Short Communication

Prevalence and correlates of zinc deficiency in pregnant Vietnamese women in Ho Chi Minh City

Vinh Quang Nguyen MD, MSc[1], Aya Goto MD, MPH, PhD[2,3], Tu Van T Nguyen MD, PhD[4], Khoa Tuan Vo MD, MSc[5], Tuyet Mai T Ta MD, PhD[6], Thuy Ninh T Nguyen MD[7], Tien Minh Nguyen MD, MSc[1], My Binh T Ho MD[1], Ngoc Anh T Phan RM[1], Hong Hanh T Vu RM[1], Thuc My Truong RM[1], Hung T Nguyen MD, PhD[8]

[1]*Department of Obstetrics and Gynecology, Nguyen Tri Phuong Hospital, Ho Chi Minh City, Vietnam*
[2]*Department of Public Health, Fukushima Medical University School of Medicine, Fukushima, Japan*
[3]*Takemi Program in International Health, Harvard School of Public Health, Boston, USA*
[4]*Department of Obstetrics and Gynecology, University of Medicine and Pharmacy, Ho Chi Minh City, Vietnam*
[5]*Department of Endocrinology, 115 Hospital, Ho Chi Minh City, Vietnam*
[6]*Department of Nutrition, Nhan Dan Gia Dinh Hospital, Ho Chi Minh City, Vietnam*
[7]*Department of Laboratory, Nguyen Tri Phuong Hospital, Ho Chi Minh City, Vietnam*
[8]*Department of Neurology, Nguyen Tri Phuong Hospital, Ho Chi Minh City, Vietnam*

Background: Although Vietnam is a region with a plant-based diet that has a high zinc deficiency, epidemiological data showing how this affects pregnant women are limited. This study explores the prevalence of zinc deficiency and possible correlates in pregnant Vietnamese women in Ho Chi Minh City. Methods: This was a cross-sectional study conducted at a general hospital in Ho Chi Minh City, Vietnam. All pregnant women who came to their first antenatal care visit from November 2011 to June 2012 were recruited. Those taking a vitamin and/or mineral supplement were excluded. Serum zinc concentrations, determined by a standard colorimetric method, of 10.7 μmol/L-17.5 μmol/L (70.0 g/dL-114 g/dL) were classified as normal and under 10.7 μmol/L (70.0 g/dL) as zinc deficient. Results: In total, 254 pregnant women were invited and 107 (42%) participated. The mean age of participants was 29 years, and mean gestational age was 10 weeks. Median zinc concentration in serum was 13.6 μmol/L, and the prevalence of zinc deficiency was 29% (95% CI=21%-39%). The daily intake of a milk product supplement was the only significant correlate of zinc deficiency of the items investigated (adjusted OR=0.40, 95% CI=0.16-0.99, p=0.049). Discussion: This is the first study reporting that more than 25% of pregnant Vietnamese women in Ho Chi Minh City are zinc deficient. Further academic and clinical input is needed to confirm the scale of this neglected issue and to investigate the potential of milk product supplementation in this population.

Key Words: zinc, deficiency, dietary supplement, pregnant women, Vietnam

INTRODUCTION

According to a WHO report,[1] the estimated global prevalence of zinc deficiency is 31%, ranging from 4% to 73%. High prevalence is observed in regions with a high consumption of plant-based diets and limited access to zinc-rich food, such as animal products, oysters, and other shellfish.[1] Vietnam is one of these regions.

Zinc is a necessary trace micronutrient for metabolism, regulation of cellular growth, and cell differentiation.[2] Zinc deficiency thus induces a wide range of system disturbances, including impairment of physical growth, immune system deficits, and problems with neuropsychological development. Thus, the clinical implications for pregnant women related to zinc deficiency are important; complications range from infertility and fetal death to intrauterine growth retardation, and include preterm birth and other anomalies.[3] Moreover, potential postnatal complications are possible, such as neurobehavioral abnormality and impaired immunocompetence.

