INTAKE OF MULTIPLE MICRONUTRIENTS SUPPLEMENTATION DURING PREGNANCY AND EFFECTS ON BIRTH WEIGHTOF INFANTS IN UMUNA, ORLU LOCAL GOVERNMENT AREA, IMO STATE, NIGERIA

***Amadi, Joy A.C[1]., Asinobi, Chinagoro. O[1]., Afam-Anene, Olivia C[1]., Elo-Ilo, Jacinta. C[2]., Akujuobi, Chidinma.I[1]., Oly-Alawuba, N., and Iwuoha, Stephanie. C.[1]**

[1]Department of Nutrition and Dietetics, Imo State University P.M.B. 2000, Owerri, Nigeria.
[2]Department of Pediatrics, Nnamdi Azikiwe University, Nnewi Campus P.M.B.5001, Anambra State, Nigeria.

**Corresponding author email:Joyevans2012@yahoo.com +2347030987007*

ABSTRACT

Background: Deficiencies in micronutrients are prevalent and may occur among women of child bearing age. This may be as a result of inadequate dietary intake and nutritional status before and during pregnancy.
Objective: This study assessed the impact of micronutrients supplementation during pregnancy on birth weight of infants in Umuna, Orlu Local Government Area, Imo State, Nigeria.
Methodology: A retrospective cross-sectional study design was adopted. Mothers and infants from 0-6 months old constituted the study population. Two hundred and twenty-two mother-child pairs were recruited from two health centers in Umuna. A structured and validated questionnaire was used to collect information on micronutrient supplementation, dietary pattern using food consumption frequency and birth weight. The data collected was analyzed using Statistical Package for Social Sciences (SPSS) version 22.0.
Results: The result showed that 59.5% of the mothers were between 26-35 years. Married women were 98.2%, 54.1% were traders, 66.7% had secondary education, 76.1% had less than 3 children and 85.1% earned between ₦5,000-₦20,000 monthly. About 89% attended antenatal visit, 61.7% commenced micronutrient supplementation in second trimester while none had prenatal supplementation. Folic acid (98.2%), Vitamin C (94.6%) and vitamin B complex (83.8%) were the supplements taken once daily by the mothers while ferrous sulphate (83.8%) and multivitamin (82%) were taken 3 times daily. Less than half (23.9%) of the mothers gave birth to macrosomic (>4.0kg) babies while 9.0% gave birth to low weight (<2.5kg) babies. The result also showed that the mothers were not taking Omega 3, Zinc, Vitamin A and Calcium supplements. There was a significant ($P<0.05$) difference between supplement intake and birth weight.
Conclusion: Multiple micronutrient supplementations in pregnant women may help in improving the birth weight of infants. Therefore, nutrition education on the importance of micronutrients supplementation before and during pregnancy should be taught to women of child bearing age.

Keywords: Birth weight, Micronutrients Supplement, Pregnant women

INTRODUCTION

Birth weight is the first weight of a newborn obtained within one hour after birth before significant postnatal weight loss occurs (1). Birth weight is an important determinant of growth and survival of infants (2) and is influenced by both endogenous and exogenous factors. Every year more than 20 million infants are born with low birth weight (LBW) worldwide (1). About 3.6 million infants die during the neonatal period (3). Two thirds of these deaths occur in Southern Asia and sub-Saharan Africa. About 5–6 million children in Nigeria is affected with LBW every year (4). WHO (5) reported that 11.7% of neonates were born with low birth weight in Nigeria. Evidence from the 2013 Nigeria Demographic and Health Survey reported that 7.3% infants were born with LBW (4). Low birth weight babies (<2.5kg) are at higher risk of morbidity (respiratory distress, sleep apnea, heart problems, jaundice, anemia, chronic lung disorders and infections) and mortality than normal birth weight babies (6). They are also at risk of postnatal growth retardation with possible adverse long term effects on their physical and cognitive development (7).

