Serum Thiamine Level in Pregnant and Non-Pregnant Women in Zaria, Nigeria

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Citation

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Abstract

Scientists have been advocating nutrient supplementation especially for pregnant women. This supplementation has included nutrients like vitamins A, folic acid, iron and recently thiamine to combat the development of congenital anomalies and to achieve a better pregnancy outcome. This study investigated the status of thiamine in pregnant and non-pregnant women. Blood samples was collected from 179 women for the thiamine analysis, 72 pregnant women were assessed for thiamine level in second trimester, 56 for third trimester and 51 non-pregnant women served as control. For thiamine analysis, the result showed a significant decrease (P<0.001) from the control (47.90 ± 25.93) to third trimester (27.09 ± 10.69). There was also significant (P<0.001) difference between control, educated pregnant and non-educated pregnant women in second and third trimester. Mean serum thiamine level decreased significantly (P<0.001) from those in tertiary level of education (61.17 ± 41.89) to those who are not educated (27.72 ± 12.72) and also between control and pregnant women according to age groups (P<0.001). In general there was a significant decrease in serum thiamine level in the pregnant women which is similar compared with other studies. Significant difference was observed in serum thiamine between educated and non-educated women. Overall there is a need for thiamine supplementation in pregnant women whether educated or not.

INTRODUCTION

Pregnancy induces a wide variety of anthropometric, physiological and biochemical changes ([1], [2], [3]) that requires close monitoring and most of the time nutritional supplementation. Thiamin (Vitamin B_1) is one of the four B vitamins essential in the citric acid cycle and therefore in energy-yielding metabolism ([4]). It is well established that thiamine requirements are increased during pregnancy and lactation. Increased thiamine requirements during the third trimester of pregnancy are generally thought to result from sequestration of the vitamin by the fetus and placenta ([5]). For example, concentrations of thiamine and other water soluble vitamins are 2-fold higher in umbilical cord blood than in maternal blood ([6]). Pregnant women and young children are at higher risk of thiamine deficiency ([7]).

The classical syndrome caused primarily by thiamine deficiency in humans is called beriberi which is characterized by neuritis in the lower extremities, often with muscle atrophy, poor coordination, and eventually paralysis ([8]). The benefit of thiamine in prevention and treatment of beriberi is uncontested ([9], [10]). Thiamine deficiency is common where highly polished rice is the major staple food and where other primary sources of thiamine (Meat, fish and legumes) are in short supply ([7]). Deficiency is compounded where local diets include foods such as fermented fish ([7]) and tea leaves which contain antithiamine factors ([11], [12]).

Derrick ([8]) reported that “beriberi” presentation also depends on the association with other vitamin deficiencies. Because thiamine is a major factor in the metabolism of glucose, it has been long known that ingestion of simple carbohydrates, processed in the body mainly to glucose, automatically increases the need for dietary thiamine. Thus, high calorie malnutrition is commonly associated with relative thiamine deficiency, irrespective of its fortification in food substances therefore an increase of dietary carbohydrate intake caused a decrease of plasma and urine levels of thiamine ([8]).

In the present study we hypothesized that serum thiamine level will be the same among pregnant and non-pregnant women, and between educated and non-educated women.

MATERIALS AND METHODS

DEMOGRAPHICS

The study obtained data from 179 women who gave their informed consent to participate in the study. Pregnant women (n = 128) and non-pregnant women (n = 51) who

served as the control. The data for 128 pregnant women were collected from women who are attending ante-natal clinic at the Ahmadu Bello University Health Services, Zaria, Samaru Clinic and Maternity, Zaria, Salama Infirmary and Maternity, Kwangila Zaria and St. Luke's Hospital Wusasa, Zaria.

ESTIMATION OF THIAMINE FROM BLOOD SERUM

Estimation of serum thiamine level was done in second and third trimester. Serum thiamine analysis was done in the Department of Biochemistry, Ahmadu Bello University, Zaria, by the method of Baker et al ([13]). Serum thiamine concentration for each sample was recorded as mµg/ml.