Previous studies in Asian countries reported a notably high prevalence of zinc deficiency among pregnant women; 45% of Chinese women in the third trimester were zinc deficient, defined as <10.5 μmol/L,[4] 55% of Bangladeshi women in the second trimester (<8.6 μmol/L),[5] and 65% of Indian women in the third trimester (9.9 μmol/L).[6] In Vietnam, the "National Nutrition Strategy period 2011-2020 and vision 2030" was recently issued. Although its

Corresponding Author: Dr Aya Goto, Department of Public Health, Fukushima Medical University School of Medicine, Hikarigaoka 1, Fukushima City, Fukushima, 960-1295, Japan.
Tel: +81-24-547-1180
Email: agoto@fmu.ac.jp
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second and third main objectives are improving maternal and child nutrition status and micronutrient status, concrete numbers are reported only for anemia. Zinc deficiency in Vietnamese women of reproductive age was reported to be as high as 67% (<10.1 μmol/L),[7] but as far as we know, there has been no prevalence data reported for zinc deficiency in pregnant Vietnamese women.

This study was designed primarily to explore the prevalence of zinc deficiency and its correlates in pregnant Vietnamese women in Ho Chi Minh City.

MATERIALS AND METHODS

This cross-sectional study was conducted from November 2011 to June 2012 at the Nguyen Tri Phuong Hospital, Ho Chi Minh City, Vietnam. It is a tertiary general hospital with 700 beds. The study was reviewed and approved by the Scientific Research Committee of Nguyen Tri Phuong Hospital. Eligible pregnant women were informed about the purposes of the study, and written consent was obtained from all participants.

All pregnant women who came to the first antenatal care visit were recruited and informed of the study, which consisted of interviews and blood sampling. Women who had been prescribed or told interviewer about taking vitamin and/or mineral supplementation or any type of "supplementation for fetal health," or who had been diagnosed with diabetes were excluded. Taking supplements and having diabetes both alter serum zinc concentration. A recent nutrition study in Ho Chi Minh City reported that over 50% of women take supplements,[8] and those with zinc included could mask a deficient status. Also relevant, an excessive intake of iron or calcium, and having diabetes, which is a common obstetrical complication in Asia, could be associated with disturbances of serum zinc concentration.[3, 9]

In order to ensure consistency in the process, two midwives were assigned and trained to interview all the participants. The midwives also handled anthropometric measurements and general survey logistics. The interview sheet asked basic background questions including demographic (age, marital status), socioeconomic (education, occupation, house ownership), lifestyle (smoking, vegetarian or not, daily milk product supplementation), and pregnancy-related questions (gestational week, birth history). For the practical purpose of interviewing at a busy outpatient unit, the length of the interview sheet was kept to one page. We referred to previous articles when selecting items in the questionnaire and when the analysis plan was constructed.[1,7,9-12] Socioeconomic status was included because of its influence on nutritional intake,[7,11] and items to elicit this status were selected following the example of a previous study in Nepal.[10] Smoking (or not) was checked because of its reported association with zinc deficiency.[9] Vegetarian status was asked because animal products are rich in zinc,[1] and there is a vegetarian tradition in Vietnam, which recommends that people avoid eating animal products for a few days each month.

The intake of milk product supplementation was asked for three reasons: it is becoming a popular method of daily dietary supplementation among pregnant women in Ho Chi Minh City; the above-mentioned national strategy recommends food fortification; and an iron-fortified milk is reported as an effective method of improving iron status of pregnant Vietnamese women.[12] The milk products for pregnant women are produced by both domestic and international companies, and generally are fortified with vitamins, iron, zinc, calcium, and DHA. It is easily available, with a price around 8-9 US dollars per 400 g can.

Ultrasonographic examination was done to confirm gestational age. Maternal height was measured to the nearest 0.5 cm using a stadiometer, weight in acceptable lightest clothes was measured to the nearest 0.5 kg by using the Tanita digital adult scale, and blood pressure was measured manually by trained midwives. The body mass index was dichotomized by 18.5 as an indicator of maternal nutritional status.