More than one third of child's death are thought to be attributable to maternal and child under nutrition. Deficiencies in micronutrients such as folate, iron and zinc and vitamins A, B_6, B_{12}, C, E and riboflavin are highly prevalent and may occur concurrently among pregnant women (8). Micronutrient deficiencies result from inadequate intake of meat, fruits and vegetables, and infections can also be a cause. Poor

maternal dietary habit and nutritional status before and during pregnancy can cause an irreversible insult with poor health outcome among children (9, 10).

Despite the consensus opinion that food based approach is the recommended strategy for the prevention of micronutrient deficiency; literature provides the basis for the adoption of supplementation programmes in certain circumstances such as in cases of severe deficiencies (3). Poor quality diet, inadequate food intake, poor absorption and metabolism, improper methods of food preparation combined with increased nutrient requirement for placental and fetal growth can lead to multiple micronutrient deficiencies during pregnancy and thus contribute to higher rates of low birth weight (3). Prevalence of micronutrient deficiencies such as folate, iron, zinc, vitamin A, B complex, C and E has been indicated among pregnant women in developing countries (11). In Nigeria, micronutrient deficiency such as anemia in pregnant women vary across the region with a prevalence of 76.5% in Abeokuta, South Western region (12), 60.0% in Abakaliki (13) and 40.4% in Enugu, South Eastern region respectively (14). Most studies reviewed maternal nutrition and birth outcomes by investigating single nutrients in isolation which is necessary for an in-depth study of the complex issues involved. However, nutrient deficiencies are generally found in low socio-economic populations, where multiple rather than single deficiencies are involved (15); and there are few studies that address and bring together the broader picture of multiple nutrient deficiencies (16).There is dearth of information on maternal micronutrient deficiency and effects on birth weight. This study was aimed to assess the impact of multiple micronutrient supplementations during pregnancy on children's birth weight.

MATERIALS AND METHODS

Study Area

The study was conducted in Umuna, Orlu Local Government Area (LGA), Imo State, Nigeria. Orlu is the second largest town in Imo State. According to 2006 National Population Census, the total population of women within the age group of 18-45 years old in Orlu was 196, 257 (17). The occupation of most women in the study area includes farming, trading, civil servants, artisans and housewives.

Study Design

A retrospective cross sectional survey design of mothers and infants who attended maternal and child health clinic in two health facilities was adopted for the study.

Sample Selection

Two health facilities, Umuna Primary Health Centre and Imo State University Teaching Hospital Orlu were purposively selected for the study because of their involvement in maternal and child health care. In each health centre, mothers who came for postnatal and immunization programmes at the time of study were recruited for the study. The study lasted for 3 months. In each health centre, a total of 111 mother-child pairs was selected which gave a total of 222 mother-child pairs.

Informed Consent

The respondents were provided with informed consent form, which they signed / thumb printed before the study was commenced.

Data Collection

Questionnaire

A structured and validated questionnaire was used to obtain information on mothers' characteristics, types of supplement taken and food consumption frequency during pregnancy. The questionnaire was interviewer administered to illiterate mothers.

Anthropometry

The weight of the full term infants at birth was obtained from the mothers and hospital records. The birth weight was categorized using WHO 2010 Growth Standard as follows low birth weight (<2.5kg), normal birth weight (2.5kg-4.0kg) and macrosomia (>4.0kg) (18, 19).

Dietary Assessment

The food consumption frequency of the women of child bearing age (18-45years) during pregnancy was determined using a food frequency questionnaire consisting list of foods from different food groups with portion sizes and frequency of consumption.

Statistical Analysis

Statistical Package for social sciences (SPSS) version 22.0 was used for data analysis. Frequencies, means and percentages were calculated for general characteristics of the mothers, micronutrient supplement intake by the mothers, birth weight of the children, food consumption frequency. Chi-square was conducted to check significant association between supplement intake by the mothers and children's birth weight. The decision criterion for accepting or rejecting all variables were set at 0.05 level of significance ($P<0.05$).

RESULTS

Table 1 shows the general characteristics of the mothers. More than half (59.5%) of the mothers were between 26-35years, 18-25 years were 21.6% and 36-45 years were 18.9% of age. Majority (98.2%) of the mothers were married, 54.1% were traders 66.7% attained secondary education, 76.1% had less than three children and 85.1% earned ₦5,000-20,000 income monthly. Majority (89.2%) of the mothers attended antenatal classes. More than half (61.7%) of mothers commenced micronutrient supplement intake

in second trimester, 29.3% third trimester and 9% first trimester of pregnancy. None of the women took micronutrients supplement before conception.

