ORIGINAL ARTICLE

Parity related changes in obesity and some antioxidant vitamins in non-pregnant women of South-Eastern Nigeria

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Abstract

Background: The delivery of many children at short interval is associated with micronutrient depletion and weight gain. However, the relationship between the levels of the micronutrients and the body weight is yet to be ascertained.
Objectives: To determine the relationship between parity, body weight and some antioxidant vitamins in non-pregnant Nigerian women.
Patients and Methods: Randomly recruited 200 non-pregnant women, comprising 82 primiparous and 118 multiparous women completed the study. Their age, parity, mid-arm circumference (MAC), waist circumference (WC), weight, height and body mass index (BMI) were determined. The serum levels of vitamins A, C and E were assayed using standard methods.
Results: The mean BMI, WC and MAC of the multiparous subjects (parity = 3.0 ± 0.58) were significantly higher than that of the primiparous subjects (parity = 1), ($P < 0.05$, $P < 0.01$ and $P < 0.01$ respectively). Furthermore, there were statistically significant decrease in the vitamin A, vitamin C and vitamin E in multiparous compared with the primiparous women ($P < 0.005$, $P < 0.05$ and $P < 0.005$), respectively.
Conclusion: Multiparty enhances weight gain, but depletes antioxidant vitamin micronutrients in non-pregnant Nigerian women.

Key words: Obesity, pregnancy outcome, antioxidant vitamins, parity

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Introduction

The body mass index (BMI) is a simple, widely accepted and universally used tool for representing weight status. According to the World Health Organization and the National Institute of Health guidelines, women with BMI of 18.5-24.9 have normal weight, whereas women with BMI of <18.5 are underweight, and those with BMI of 25.0-29.9 and ≥30 are overweight and obese, respectively.[1,2]

It is well established that being overweight and obese are associated with a variety of adverse health outcomes such as cardiovascular disease, some types of cancer, diabetes, stroke, respiratory problems and arthritis[2-4] and a host of pregnancy-related complications, such as gestational diabetes mellitus (GDM), pre-eclampsia, eclampsia, cesarean delivery, large for gestational age (LGA) infants, early neonatal death, still births after 28 weeks gestation.[5,6]

Antioxidant vitamins are essential for the healthy growth and function of both, humans and animals. They play essential roles

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in cellular metabolism, maintenance and growth throughout the life. They are also central components of many enzymes and transcription factors. They are micronutrients that prevent peri-oxidative damage, either in the cell membranes or in the cytoplasm and are essential for a well-functioning immune system.[7,8] The antioxidant vitamins A and E are of particular importance during pregnancy as both excesses and deficiencies can have profound and sometimes persistent effects on many fetal tissues and organs in the absence of clinical signs of deficiency in the mother.[9]

Following the adverse effects of overweight, obesity, deficiency and excess of antioxidant vitamins on health of both, the mother and the baby, it is now being recommended that women of child-bearing age and their healthcare providers should work together to assess and address the weight issue and the antioxidant vitamin status before, during and after pregnancy. Nutritional deficiencies occur in pregnancy and an impact is felt more in poor socio-economic settings prevalent in Sub-Saharan Africa, including Nigeria. The situation is further aggravated by too many unplanned pregnancies, which tend to deplete maternal micronutrient stores. Consequently, all forms of micronutrient supplementation are administered during pregnancy and lactation irrespective of pre-pregnancy weight and plasma levels of the micronutrients.

Unfortunately, there is dearth of data on the weight status and antioxidant vitamin level in urban Eastern Nigerian women. Thus, this study was designed to investigate whether the number of pregnancies this group of women have had would affect BMI and some antioxidant vitamins in the non-pregnant and non-lactating states.

Patients and Methods

Study area

The study was done in Enugu, which is located at about 230 m above sea level. An average annual temperature is between 23.1°C and 31°C with a rainfall of 1520 mm to 2030 mm. There are two major seasons; rainy season (March to October) and dry season (November to February). It has a mixed rural and urban population with the majority being Igbo's, with a population of about 464,514 inhabitants, of which 52.1% are female.