ETHICAL CONSIDERATION

Permission to conduct this study was given by the Scientific and Ethical Committee on Human Research of the Faculty of Medicine, Ahmadu Bello University, Zaria and participants gave their informed consent before they participated in the study.

STATISTICAL ANALYSES

Data were expressed as mean ± standard deviation. Student's t-test and one way analysis of variance was used to test the difference between thiamine levels of control and pregnant women and within pregnant women in second and third trimester. The data was analysed with statistical significance acceptable at $P < 0.05$, using SigmaStat 3.5 (Systat Inc, Point, Richmond, CA).

RESULTS

The women (n = 179) ranging from 16-50 years were use for this study. Out of these, 72 pregnant women with a mean age of 24.95 ± 5.19 for second trimester, 56 pregnant women with a mean age of 27.86 ± 5.93 and 51 non-pregnant women with a mean age of 27.04 ± 6.04 served as control.

Thiamine levels in the three study groups (control, second and third trimester) are presented in Fig. 1. Using one way analysis of variance the result show a significant decrease ($P<0.001$) from the control (47.90 ± 25.93) to third trimester (27.09 ± 10.69). Tukey post hoc test showed that there was statistical significant difference between control, second and third trimester ($P<0.05$), however there was no statistically significant difference between second trimester and third trimester $P>0.05$.

The pregnant women were categorised according to their level of education (Fig. 2). The thiamine level in the pregnant women who have tertiary education is significantly higher ($P<0.001$) from the others. The control and pregnant women were categorised on the level of their education (Fig. 3). Thiamine levels in the control was significantly higher ($P<0.001$) than thiamine level in the pregnant women who are well educated. Also there was a significant difference ($P <0.001$) between control and pregnant women, when they were categorised according to age group (Table 1).

Figure 1

Figure 1: Means of serum thiamine level in pregnant and non-pregnant women. Control is significantly different from second and third trimester groups * P

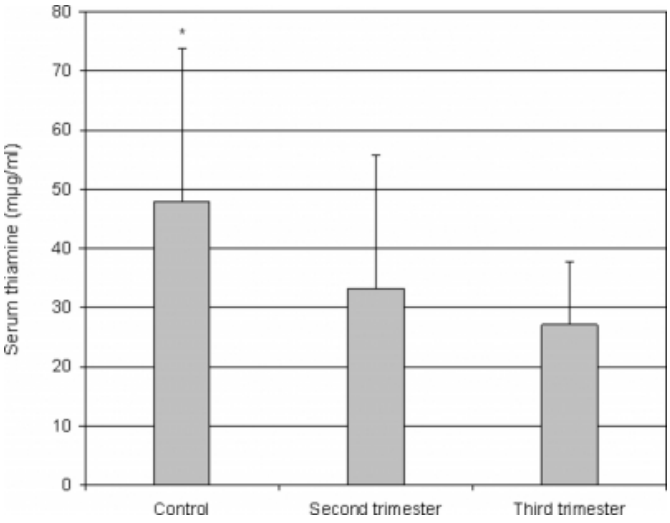

Figure 2

Figure 2: Thiamine level according to level of education. Women with tertiary education showed significantly higher thiamine level than the other group *P 0 001.

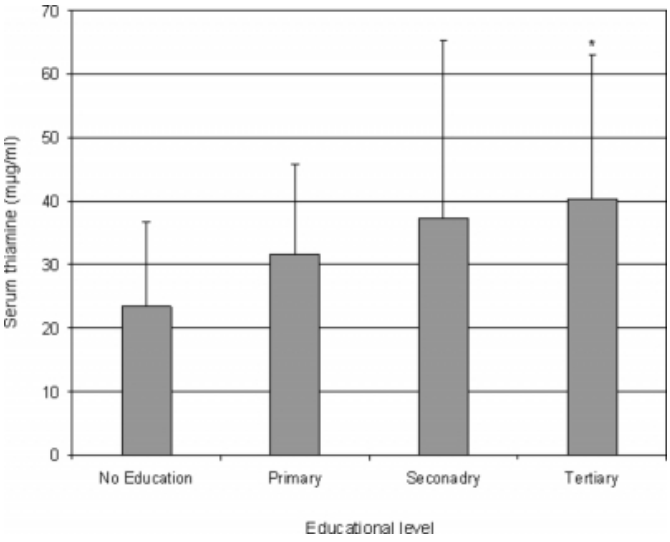

Figure 3

Figure 3: Thiamine level according to level of education and pregnancy in women. Control is statistically significantly different from pregnant non-educated and pregnant educated women * P