About (98% - 95%) of the mothers took folic acid and vitamin C respectively, 80% vitamin B complex and ferrous sulphate, and 52% multivitamin three times daily (Table 2). More than 80% took vitamin B complex and ferrous sulphate three times daily respectively. None of the mothers took Omega 3, Zinc, Vitamin A and Calcium supplements. Table 3 shows the birth weight of the children. Some (23.9%) of the children were macrosomic (>4.0kg), 9.0% were below normal birth weight (<2.5kg) and 66.7% had normal birth weight (2.5-4.0kg).

A positive significant ($p<0.05$) associations were observed between micronutrient supplement intake by the mothers and birth weight of their children (Table 4). None of the mothers who had low birth weight babies took ferrous sulphate three times daily while 23.9% of mothers with macrosomic babies and 59.9% of mothers with normal birth weight babies took ferrous sulphate three times daily. Mothers (3.6%) who took ferrous sulphate twice per day had babies who had birth weight of <2.5kg while 7.2% had infants with normal birth weight. Mothers with low birth weight babies that took ferrous sulphate once/day were 5.4%. Less than one quarter (23.9%) of the mothers who took vitamin B complex supplement had macrosomic babies while 59.9% had normal birth weight babies. About three percent of mothers with <2.5kg weight babies took vitamin B complex supplement twice per day while 5.4% took vitamin B complex once per day. Folic acid intake by 65.3% the mothers during pregnancy resulted in normal weight babies, 23.9% macrosomic babies and 9.0% low birth weight babies. Multivitamin supplement intake three times per day by 18.0% of the mothers during pregnancy resulted in 48.2% normal birth weight babies while 40% macrosomic babies and 15.8% low birth weight babies. Majority (67.1%) of the mothers who took vitamin C supplement had normal weight babies while 23.9% had macrosomic and 9.0% low had birth weight babies.

Table 5 shows the food frequency consumption by the mothers. In meat, milk and legume group, majority of the women consumed beef (87.4%), chicken (72.5%), fish (69.4%), egg (98.2%), crayfish (65.3%), and bean cake (67.6%) on weekly basis, while the highest occasionally consumed foods include yogurt (65.3%), ice cream (74.8%), snail (53.2%), breadfruit (52.7%) and soybean (54.1%). In cereals and grains; pap, bread, and maize were mostly consumed by the women on weekly basis 59.9%, 89.2% and 67.6% respectively. In root and tubers, some women consumed cocoyam (40.1), garri (45.9), and plantain (45.5%), while less than half consumed yam (29.3%), cocoyam (40.1%), and fermented cassava fufu (24.3%) on weekly basis. In fruits and vegetable group, majority of the women consumed watermelon (68.9%), banana (65.3%), tomatoes (92.8), onions (65.8%), pepper (76.6%), pumpkin leaf (64.0%) and bitter leaf (91.0%) on weekly basis. In fats and oil group, groundnut oil (68.9%), palm oil (96.4%), and groundnut (63.1%) were mostly consumed by the women on weekly basis. None of the women consumed butter, groundnut oil, palm oil, melon seed, and groundnut on daily basis except 5.4% of the women that took cashew nuts.

Table 1: General Characteristics of the Mothers

Variables	Frequency (n)	Percentage (%)
Age (yrs)		
18-25	48	21.6
26-35	132	59.5
36-45	42	18.9
Total	**222**	**100.0**
Material status		
Single	4	1.8
Married	218	98.2
Total	**222**	**100.0**
Occupation		
Trading	120	54.1
Civil service	37	16.7
Housewife	4	1.8
Artisans	57	25.7
None	4	1.8
Total	**222**	**100.0**
Level of Education		
Secondary school	148	66.7

