Nutrición Hospitalaria

Original

Zinc in plasma and breast milk in adolescents and adults in pregnancy and pospartum; a cohort study in Uruguay

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Abstract

Objective: To assess if age is a risk factor for low zinc nutritional status in pregnancy, postpartum and in breast milk concentration, and the association between mother zinc plasma level with zinc milk concentration.

Design: Cohort study comparing adolescents with adult women, with < 14 weeks of gestation at first prenatal care. Socio demographic and plasma zinc data were collected at that moment and at postpartum time (4 + 1 month). Milk zinc concentrations were also measured at 4 [th] month postpartum.

Setting: Women were recruited from 16 public primary health care services in Uruguay

Subjects: 151 adolescents and 161 adult women

Results: Adolescent average plasma zinc at < 14 weeks of gestation was 84.4 ± 3.6 ug /dl and did not differ significantly from that for adult women (85.2 ± 13.6 ug/dl). Prevalence of hypozincemia was relatively low with but with no difference by age (14.6% in adolescents and 12.3% in adults).

Zinc concentrations in breast milk were similar for adolescents, 1.24 mg. /L (CI 1.06 to 1.44) and adult women, 1.27 mg./L (CI .1.0-1.46). There was no correlation between plasma zinc and breast milk zinc concentrations in adults and a weak correlation in adolescents (-0.27, p <0.05).

Conclusions: Prevalence of hypozincemia in pregnancy was relatively low but similar in adolescents and adult women. Neither pregnancy nor age had negative consequences over postpartum plasma zinc, nor over breast milk zinc concentrations. No correlation was found between mother s plasma zinc and breast milk levels.

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Key words: *Pregnancy. Zinc. Adolescent. Breast milk. Uruguay.*

ZINC EN EL PLASMA Y LECHE MATERNA EN EMBARAZADAS ADOLESCENTES Y ADULTAS Y EN EL POSTPARTO; ESTUDIO DE COHORTE EN URUGUAY

Resumen

Objetivo: Evaluar la edad como factor de riego para el déficit nutricional de zinc en el embarazo y en el posparto y la correlación entre la concentración de zinc plasmático y de la leche materna.

Diseño: Estudio de cohorte de 151 embarazadas adolescentes y 161 adultas con < 14 semanas de gestación al primer control prenatal, seleccionadas en 16 centros públicos de salud de primer nivel de atención de Uruguay. Se obtuvieron datos socio demográficos y se determinó zinc plasmático al primer control prenatal y 4 meses posparto (± 1 mes). En el último control se midió también la concentración de zinc en la leche materna.

Resultados: La media de concentración de zinc plasmático a las 14 semanas de gestación fue 84.4 ± 3.6 ug. /dl sin diferencias significativas con las adultas (85.2 ± 13.6 ug/dl). La prevalencia de hipozincemia fue relativamente baja, sin diferencias entre los grupos (14.6% en adolescentes y 12.3% en adultas). La concentración de zinc en la leche materna fue similar en adolescentes y adultas (1.2 CI 1.1-1.4 mg. /L en el grupo total). No se encontró correlación entre el nivel plasmático de zinc materno y la concentración en la leche en adultas y una débil correlación en el grupo de adolescentes (-0.27, p <0.05).

Conclusión: La prevalencia de hipozincemia en el embarazo es relativamente baja y similar entre adultas y adolescentes. No se observó relación entre la edad materna y los niveles plasmáticos de zinc post parto en la madre ni en la leche materna. La concentración de zinc plasmático materno no se correlacionó con el zinc en la leche materna.

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Palabras clave: *Gestación. Zinc. Adolescencia. Leche materna. Uruguay.*

Introduction

During adolescence, the last stage of life with accelerated linear growth, nutritional requirements during pregnancy are exceptionally high. There is limited knowledge about changes in plasma zinc generated by additional demand in pregnancy and its relation with maternal age, but some studies showed that plasma zinc levels from teenagers were not significantly different than those from adults[1-3].

Different studies show association between maternal zinc deficiency during pregnancy and spontaneous abortions, malformations, low birth weight, intrauterine growth retardation, birth complications, and fetal development[4-8].

Zinc concentrations in milk have been shown to be independent of maternal Zn intake and nutritional status, especially in well nourished women[9-10], also in women with marginal intakes[11-12].

It is still unknown the effects of adolescence on milk Zn concentrations and on Zn status a period of time with high demands for Zn for growth and with frequently marginal quality of diets. The aim of this study was to examine if age is associated with zinc status at early pregnancy and postpartum in plasma and breast milk.