Serum was collected, without Versenate (EDTA), by using rubber caps free from zinc contamination in a hospital laboratory. Standardization and calibration were done regularly, with each series of samples run with Olympus AU400 apparatus. Serum zinc concentrations were determined by a standard colorimetric method.[13] Measured values under 10.7 μmol/L (71 μg/dL) were classified as zinc deficient, and values of 10.7 μmol/L-17.5 μmol/L (71 μg/dL-114 μg/dL) were considered normal. In addition to the zinc concentration, albumin, hemoglobin, and ferritin levels were measured. Both albumin and ferritin bind zinc.

Data were analyzed by Stata software version 12.0. The binominal distribution was used to calculate the 95% confidence interval (CI) of zinc deficiency, and logistic regression analysis was used to examine the association of zinc deficiency (yes or no) with survey items as listed in Table 1. In order to confirm a possible association of the significant correlate in univariate analyses, a multivariable logistics regression analysis was performed by entering zinc deficiency as a dependent variable, the significant correlate as an independent variable of our interest, and also three socioeconomic items (educational level, occupation, and house ownership), and two nutrition-related items (BMI and vegetarian status) as potential confounders.

RESULTS

A total of 254 pregnant women fulfilling the eligible criteria were invited to the study after excluding 55 women who were taking vitamin mineral supplements and who had not been assessed for diabetes. No one was excluded for diabetes. Among 254 women, 147 (58%) refused and 107 (42%) participated. There was no significant difference between the two groups (that refused and participated) in maternal age, gestational age, and number of previous pregnancies. As shown in Table 1, the mean age of participants was 29 years, and mean gestational age was 10 weeks. Fifty-six percent had an educational level of secondary school or lower, 8% were laborers, and 38% did not own a house. Thirty-two percent were vegetarians and 64% took a milk product supplementation daily.

Median zinc concentration in serum was 13.6 μmol/L ranging from 1.3 μmol/L to 19.9 μmol/L. Prevalence of zinc deficiency (lower than 10.7 μmol/L) was 31/107 (29%; 95% CI=21%-39%) (Figure 1). Among the items

Table 1. Correlates of zinc deficiency in pregnant Vietnamese women

	Mean (SD), median (min; max)†, or frequency (%)			Logistic regression analysis	
	Total (N=107)	Zinc Deficiency (N=31)	Normal zinc level (N=76)	Crude OR‡ (95% CI)	Adjusted OR§ (95% CI)
Demographic and reproductive status					
Maternal age (years)	28.7 (4.6)	28.4 (4.3)	28.9 (4.7)	0.98 (0.89-1.07)	-
Gestational age (weeks)	10 (6; 23)	9 (6.5; 20)	10 (6; 23)	0.93 (0.80-1.08)	-
Number of children (first-time mother)	42 (39%)	15 (48%)	27 (36%)	1.05 (0.97-1.15)	-
Socioeconomic items					
Educational level (secondary school or lower)	60 (56%)	18 (58%)	42 (55%)	1.01 (0.96-1.06)	-
Occupation (laborer)	9 (8%)	2 (6%)	7 (9%)	0.68 (0.13-3.47)	-
House ownership (no)	41 (38%)	9 (29%)	32 (42%)	0.94 (0.85-1.04)	-
Lifestyle items					
Passive smoking at home¶ (yes)	61 (57%)	21 (68%)	40 (53%)	1.89 (0.79-4.54)	-
Vegetarian (yes)	34 (32%)	9 (29%)	25 (33%)	0.83 (0.34-2.08)	-
Daily milk product supplementation (yes)	68 (64%)	15 (48%)	53 (70%)	0.41 (0.17-0.96)	0.40 (0.16-0.99)
Anthropometric item					
Body mass index (lower than 18.5 kg/m^2)	21 (20%)	7 (23%)	14 (18%)	1.29 (0.46-3.59)	-
Blood tests					
Albumin (g/L)	41.5 (24.9; 51.3)	42.0 (34.9; 45.5)	41.5 (24.9; 51.3)	0.98 (0.86-1.11)	-
Hemoglobin (g/L)	123.2 (10.9)	122.5 (10.6)	123.5 (11.0)	0.99 (0.95-1.03)	-
Ferritin (mg/L)	78.0 (6.8; 268.1)	83.5 (8.0; 268.1)	77.5 (6.8; 250)	1.00 (0.99-1.01)	-