Study design and setting

This is a cross-sectional study that was undertaken between 3rd March and 31st December 2009. The subjects were 200 non-pregnant women (82 primiparous and 118 multiparous) made-up of staff working at University of Nigeria and University of Nigeria teaching hospital, Enugu. They belonged to the same social class. Exclusion criteria included pregnancy and lactation, febrile conditions, diabetes mellitus, chronic renal disease, sickle cell anemia and HIV infections. After obtaining an ethical clearance and informed verbal consent, the subjects, that met the above criteria, were randomly recruited by simple random sampling using a lucky dip of yes or no. The subjects were not on vitamin A, C or E supplementations. Personal history, past obstetric history, past medical history, family and social history and review of the systems were obtained. A 24 hour dietary history was obtained and caloric as well as vitamins A, E and C contents were estimated using the nutrient composition of commonly eaten foods in Nigeria[10] and other parts of the world.[11] History and medical examination were performed. Pregnancy was excluded by performing an examination on the last day of the menstrual period, after a negative early morning urine pregnancy test. Participants were told to have an overnight fast with the last meal before 10 pm the previous night. Previous studies in the same population were few and did not use the same units of measurement. As a result, in a pilot study conducted with 50 subjects in each group, the widest SD obtained among the 3 micronutrients measured was 6.78, while the narrowest mean difference obtained was 2.65. Using Statmate for windows version 2.0, the minimum sample size (per group) required getting to one-sided percentage point of the normal distribution; corresponding to 80 % power and % point of the normal distribution corresponding to the one-sided significance level of 5% is 80. However, in order to make room for attrition, 120 women per group were initially recruited, but only 82 primiparous and 118 multiparous women completed the study. The weight was measured to the nearest 0.1 kilogram using a standard scale (STADIOMETER, SECA, MODEL 220, GERMANY). Before each measurement, the stadiometer was adjusted to ensure standardization. The height was measured to the nearest 0.1 cm with the same instrument without shoes, with the feet together, standing as tall as possible with the eyes level and looking straight ahead. The body mass index (BMI) was calculated from the formula; weight in kg divided by height in meter square. The mid-arm and waist circumference were measured to the nearest 0.1 cm using a measuring tape. The waist circumference was measured by locating the iliac crest, and thereafter, applying a tape mid way between the lower rib and the iliac crest, by wrapping it round the participants. All the information was recorded on a pre-tested interviewer administered questionnaire.

Estimation of antioxidant vitamins

After an overnight fast, the volar surface of the arm was cleansed with cotton wool moistened with methylated spirit. About 5 ml venous blood was collected from the antecubital vein of the subjects using sterile, disposable syringes and transferred into sterile plain tubes. Samples were allowed to stand for about 30 minutes to clot and then centrifuged at 3,500 rpm for 10 minutes. The serum was collected and kept frozen in the refrigerator at a temperature of -70°c. Vitamin C was determined by colorimetric method using dinitro phenyl-hydrazine,[12] while vitamin E was determined by the absorptiometric method in ferric chloride oxidation reaction.[13] Vitamin A was estimated colorimetrically using Tri fluoro-acetic Acid (TFA).[14]

Statistical analysis; this was done using SPSS version 11 computer software. Results were presented as mean and standard deviation. Test for significance was done using a student's *t*-test. *P* values ≤ 0.05 were considered significant.