Higher education	74	33.3
Total	**222**	**100.0**
Parity		
Less than 3	169	76.1
3-5	53	23.0
Total	**222**	**100.0**
Monthly Income		
Below N5,000	8	3.6
N5,000-20,000	189	85.1
N21,000-50,000	25	11.3
Total	**222**	**100.0**
Antenatal Visit		
Yes	198	89.2
No	24	10.8
Total	**222**	**100.0**
Supplementation Commencement		
1st trimester	20	9.0
2nd trimester	137	61.7
3rd trimester	65	29.3
Total	**222**	**100.0**
Prenatal Supplementation		
Yes	0	0
No	222	100.0
Total	222	100.0

Table 2: Micronutrient Supplements Intake by the Mothers

Variable	**Once**		**Twice**		**3 times daily**		**Total**	
	F	(%)	F	(%)	F	(%)	F	(%)
Folic Acid	218	98.2	4	1.8	0	0.0	222	100.0
Vitamin B complex	16	7.2	20	9.0	186	83.6	222	100.0
Ferrous Sulphate	12	5.4	24	16.2	186	83.8	222	100.0
Vitamin C	210	94.6	8	3.6	4	1.8	222	100.0
Multivitamin	8	3.6	32	14.4	182	82.0	222	100.0
Omega 3	0	0	0	0	0	0	222	100.0
Vitamin A	0	0	0	0	0	0	222	100.0
Zinc	0	0	0	0	0	0	222	100.0
Calcium	0	0	0	0	0	0	222	100.0

Key: F= frequency %= percentage

Table 3: Birth Weight of the Children

Birth weight (kg)	Frequency (f)	Percentage (%)
<2.5	**20**	**9.0**
2.5-4.0	**149**	**66.7**
>4.0	**53**	**23.9**
Total	**222**	**100.0**

Table 4: Relationship between supplement intake and birth weight

Micronutrient	<2.5kg		2.5-4.0kg		>4.0kg		Total		X^{2} value	P value
Supplement	**N**	**(%)**	**N**	**(%)**	**N**	**(%)**	**N**	**(%)**		
Ferrous Sulphate										
Once	12	(5.4)	0	0	0	0	22	(5.4)	204.466	0.000
Twice	8	(3.6)	16	(7.2)	0	0	24	(10.8)		
3 times daily	0	0	133	(59.9)	53	(23.9)	186	(83.8)		
Total	**20**	**(9.0)**	**149**	**(67.1)**	**53**	**(23.9)**	**222**	**(100.0)**		
Vitamin B Complex										
Once	8	(3.6)	8	(3.6)	0	0	16	(7.2)	148.495	0.000
Twice	12	(5.4)	8	(3.6)	0	0	20	(9.0)		
3 times daily	0	0	133	(59.9)	53	(23.9)	186	(83.8)		
Total	**20**	**(9.0)**	**149**	**(67.1)**	**53**	**(23.9)**	**222**	**(100.0)**		
Folic Acid										
Once	20	(9.0)	145	(65.3)	53	(23.9)	218	(98.2)	16.479	0.001
Twice	0	0	4	(1.8)	0	0	4	(1.8)		
Total	**20**	**(9.0)**	**149**	**(67.1)**	**53**	**(23.9)**	**222**	**(100.0)**		
Multivitamin										
Once	3	(3.6)	20	(9.0)	8	(3.6)	4	(3.6)		
Twice	4	(1.8)	20	(9.0)	8	(3.6)	4	(13.8)	8.033	0.045
3 times daily	35	(15.8)	107	(48.2)	40	(18.0)	182	(81.9)		
Total	**47**	**(21.2)**	**127**	**(57.2)**	**48**	**(21.6)**	**222**	**(100.0)**		
Vitamin C										
Once	12	(5.4)	145	(65.3)	53	(23.9)	210	(94.6)	100.063	0.000
Twice	8	(3.6)	0	0	0	0	8	(3.6)		
3 times daily	0	0	4	(1.8)	0	0	25	(86.2)		
Total	**20**	**(9.0)**	**149**	**(67.1)**	**53**	**(23.9)**	**222**	**(100.0)**		