† Mean was shown for items with a normal distribution and median for those with a non-normal distribution. SD = Standard deviation.
‡ Dependent variable was the zinc deficiency status (yes or no). Independent variables are listed on the left column. Categorical variables are dichotomies and reference groups are as follows: number of children (experienced mothers with children), educational level (high school or higher), occupation (office worker), house ownership (yes), passive smoking at home (no), vegetarian (no), daily milk product supplementation (no), and body mass index (18.5 kg/m^2 or higher).
§ Adjusted for three socioeconomic items (educational level, occupation, and house ownership) and two nutrition-related items (body mass index and vegetarian status).
¶ No pregnant woman smoked, and only the data on passive smoking were shown.

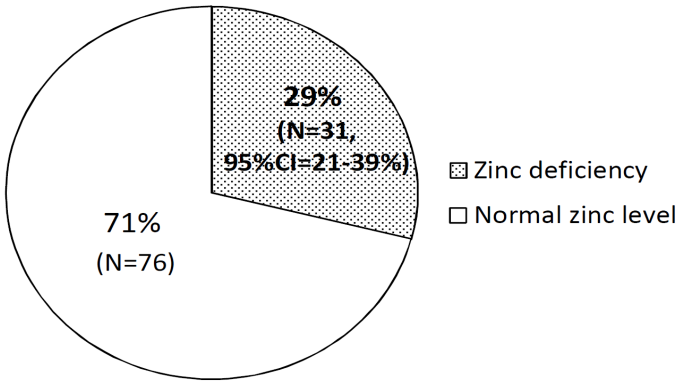

Figure 1. Prevalence of zinc deficiency in pregnant Vietnamese women (N=107)

listed in Table 1, only daily milk product supplementation was significantly associated with zinc deficiency: 48% of women with zinc deficiency contrasted with 70% of women with normal concentration (crude odds ratio=0.41, 95% CI=0.17-0.96, p=0.04) (Table 1). The significance remained after controlling for socioeconomic and nutritional indicators (adjusted OR=0.40, 95% CI=0.16-0.99, p=0.049).

DISCUSSION

This is the first study reporting a prevalence of zinc deficiency in pregnant Vietnamese women attending their

first antenatal care visit at a general hospital in Ho Chi Minh City. In this population, about 30% had zinc deficiency, which was very close to the World Health Organization's global prevalence estimate,[1] but much lower than the above-mentioned prevalence in women of reproductive age in Vietnam and in pregnant women in China, Bangladesh, and India.[4-7] One possible explanation is an urban-rural difference. Whereas the previous studies targeted or included rural areas,[4-7] our study focused on an urban area with significantly higher levels of meat product consumption, as well as obesity.[11,14] Another possible explanation is the specific characteristic of pregnant women coming to a tertiary hospital for their first antenatal checkup and their willingness to participate in the present study. Our obtained prevalence was even lower than the data in the urban area (63%), reported from a region-stratified analysis of the above-mentioned study of Vietnamese women of reproductive age.[7] The fact that 58% of women with lower education, 67% of laborers, and 73% of non-house owners were consuming milk product supplement in the present study may indicate a high health awareness in our participants.

Of interest, this commonly used commercialized milk product supplementation for pregnant women seemed to protect against zinc deficiency among our participants, even after controlling for socioeconomic and nutritional indicators that were available in our dataset. Despite growing evidence of a positive effect of zinc on pregnancy outcomes, zinc supplementation alone has not been proved to have a definite positive effect in developing countries.[15] The most recent Cochrane review[16] concluded that a risk of preterm birth related to zinc deficiency might only reflect poor nutrition in general, and efforts are needed to address ways of improving the overall nutritional status of populations rather than focusing on zinc supplementation in isolation. In line with the Cochrane recommendation, a previous study to prevent iron deficiency showed that milk fortification was also effective in increasing weight gain in pregnant women, due to additional benefits of energy and nutrient inputs.[12] Milk consumption in Vietnam has increased by 20% from 2005 to 2010, with nearly 80% of all dairy products consumed occurring in the in two largest cities (Ho Chi Minh City and Hanoi),[17] suggesting that milk fortification is a locally adequate strategy. Further large-scale studies with detailed information on dietary habits are needed to evaluate the impact of this product in pregnant Vietnamese women.