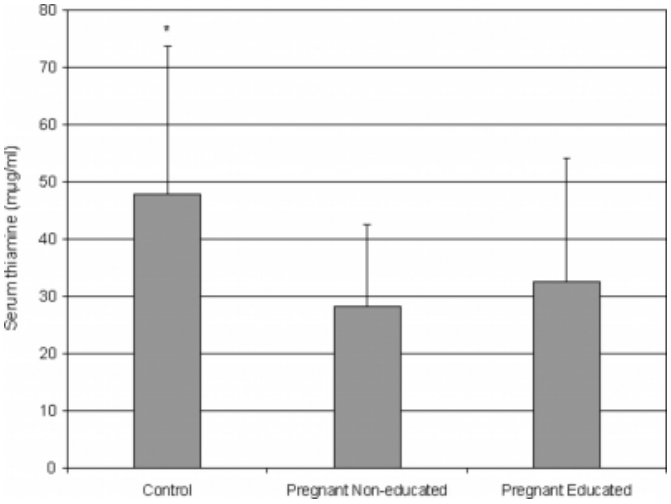

Figure 4

Table 1: Mean thiamine level according to age

Age (years)	Control	Pregnant Women	t	P
10 – 19	-	41.42 ± 12.01 (n= 12)	-	-
20 – 29	49.17 ± 23.25 (n= 28)	30.52 ± 13.67 (n= 77)	6.14	<0.001
30 – 39	46.92 ± 31.23 (n= 20)	25.03 ± 12.35 (n= 33)	6.07	<0.001
40 – 49	42.55 ± 12.46 (n= 3)	29.43 ± 18.49 (n= 6)	4.55	<0.001

DISCUSSION

Previous studies ([5], [7], [14]) reported low thiamine level in pregnancy. This present study also shows that thiamine level is reduced significantly towards delivery (P<0.001). Thiamine requirements are increased during pregnancy and lactation, increased thiamine requirements is as a result from sequestration of the vitamin by the fetus and placenta ([5]). Food and Nutrition Board, Institute of Medicine ([15]) gave required daily allowance (RDA) of thiamine for pregnant women to be 1.4mg/d. but these recommendations is only for a biochemically healthy individual ([8]). Report of high incidence of thiamine deficiency during pregnancy and lactation have previously been reported in India, Malaysia, Ghana and Thailand where stable diet of milled or polished grains instead of brown rice is been consumed, and also the consumption of food rich in thiaminases was also implicated ([5]). In Nigeria thiaminase was found in pupae of an African silkworm that is consumed as a source of protein ([16]).

The low thiamine level among pregnant women in Zaria may be attributed to the fact that there is high ingestion of simple carbohydrate in all its different forms. Derrick ([8]) reported that ingestion of simple carbohydrate results into high calorie malnutrition, and because thiamine is a major factor in the metabolism of glucose, there is an automatic increase in the need for dietary thiamine. Thus high calorie malnutrition is commonly associated with relative thiamine deficiency irrespective of its fortification in food substances ([8]).

This present study also shows that thiamine level has significant relationship or association with educational level of the pregnant women (P<0.001), with the women who have had tertiary education or who are in tertiary institutions having higher thiamine level than those who have had secondary, primary or who have never received any formal education respectively. But however when the pregnant women were categorised into educated, non educated, the control group still had higher values than the pregnant educated, this is due to the fact that the pregnant women though educated still need supplementation of thiamine, because of the increase demand of thiamine in pregnancy. But however parity had no effect on thiamine level in this study, probably due to size effect.

When the women were categorised according to age group, control still had significantly higher thiamine level over the pregnant women (P<0.001). This shows that irrespective of age there is an increase demand of thiamine during pregnancy.