Methods and procedures

We conducted a cohort study in Uruguay comparing 151 adolescents (13-19 years old) with 161 adult women (24-35 years old), with ≤ 14 weeks of gestation at first prenatal control.

Sample size was calculated based in previous studies which showed 98.2 ug/dl of plasma zinc concentration in adults and 94 ug/dl in adolescents, assuming a normal distribution within each group, standard deviation of 11 and a difference between means of 4. Considering a power of 0.8 and type I error probability of 0.05 we need to study 120 subjects in each group to be able to reject the null hypothesis [13-14].

Women were recruited from sixteen public primary health centers and invited to participate when they attended for their first prenatal visit. The inclusion criteria were age, 10-19 years old for adolescents and 24-35 for adults; single pregnancy; without pathologies; ≤ 14 weeks gestational age at first prenatal control measured by last date of menstruation if known or gestational age estimated by ultrasound if unknown; agreement to participate and informed consent signed. We included all mothers who met these criteria regardless their ethnicity, socio-economic and cultural level, marital status, parity, tobacco or alcohol consumption. Exclusion criteria were twin pregnancies and mothers with previously diagnosed of chronic diseases. The study was submitted to local and Pan-American Health Organization (PAHO) ethical approval, informed consent were obtained and signed, and in all cases confidentiality had been ensured.

Data were obtained at ≤14 weeks gestation age, and 4 ± 1 months postpartum. At the first prenatal visit demographic data were obtained including age, race, marital status, and schooling. At 4 ± 1 month postpartum second blood samples were taken at health centers. Patients who were not found at health centers were visited at home to collect data, in many cases mothers were moved to capital city to obtain blood sample. A sample of breast milk also was taken in mothers who were lactating at 4th month. A precise logistic plan was undertaken and monitoring visits were made to assess quality of data collected.

Blood sample

A 7 ml. blood sample was collected by peripheral venipuncture using disposable plastic syringes and stainless steel needles or butterflies if veins were very thin. The samples were collected at morning and at fasting. Samples were transferred to plastic Eppendorf tubes containing heparin. After centrifuging for 10 minutes at 1200-1500 xg, plasma was separated in and transferred to four plastic Eppendorf (0,5 to 0,7 ml/tube) and immediately frozen at -20 ºC. The syringes, heparin, and tubes were free of detectable zinc.

Breast milk sample

After washing breast de-ionized water, milk samples of 5 ml. were collected at 5 minutes of feeding by manual expression directly into zinc – free polypropylene containers, and immediately frozen at -20ºC until thawed for analysis.

Laboratory assays

All sample analyses were performed at the University of Colorado, Denver. Instructions of United Nations for packing and regulations for shipment were followed. Samples ashing analytical procedures were identical for blood and milk and were analyzed by flame atomic absorption spectrophotometer with a modified Perldn-Elmer 503 fitted with deuterium arc background correction and AS-3 auto sampling system (Perkin Elmer Corp, Norwalk, CT).

The cutoff point used as a reference of low plasma zinc was the proposed by the International Zinc Nutrition Consultative Group (IZiNCG): < 70 ug/dL, which is the lower limit of normality [15].

Statistical analysis

For testing normality, Kolmogorov-Smirnov Z test was used. For comparing quantitative variables

between adolescents and adults t-test for independent samples was assessed, and if normality not met, Mann Whitney U test was applied. Summary measures were used as means and standard deviations for normal continuous variables and proportions for categorical ones, analyzing the differences between adolescent and adult women in early pregnancy and postpartum.

Mixed models were used for comparison of zinc values between groups (adolescents and adults) and between stages (first pregnancy control with postpartum). For normalizing and comparing breast milk zinc between groups we calculated the Logarithm (breast milk). For comparing categorical variables, Chi square test was assessed. If expected values were less than 5, categories were joined. For comparing qualitative variables between pregnancy and postpartum, Mc Nemar test was applied. Spearman coefficient was calculated for assessing the correlation between breast milk and plasma zinc. P-values <0.05 was considered significant for all tests. For the statistical analysis it was used SPSS version 15.

Results

312 mothers were recruited and 245 finished inside the study. The causes of lost were: abortion: 34; still birth: 1; deserted: 6 and lost in follow-up: 26. This flowchart shows the follow- up:
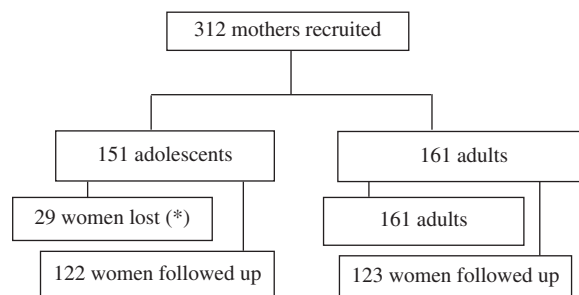
Both groups had similar characteristics socio-demographic, years of study, stable union, Caucasian more than 70% and with no difference in gestational age at delivery (table I).

