparison to concentration of this metal in breast milk samples from multiparous women. Our results are in opposite to those found in another studies **(Feleey *et al.*, 1983; Laskey *et al.*, 1990)**. They observed no significant relationship between parity and the calcium concentration in

transitional and mature milk. This observations are indirectly accordance with data presented by **Karlsson *et al.* (2001)** analysed the influence of lactation on bone mineral density (BMD) and they observed that lactation was not correlated with the BMD, women with four pregnancies or more had a BMD no lower than women with two pregnancies or fewer. Additionally, we observed that the concentration of magnesium did not change in relation with parity. Similarly, **Rajalakshmi *et al.* (1980)** and **Honda *et al.* (2003)** reported that there was no significant relationship between number of pregnancies and the concentrations of magnesium in milk.

In our study we noted positive correlation between concentration of calcium and concentration of magnesium in transitional breast milk. Similar relationship between this metals was presented by **Kippler *et al.* (2009)**. It is known that these elements are main metals in skeleton, during lactation appears increased mobilization of these elements from bones in order to assure adequate dose of these metals with milk to the newborn **(Chan *et al.*, 1982)**. Besides, a number of studies in animals and humans, using a variety of in vivo and in vitro techniques, have indicated that there is direct competition between Ca and Mg absorption and intestinal transport. Increasing Ca in the diet could significantly depresses Mg absorption **(Hardwick *et al.*, 1991)**. The possible that this positive relationship between metals is caused by changes in mineral status of mother's bones and mechanisms responsible for proper absorption by newborn's digestive system.

CONCLUSION

The present study has confirmed other reports that magnesium concentrations in human milk appear constant when different groups are compared. For calcium, the results indicate that the women's age and parity causes higher calcium concentrations in milk. Further studies involving bone metabolism are necessary to clarify the results of the present study.

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