CONCLUSION

In this part of the country where diet is loaded with simple carbohydrate, there will be need for fortification of thiamine because of its biochemical association with glucose metabolism. It is also well established that thiamine requirements are increased during pregnancy and lactation. Considering the fact that women, especially those in low socioeconomic class have low nutritional standards and their carbohydrate intake is high, it will become necessary for supplementation of thiamine in their diet. But in general irrespective of age, educational level or socioeconomic status, there is a need for vitamin supplementation especially thiamine for pregnant women, because vitamins and minerals are very important in the oxidative processes of the body, since these processes requires oxygen, fuel and catalyst for their normal functions.

RECOMMENDATIONS

This study was able to take only a cross-sectional study. A longitudinal study can be conducted involving more pregnant women and from more hospitals so as to establish the fact that pregnant women in Zaria, Nigeria have low thiamine level, because there is an urgent need for adequate thiamine supplementation in high-risk population, of which Zaria is one. The cultural stigma associated with consumption of brown rice which is considered to be a food for the poor should be discouraged and a return to traditional brown rice is highly recommended. There is also a need to ascertain the effect of low thiamine level on birth weight. There is a need also to conduct a study of thiamine level in lactating mothers and its effect on the babies.

References

1. Piperata B, Dufour DL, Reina JC, Spurr GB. Anthropometric characteristics of pregnant women in Cali Colombia and relationship to birth weight. Am J Hum Biol 2002; 1429-38.
2. Rockwell CL, Vargas E, Moore LG. Human physiological adaptation to pregnancy: inter-and intraspecific perspectives. Am J Hum Biol 2003; 15:330-341.
3. Kirchengast S, Hartmann B. Impact of maternal age and maternal somatic characteristics on newborn size. Am J Hum Biol 2003; 15:220-228.
4. Murray RM, Granner DK, Mayes PA, Rodwell VW. Harper's illustrated biochemistry. Twenty-sixth edition, Mc Graw Hill. New York, 2003; p 488-489.
5. Butterworth RF. Maternal thiamine deficiency: still a problem in some communities. Am J Clin Nutr 2001; 74:712-713.
6. Baker H, Frank O, Thompson AD, et al. Vitamin profile of 174 mothers and newborns at parturition. American Journal Clinical Nutrition 1975; 28:59-65.
7. Mc Gready R, Simpson JA, Cho T, et al. Postpartum thiamine deficiency in a Karen displaced population. Am J Clin Nutr 2001 74:808-13.
8. Derrick L. A review of the biochemistry, metabolism and clinical benefits of thiamine and its derivatives. Advanced Access Publication Ecam 2006; 3:49-59
9. World Health Organization. Thiamine deficiency and its prevention and control in major emergencies. Report No: WHO/NHD/99-13 Geneva: Department of Nutrition for Health and Development 1999.
10. Fatal-Valegski A, Kesle A, Sela B, Nitzan-Kaulski D, Rotste M, Mesterman R et al. Outbreak of life threatening thiamine deficiency in infants in Israel caused by defective soy based formula. Pediatrics 2005; 115:33-8
11. Vimokesant SL, Hilker DM, Nakornchai, S, Rungruangsak K, Dhanamitta S. Effects of betel nut and fermented fish on the thiamin status of northeastern Thais. Am J Clin Nutr 1975; 28:1458-63.
12. Davis RE, Leke GC. Clinical chemistry of thiamin. Adv Clin Chem 1983; 23:93-140.
13. Barker H, Frank O, Fennelly JJ, Leevy CM.. A method for assaying thiamine status in man and animals. Am J Clin Nutr 1964; 14: 197-201.
14. Osho Y. Thiamine profile in pregnant women in Zaria. Undergraduate Project Submitted to the Department of Human Physiology, A.B.U. Zaria 2004.
15. Institute of Medicine, Food and Nutrition Board. Dietary reference intakes (DRIs): Recommended intakes for individual vitamins. 2004.
16. Nishimune T, Watanable Y, Okazaki H, Akai H. Thiamine is decomposed due to anaphe spp. Entomophagy in seasonal ataxia patients in Nigeria. J Nutr 2000; 130:1625-8.

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