Adolescent mean plasma zinc at <14 weeks of gestation was 84.4 ± 13.6 ug/dL and did not differ from that of adult women (85.2 ± 13.6 ug/dL). Plasma zinc levels were similar when compared recruited mothers with actually followed up with mothers lost in follow-up (p= NS). The prevalence of hypozincemia was relatively low in both groups. When postpartum results were compared with pregnancy results, differences were not found either in prevalence of hypozincemia or of mean plasma zinc (table II).

The majority of women with hypozincemia at ≤ 14 weeks gestation had values within the normal range post-partum and very few normal values at ≤14weeks gestation had hypozincemia post-partum, without differences in relation to age (table III).

Table I
Comparison of socio-demographic characteristics between two groups studied

	Adolescents n = 122		Adults n = 123		
	Mean	*SD*	*Mean*	*SD*	
Age (years)	17.3	1.5	28.7	2.5	—
Age of first pregnancy (years)	16.7	1.5	21.0	4.0	< 0.01
Years of study	7.7	1.7	8.1	2.5	NS
Gestational age at birth * (weeks)	38.5	2.0	38.6	2.2	NS
Marital State		*%*	*%*		
Married		6.5	46.7		
Cohabiting		48.8	45.1		
Single/separated/widowed		44.7	8.2		<0.001
Schooling		*%*	*%*		
Primary incomplete		2.4	5.7		
Full Primary		30.9	32.8		
Secondary incomplete		65.0	51.6		
Full secondary and over		1.6	9.8		NS

*Only in live birth
**comparing «at least secondary incomplete between groups»

Table II
Plasma zinc levels (ug/dl) at ≤ 14 weeks gestational age and 4 ± 1 month postpartum in adolescents and adults

Time of measure	Adolescents n = 122		Adults n = 123		
	Mean	SD	Mean	SD	p
Plasma zinc					
≤ 14 weeks pregnancy	84.4	13.6	85.2	13.6	NS
4 ± 1 month postpartum	85.7	16.4	84.6	12.2	NS
P	NS*		NS*		
Hipozincemia (<70 ug./dl)	%		%		
≤ 14 weeks pregnancy	14.6		12.3		NS
4 ± 1month postpartum	7.3		12.3		NS
P	NS**		NS**		

*Test de Student
**McNemar test

Table III
Prevalence of hipozincemia at 4 months postpartum depending on plasma zinc level at first control in pregnancy by maternal age

Plasma zinc at 1st health care control		Plasma zinc at 4th month postpartum	
		> 70 ug/dl	< 70 ug/dl
Adolescents (n = 122)	n	n	n
Normal ≥70 ug/dl	107	92	8
Hypozincemia <70 ug/dl	16	94	6
			p NS
Adults (n=123)			
Normal ≥70 ug/dl	108	88	12
Hypozincemia <70 ug/dl	15	87	13
			p NS

Table IV
Zinc in breast milk in adolescents and adults (mg/l=

	Adolescents mg/l	Adults mg/l	Total mg/l	p p
Median	1.20	1.20	1.20	NS
IC 95%	1.06-1.44	1.10-1.46	1.08-1.40	

Milk zinc concentrations had similar values in both groups (p= NS) and with the same median value (1.20 ml/L, table IV), and the same declining from 3rd to 5th lactation month (data not shown). When Spearmann coefficient was applied between plasma zinc and milk zinc levels, correlation was not found in adult group (-0.02, NS), and a very weak correlation in adolescent (0.08, p< 0.05). Also no significant difference was found between mother's BMI and milk zinc levels for two groups (data not shown).

Discussion

This is the first study in Uruguay of plasma and milk zinc concentrations in adolescent and adult women. In this study we found a plasma zinc media of 84 ug./dl, which is lower than studies done in other countries as Brazil and Spain but slightly higher of those found in Venezuela and México[13-20].We found a prevalence between 7 to 14 % of women with hypozincemia at early pregnancy, defined as values below 70 ug/dl. This prevalence is lower than that found by Meertens in Venezuela, Villapando in Mexico and Sanchez in South Spain but similar as found in Argentine[15-16,19]. These differences could be due to different dietary habits. In Uruguay meat eating is relatively high, according to Food Balance Sheets of FAO, media zinc consumption for the whole population from this source is 6.46 mg./day[21]. Sample size could be another explanation, because some of other studies were done over smaller samples than this one, so variances may be wider. Another explanation could be the different methods used to measure zinc in plasma.