This study has two main limitations. First, we had difficulty in recruiting pregnant women coming to their first antenatal care visit. Although provincial and central hospitals (tertiary hospitals) were reported to be the most popular types of facility for antenatal care in an urban area in Vietnam,[18] most patients at our study site were referred after their first visits to other hospitals, clinics or health centers. In addition, nearly half of the invited women refused to take part in this study because it involved blood sampling and many women were unfamiliar with the term-'zinc'. Although there was no statistically significant difference in basic characteristics between respondents and non-respondents, results with negative significance, in particular, should be carefully interpreted, and more efforts are needed to increase the sample size and response rate. In addition, our study lacked detailed data on women's socioeconomic status and dietary intake and simply excluded those taking supplements. More comprehensive data collection is recommended in future large-scale investigations. Despite these limitations, we hope that the present exploratory study may play an important role in increasing academic and clinical awareness and in promoting larger-scale prospective investigation into zinc deficiency in pregnant Vietnamese women.

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AUTHOR DISCLOSURES

We declare that there is no conflict of interest. This study was conducted in part as the Japan International Cooperation Agency's Partnership Program "Capacity building toward evidence-based medicine among health care professionals at University of Medicine and Pharmacy, Ho Chi Minh City and its related institutes".

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[1]*Department of Obstetrics and Gynecology, Nguyen Tri Phuong Hospital, Ho Chi Minh City, Vietnam*
[2]*Department of Public Health, Fukushima Medical University School of Medicine, Fukushima, Japan*
[3]*Takemi Program in International Health, Harvard School of Public Health, Boston, USA*
[4]*Department of Obstetrics and Gynecology, University of Medicine and Pharmacy, Ho Chi Minh City, Vietnam*
[5]*Department of Endocrinology, 115 Hospital, Ho Chi Minh City, Vietnam*
[6]*Department of Nutrition, Nhan Dan Gia Dinh Hospital, Ho Chi Minh City, Vietnam*
[7]*Department of Laboratory, Nguyen Tri Phuong Hospital, Ho Chi Minh City, Vietnam*
[8]*Department of Neurology, Nguyen Tri Phuong Hospital, Ho Chi Minh City, Vietnam*

胡志明市懷孕的越南婦女鋅缺乏的盛行率及相關因素

背景：儘管越南是一個以蔬食為主而有高的鋅缺乏地區，但是這對於懷孕婦女影響如何，仍缺乏流行病學的數據。本研究探討胡志明市的越南懷孕婦女其鋅缺乏盛行率與可能相關因素。方法：這個橫斷性研究執行於越南胡志明市的一間綜合醫院。自 2011 年 11 月到 2012 年 6 月第一次來產檢的孕婦為研究對象，但排除那些有服用維生素及/或礦物質補充劑的孕婦。以標準比色法評估血清鋅濃度，濃度範圍 10.7 μmol/L-17.5 μmol/L (70.0 g/dL-114 g/dL)被分類為正常組，低於 10.7 μmol/L(70.0 g/dL)為鋅缺乏。結果：共有 254 名孕婦受邀，最後計 107 名(42%)參與研究。參與者平均年齡為 29 歲，平均懷孕週數為 10 週。血清鋅中位數為 13.6 μmol/L，鋅缺乏盛行率為 29%(95% CI=21%-39%)。在所有研究項目中，只有乳製品補充的每日攝取量與鋅缺乏具有相關性(校正 OR=0.40，95%CI=0.61-0.99，p=0.049)。討論：這是第一個研究報告胡志明市懷孕的越南婦女有超過 25%鋅缺乏。需要更進一步的學術及臨床的投入，以確認這個被忽視的問題嚴重性，並研究乳製品補充在這個族群的可能性。

關鍵字：鋅、缺乏、膳食補充、懷孕婦女、越南