Table 5: Food Consumption Frequency

Food Group	Daily		Weekly		Occasional		Never		Total	
	N	%	n	%	N	%	n	%	n	%
Meat, Milk and Legume										
Milk	8	49.1	81	36.5	52	23.4	0	0.0	222	100.00
Yoghurt	0	0.0	0	0.0	145	65.3	77	34.7	222	100.00
Ice Cream	0	0.00	16	7.2	166	74.8	40	18.0	222	100.00
Beef	16	7.2	194	87.4	12	5.4	0.	0.0	222	100.00
Chicken	56	25.7	158	72.5	4	1.8	0.	0.0	222	100.00
Fish	12	5.4	154	69.4	56	25.2	0.	0.0	222	100.00
Egg	0	0	218	98.2	4	1.8	0.	0.0	222	100.00
Crayfish	4	1.8	145	65.3	65	29.3	8	3.6	222	100.00
Snail	4	1.8	84	37.8	118	53.2	16	7.2	222	100.00
Beans	13	5.9	160	72.1	41	18.5	8	3.6	222	100.00
Breadfruit	12	5.4	93	41.9	117	52.7	0	0.00	222	100.00
Soyabeans	8	3.6	82	36.9	120	54.1	12	5.4	222	100.00
Bean cake	28	12.6	150	67.6	44	19.8	0	0.0	222	100.00
Cereals and Grains									222	100.00
Pap	41	18.5	133	59.9	36	16.2	12	5.4	222	100.00
Bread	12	5.4	198	89.2	8	3.6	4	1.8	222	100.00
Rice	48	21.6	150	67.6	24	10.8	0	0.0	222	100.00
Maize	0	0.0	81	36.5	129	58.1	5	2.2	222	100.00
Roots and Tubers									222	100.00
Yam	8	18.5	149	67.1	65	29.3	0	0.0	222	100.00
Cocoyam	12	5.4	89	40.1	89	40.1	32	14.4	222	100.00
Garri	92	41.4	102	45.9	28	12.6	0.	0.0	222	100.00
Fermented cassava fufu	4	1.8	144	64.9	54	24.3	20	9.0	222	100.00
Plantain	4	1.8	101	45.5	117	52.7	0	0.0	222	100.00
Fruits and vegetables										
Orange	57	25.7	133	59.9	32	14.4	0	0.0	222	100.00
Pineapple	0	0.0	122	55.0	100	45.0	0	0.00	222	100.00
Paw-paw	24	10.8	77	34.7	117	52.7	4	1.8	222	100.00
Apple	29	13.1	101	45.5	92	14.4	0	0.0	222	100.00
Watermelon	0	0.0	153	68.9	69	31.1	0	0.0	222	100.00
Banana	28	12.6	145	65.3	41	18.5	8	3.6	222	100.00
Tomatoes	0	0.0	206	92.8	16	7.2	0	0.0	222	100.00
Onion	0	0.0	146	65.3	41	18.5	8	3.6	222	100.00
Pepper	0	0.0	170	76.6	40	18.0	12	5.4	222	100.00
Okra	0	0.0	58	26.1	152	68.2	12	54	222	100.00
Waterleaf	0	0.0	76	34.2	130	58.6	16	7.2	222	100.00
Pumpkin leaf	0	0.0	142	64.0	80	36.0	0	0.0	222	100.00
Bitter leaf	0	0.0	202	91.0	20	9.0	0	0.0	222	100.00
Fats & Oil										
Butter	0	0.0	12	5.4	81	36.2	129	58.1	222	100.00
Groundnut oil	0	0.0	153	68.9	69	31.1	0	0.0	222	100.00
Palm oil	0	0.0	214	96.4	8	3.6	0	0.0	222	100.0
Melon seed	0	0.0	68	30.9	152	69.1	0	0.0	222	100.00
Cashew nut	12	5.4	186	83.8	16	7.2	8	3.6	222	100.00
Groundnut	0	0.0	140	63.1	74	33.3	8	3.6	222	100.0

DISCUSSION

Majority of the women were within the age group of 18-25 and 26-35 years, this is because more women are getting married at the beginning of their reproductive year as shown by high number of married women in the study (20). About half of the women studied were traders even though majority of them had secondary school education (21). This could be as a result of unemployment in the country.