Results

Some anthropometric parameters and estimated daily dietary vitamin intake are presented in Table 1. The mean BMI of the multiparous subjects (parity = 3.0 ± 0.58) was significantly higher than that of the primiparous subjects (parity = 1) (25.99 ± 1.49 vs. 22.45 ± 0.76, *P* = 0.035). There was also a significantly increased waist circumference (WC) cm (100.14 ± 3.26 vs. 87.33 ± 2.47, *P* = 0.006) and mid-arm circumference (MAC) cm (29.71 ± 1.15 vs. 25.67 ± 0.67, *P* = 0.007) in the multiparous subjects compared with the primiparous subjects. Estimated daily dietary vitamin intake did not show any significant changes (*P* > 0.05). There was no subject above the 35 kg/m^2 BMI category. Majority of the primiparous women (66%) and multiparous women (57%) were in 20-25 (kg/m^2) BMI category as shown in Table 2. Table 3 shows the concentration of the vitamins A, C and E among the various BMI categories. The level of all the vitamins was lowest among the primiparous women less than 20 kg/m^2. The values for the multiparous women did not follow any pattern. This is shown in Table 3. Table 4 shows a statistically significant decrease in the antioxidant vitamin levels (μmol/l) in the multiparous subjects compared with the primiparous subjects. Vitamin A was 39.97 ± 2.96 in multiparous vs. 53.47 ± 2.95 in primiparous (*P* = 0.004), vitamin C was 68.48 ± 5.82 in multiparous vs. 82.79 ± 5.13 in primiparous (*P* = 0.048), while vitamin E was 3.91 ± 0.31 in multiparous vs. 5.77 ± 0.39 in primiparous (*P* = 0.002).

Table 1: Some anthropometric data of subjects

	Non pregnant		*P*-values
	Primiparous	Multiparous	
Age	24.67±1.63	32.14±2.54	0.018
Weight	60.5±2.38	70.86±4.37	0.037
Height	1.64±0.03	1.65±0.02	0.390
BMI	22.45±0.76	25.99±1.49	0.035
WC	87.33±2.47	100.14±3.26	0.006
MAC	25.67±0.67	29.71±1.15	0.007
EDCI (kcal)	2160±110	2160±110	0.580
EDVAI (μmol)	24±4	26±5	0.720
EDVCI (μmol)	3970±126	3820±126	0.390
EDVEI (μmol)	14±2	15±2	0.780

BMI = Body nass index, WC = Waist circumference, MAC = Mid arm circumference, EDCI = Estimated daily calorie intake, EDVAI = Estimated daily vitamin a intake, EDVCI = Estimated daily vitamin c intake, EDVEI = Estimated daily vitamin e intake

Table 2: Distribution of subjects according to BMI categories (Kg/m^2)

	<20	20-25	25.1-30	30.1-35	>35
Primiparous					
N = 82					
Mean±sd. = 22.45±0.76					
N	14	54	14	Nil	Nil
%	17	66	17	Nil	Nil
Mean±sd.	19.09±0.56	22.34±0.43	25.93±0.30	NIl	Nil
Multiparous					
N = 118					
Mean±sd. = 25.99±1.49					
N	Nil	67	34	17	Nil
%	Nil	57	29	14	Nil
Mean±sd.	Nil	20.00±0.01	25.01±0.11	32.99±1.79	Nil

Table 3: Antioxidant vitamin levels according to BMI categories

BMI (Kg/M^2)	<20	20-25	25.1-30	30.1-35	>35
Vitamin A (μmol/l)					
Primiparous	41.37±1.02	54.54±1.89	64.49±1.06	Nil	Nil
Multiparous	Nil	39.96±4.95	41.58±5.36	38.38±6.45	Nil
Vitamin C (μmol/l)					
Primiparous	60.40±2.58	89.48±4.27	98.49±0.41	Nil	Nil
Multiparous	Nil	68.73±10.34	70.32±12.08	66.39±10.84	Nil
Vitamin E (μmol/l)					
Primiparous	5.33±0.79	6.60±0.34	5.37±0.77	Nil	Nil
Multiparous	Nil	3.78±0.50	3.85±0.58	4.11±0.69	Nil

Table 4: Serum level of antioxidant vitamins between primiparous and multiparous women

Vitamins (μmol/l)	Non-pregnant		*P*-values
	Primiparous	Multiparous	
Vitamin A	53.47±2.95	39.97±2.96	0.004
Vitamin C	82.79±5.13	68.48±5.82	0.048
Vitamin E	5.77±0.39	3.91±0.31	0.002