Plasma zinc levels did not differ between adolescents and adults in early pregnancy and also in postpartum, so it seems to be that both groups face pregnancy with same nutritional conditions and responded in the same way to the zinc increased demands caused by pregnancy and lactation. Our findings are consistent with the study of Lima de Moraes, who studied 40 adolescents and 40 adults in Brazil, Ruiz who studied 108 pregnant women in Venezuela and Martin Lagos in

Spain, who found no association between serum zinc and age in any of three trimesters of pregnancy[21-23]. Also Neggers found no significant difference related to maternal age and his multiple regression analysis indicates that race, parity, and pregnancy weight were significantly associated with plasma zinc levels adjusted for gestational age[24].

In our study we found no significant differences when compared plasma zinc concentration between postpartum and early pregnancy, both groups had the same performance. Also, most of women which began pregnancy with hypozincemia raised their plasma values resulting at 4th month postpartum over 70 ug/dL. A possible reason lies on what Christine Hotz explains in her paper about cutoffs of serum zinc concentrations for assessing zinc status[25]. This paper was a reanalysis of the second National Health and Nutrition Examination Survey data (1976-1980), and studied variations in zinc concentration by different characteristics, including pregnancy. It described a decline of plasma zinc concentration since very early in pregnancy and suggested a cutoff of 56 ug/dL at first trimester of pregnancy[25, 26].

In our study, milk zinc was not correlated to plasma zinc concentration and also mother's nutritional status. Although in the group of adolescent mothers was statistically significant, the correlation found is considered very weak. These findings are similar with some previous studies which found that milk zinc is not affected by plasma values[27-29].

Hannan and Rashed showed no significant correlation between zinc intake and mineral concentration in breast milk[30, 31]. Also other recent studies, one on a sample of malnourished women in Honduras and other on a sample of well-nourished women in Sweden, assessed correlation between concentrations of iron, zinc and copper between plasma and milk. These studies showed no association between mother's plasma zinc and milk zinc measured at 9 months postpartum, which is consistent with our results although we found a weak association en adolescent group[32].

A plausible reason appears to be that the drop in plasma zinc during pregnancy may be due to hormonal effects and hemo–dilution. Also this drop in plasma zinc causes increased absorption and some authors showed that depending on quantity of zinc consumed, is the quantity of zinc absorbed[33, 34].

Our study also found a mild declining of milk zinc from 3rd to 5th month of lactation (adolescents and adults) as published in previous studies. As milk zinc concentration changes along post-partum time, it is important to highlight that the spread of sample around 4 month time point was similar between adults and adolescents[35, 36].

Research on nutritional zinc status is still a controversial issue. A review conducted in 2007 suggests that zinc research particularly in pregnant adolescents is still very limited and therefore results are not conclusive[37]. Another review in 2000, by Janet C King does not show age as a risk factor in the nutritional status of zinc in pregnancy[38]. The mean age of the adolescents was relatively high and well past growth spurt. It might have been different if the young women had been in stage Tanner 3 or so. In our study the mean of adolescent age was 17 years old.

According to these results, adolescents begin their pregnancy under similar zinc condition of adult ones. In this nutrient body seems to be ready and do not put them in a greater vulnerable position to face pregnancy demands.

As findings in literature show that health outcomes in adolescent pregnant and perinatal outcomes are worse than adults, we must search for other constraints than zinc[39].

This study also do not allow to go in depth in the identification of social factors which may be influencing, because both groups are very similar in social conditions, and the design was made to prove other hypothesis. From this perspective we must review clinical practice in nutrition and social policies to address pregnant adolescents and to identify areas where progress is required to increase knowledge in this subject. Our results of similar Body Mass Index between adolescent and adult women support the same conclusion than zinc results, that age by herself appears not to be a risk factor in pregnancy and postpartum[40].

One weakness is that inside the sample of adolescent studied were very few under 15 years old, although we carried out an stratified analysis under and over 16 having the same findings (100 women but only 15 cases under 15). It will be important to carry out a study with a sample of women under 15 to see if findings being equal.

We can conclude from this study that neither pregnancy nor age over 16 had negative consequences over postpartum plasma zinc, nor over breast milk zinc concentrations.

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