Though it was contrary to the study by Oguiz (20) who reported that most of the secondary school leavers were civil servant. Most respondents were earning monthly income of ₦5000-₦20,000 an average of ₦12,500 which is less than one dollar per day. This shows that many people are still living below poverty line in the study area. However, this could explain why the household size was less than three. Income affects household nutritional status and amount of food available for every member of the family.

High intake of multiple micronutrient supplement observed in this study could be as a result of antenatal care classes the mothers attended. Adequate intake of folic acid has been shown to reduce low birth weight and the risk of neural tube defects (21). The result of this study is consistent with the study by Anzaku (22) where 83% of the child age took folic once acid daily. It was observed that 94.9% of the women took vitamin C once daily instead of three times daily as recommended by the physicians. Vitamin C helps in absorption of Iron (Ferrous sulphate) necessary for red blood cells production. Iron supplement intake observed in the study agrees with Ugwu*et al.* (23) though it was contrary to the study by Dairo and Lawoyin (24) who reported that 37.5% of the women took iron supplement. Vitamin B complex and multivitamin supplement intakes by the mothers were also high (10).

The prevalence of low birth weight (LBW) in the present study was similar to the findings by Ugboma and Onyearugha (25), where 8.3% low birth weight was observed. However, it is lower than figures obtained in other studies (26, 27) but higher than that observed by Takai *et al.* (28), in Maiduguri, Nigeria. Differences in nutritional status, socioeconomic factors, health status, life style and micronutrient intake could be accounted for the observed variations in previous studies (29). Low birth weight is a major determinant of infant mortality and morbidity. Infants with high birth weight were more than that reported by Onyirinka (30) which indicated 8.1% in the Benin, Nigeria though higher 76.6% observed by Onalo*et al.* (31).

The study observed a positive significant ($P<0.05$) relationship between micronutrient supplementation and birth weight of infants. Majority of the infants had normal birth weight (2.5kg - 4.0kg) which indicates that multiple micronutrient supplement intake improves birth weight. This is consistent with other studies on the effect of micronutrient supplementation on birth weight (5, 11) but contrary to Zeng *et al.* (32). Zeng *et al.* (32) in their study did not observe significant relationship between iron and folic acid supplementation on birth weight of infants. This could be as a result of folate and iron rich food consumed by the women. Supplement alone without dietary intake may not give a satisfactory result in folate status because about half of dietary folate is in a reduced form while 100% of the folic acid contained in multivitamin and mineral supplement is unreduced (33). Vitamin B complex was significantly associated with birth weight. The study observed high normal birth weight infants among mother that took vitamin B complex 3 times per day. Vitamin B is essential for cellular growth and differentiation as well as for DNA methylation and could be an independent factor for fetal development (34) and was reported to have a positive relationship with birth weight (35). Multivitamin intake had significant effect on birth weight. Majority of the women (81.9%) were taking the supplement three times daily and it resulted in the overall increase in birth weight. Multivitamin intake improves appetite (36), which is a mechanism for maternal weight gain and subsequent positive effect on birth weight (37). Also multivitamin have been implicated to have a role in protein and energy metabolism which could affect fetal growth by improving micronutrient handling by the fetus (38). However, low birth weight (21.2%) was observed in the study, this may be associated with the low purchasing power among the women (39). The women were living below poverty level with an average of ₦12,500 per month (40). Vitamin C intake was significant with birth weight of the babies. This is consistent with the study by Siddiqui *et al.* (41) on effect of vitamin C on birth weight of new born babies. Maternal oxidative stress plays an important role in the pathophysiology of low birth weight (42) and vitamin C is an anti-oxidant which would help in fighting the oxidative stress. Also dietary consumption of fruits and vegetables by the women enhanced their vitamin C status.

In conclusion, maternal micronutrient supplementation enhanced pregnancy outcome by significantly reducing low birth weight. Pre-pregnancy micronutrients supplementation should be taken by women of child bearing age to enhance child birth weight. More research is needed to address the safety, efficacy and effective delivery of maternal micronutrient supplementation.

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