Discussion

In the present study, we observed a significantly increased BMI, WC and MAC in the multiparous, non- pregnant subjects compared with the primiparous, non-pregnant subjects. Accordingly, the BMI for the primiparous subjects can be said to be normal, whereas, the BMI for the multiparous subjects showed a tendency toward overweight.[1,2] This may suggest a parity-related predisposition to obesity. Furthermore, the level of all the vitamins was lowest among the primiparous women less than 20 kg/m^2, and the values for the multiparous women did not follow any pattern in relation to BMI. The primiparous women under the 20 kg/m^2 BMI category may not have been taking enough nutrients and calories, and this may have affected their weight. An inconclusive pattern in the multiparous women may have been resulted from the unavailability of pre-multiparous weights and antioxidant vitamin status. Again, it may be due to the fact that all the multiparous women were lumped together as one group. The effects of WC, MAC and pre-pregnancy overweight and obesity on pregnancy outcome are well documented.[15-19] Thus, observations from this study supports the clamor for women of child-bearing age and their healthcare providers to work together to assess and address the pre-pregnancy weight issue so as to ensure optimum pregnancy outcome.

In this study, there was statistically significant decrease in the antioxidant vitamin levels in the multiparous subjects compared with the primiparous subjects. It is well recognized that the maternal antioxidant nutrition plays important roles in pregnancy outcome, growth and development of the fetus. Some of these antioxidant levels are low in pregnancy because of their increased utilization in the defense mechanisms against pregnancy-induced oxidative stress.[20] Multiparous women in our environment may not have taken adequate steps to replenish what was lost during the pregnancy. Frequent pregnancies at short intervals may also have contributed to this finding. Antioxidant vitamins play a crucial role in cellular metabolism, maintenance and growth, regulation of the expression of key developmental genes involved in the commitment of cells to specific lineages and pattern formation.[9] Specifically, vitamin C has been reported to play an important role in embryogenesis and fetal growth as well as in the progression of pregnancy and delivery.[21] Indeed, it has been reported that maternal vitamins A and C status tends to affect the fetal size.[22]

Furthermore, it has been shown that supplementation with vitamins C and E after preterm premature rupture of membranes (PPROM) is associated with statistically significant increase in difference in the number of days before delivery.[23]

Lipopolysaccharide (LPS) is a molecule that has been associated with adverse developmental outcomes including embryonic resorption, intra-uterine fetal death (IUFD), intra-uterine growth retardation (IUGR) and preterm labor through reactive oxygen species (ROS) generation. Fortunately, it has been demonstrated that, pre-treatment with ascorbic acid (vitamin C) significantly attenuated LPS-induced lipid peroxidation, decreased fetal mortality, and reversed LPS-induced retardation of fetal growth and skeletal development.[24]

Micronutrient (including antioxidant vitamins) malnutrition is prevalent in developing countries[25] and their levels are low in pregnancy.[20] The observed significantly reduced levels of vitamins A, C and E levels in the multiparous non-pregnant subjects, compared with the primiparous non-pregnant subjects further highlights an importance of a comprehensive study of the antioxidant status of the women of reproductive age, who are planning to become pregnant. This will ensure an appropriate determination of the quantity of the antioxidants vitamins needed daily for the replacement therapy before, during and after pregnancy.

Observations from this study lend credence to the importance of the pre-pregnancy weight monitoring and the use of multivitamin supplements by the women of child-bearing age, especially those who have had children and are planning of becoming pregnant.

Generally speaking, pre-pregnancy care, an essential aspect in obstetrics practice, has received little or no attention from the practitioners in our environment. Specifically, the relationship between the pre-pregnancy weight and the micronutrient levels is yet to be clearly elucidated. This study, therefore, forms a pivot through which more information should emanate from researchers in this part of the world. However, the study would have been more comprehensive and more robust if the nulliparous weight of the women were known. Furthermore, the cross section should have included nulliparous, primiparous, multiparous and grand multiparous non-pregnant women. These issues will be addressed in further studies.A 2 week dietary recall would have been better than the 24 hour recall. However, this is cumbersome and extremely difficult to accomplish in our peculiar socioeconomic circumstance.

In our poor socio-economic environment, laden with multiple micronutrient deficiencies, the need to determine the pre-

pregnancy weight and micronutrient levels should not be overemphasized. This will not only be beneficial to the woman's health, but will also improve the pregnancy outcome.

Obesity increases with parity, while some antioxidant vitamins (A, C and E) decreases with parity

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