

# Dietary Patterns and Nutrient Adequacy of Diets Consumed by Pregnant Women in Nsukka Area of Enugu State, Nigeria.

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## ABSTRACT

**Background:** Adequate nutrition during pregnancy is essential to support fetal growth and physiological changes in the body of the mother, and had been associated with good pregnancy outcomes.

**Objective:** This study assessed the dietary patterns and nutrient adequacy of diets consumed by pregnant women in Nsukka Area of Enugu State, Nigeria.

**Methods:** The cross-sectional survey design was adopted for the study. Multistage sampling technique was used to obtain representative sample of 386 pregnant women. Food frequency questionnaire was used to collect data on respondents' dietary patterns. Nutrient intakes were assessed by 3-day weighed food intake study, and were analyzed as percentages of FAO/WHO daily nutrient requirement values for pregnant women. Descriptive statistics were carried out on data collected.

**Results:** Respondents consumed varied nutrient sources (mostly plant-based) which led to adequate intakes of most nutrients. However, niacin and riboflavin intakes were lower (12.2mg [72.6%] and 0.95mg [63.3%], respectively) than requirements due to low consumption of animal foods. Starchy roots/tubers made highest contribution to respondents' energy (591Kcal [23%]) and carbohydrate (124Kcal [34.7%]) intakes. Legumes contributed most to protein (35.2g [52.3%]), iron (11.2mg [41.9%]), thiamin (0.8mg [53.3%]) and niacin (4.05mg [33.2%]) intakes. Fruits and vegetables contributed most to riboflavin (0.3mg [31.6%]), ascorbic acid (121mg [77.7%]) and calcium (317mg [33.8%]) intakes.

**Conclusion:** Nigerian plant-based foods, when well mixed to complement one another and with proper preparation techniques to conserve sensitive nutrients, can provide adequate amount of nutrients. Promotion of traditional dishes and proper processing technique through nutrition education of women is therefore, imperative. Again, animal foods should be made more affordable through government subsidization.

**Keywords:** Dietary intakes, pregnant women, Nsukka

## INTRODUCTION

Adequate nutrition during pregnancy is essential to support optimal growth of the fetus and the physiological changes that occur in the body of the pregnant woman. The formation of fetal organs and rapid growth of the fetus lead to increased nutrient needs which necessitate increase in both the diversity and amount of food consumed by pregnant women (1, 2). Pregnancy

is shown to be a critical window of opportunity which begins the determination of the fate of a fetus (3), and maternal nutritional status during pregnancy has been repeatedly demonstrated to be associated with pregnancy outcomes for the infant (4). Poor nutrition often starts in-utero and nutrient deficits before birth can never be fully reversed after birth (5).

In addition, women are the crucial link between the family and the family's nutrition, as well as the traditional and modern health systems. Women throughout most parts of the world have the responsibility for their families' nutrition while their own nutrition is often impaired due to the social and biological stresses they face. They simultaneously exercise roles in economic production, home production and reproduction, often with damaging consequences for their own nutritional status (6). It is obvious that proper nutrition throughout the life-cycle of a woman would make her healthier and able to pursue her multiple responsibilities more efficiently, making their children to thrive better and their entire families, communities and nations healthier and economically better-off.

Unfortunately, pregnant women in developing countries have been observed to consume diets with low contents of minerals and vitamins. Their food choices are based on ignorance, misconceptions, superstitions and traditional/cultural beliefs resulting in poor dietary patterns and lifestyles (7). It has also been observed that there are abundant sources of micronutrient-rich indigenous foods in some areas and people in these areas still suffer deficiencies of the micronutrients (8). It became pertinent to assess the dietary patterns and nutrient adequacy of diets consumed by pregnant women in Nsukka Area of Enugu State, Nigeria because a lot of food crops are produced in Nsukka, but a previous study (8) showed that not much was consumed by the local people because they sell most of their products to outside communities as source of income. The study was carried out with the view to building health promotion activities that would alleviate identified nutritional problems.

## **METHODS**

**Study design:** A cross-sectional survey design was adopted for the study.

**Study Area:** The study was carried out in Nsukka Local Government Area, located in the northern part of Enugu State, Nigeria.

**Study population:** The population for the study was made up of all pregnant women in Nsukka Local Government Area of Enugu State, Nigeria.

**Sample size determination and selection:** The formula  $N = Z^2P(100-P)/X^2$  was used to determine the sample size for the study, where N is the number of pregnant women required; Z is the confidence level (1.96 at 95%); P is the estimated proportion of pregnant women who were deficient in micronutrients (35.3% was assigned to P in line with result of an earlier study (9); X is margin of error (0.05). A sample size of 351 was obtained and 10% (35.1) was added to it to make room for drop-outs bringing the sample size to 386.

The sample was drawn through multistage sampling technique. Three towns were selected namely, Nsukka, Ede-Oballa and Okpuje (one from each Development Council Area) in Nsukka Local Government Area. In each town selected, two health facilities (one public and one private) were selected. The random sampling technique was used to draw the sample from the pregnant women attending antenatal clinics in six selected health facilities.

**Inclusion criteria:** Only pregnant women who had no apparent sign of ill-health and who gave their consent participated in the study.

**Exclusion criteria:** Pregnant women with apparent signs or complaint of ill-health were excluded from participating in the study.

## **Data collection**

### **Questionnaire**

A validated and pretested food frequency questionnaire was used to collect data on the socio-demographic characteristics of the respondents including their educational and income levels, and respondents' dietary patterns, food preferences and taboos. The questionnaire was administered by the researchers themselves, and each item of the questionnaire was explained to the respondents in the language they understood. The responses of illiterate respondents were elicited by interview method.

### **Validation and pretesting of Questionnaire:**

The questionnaire was validated by lecturers in the Department of Home Science, Nutrition and Dietetics, University of Nigeria, Nsukka. To ascertain its clarity, the questionnaire was pretested by administering it to 30 ante-natal women in Ibagwa-Aka Cottage Hospital in Igboeze-south Local Government Area of Enugu State.

### **Weighed food intake**

A three-day weighed food intake was used to determine the nutrient contents of foods consumed by the pregnant women. The 3 days included two week-days and one week-end day. All raw ingredients that were used in preparing each meal consumed by the respondents were weighed. The preparation methods were all noted. The whole meal after cooking was weighed and the weight of the cooking pot subtracted from it to get the actual weight of the cooked food. The respondent's food portion was weighed as well. The plate wastes were weighed and subtracted from the weight of the respondent's food portions to get the actual food intake of the subject. All snacks taken throughout the period were also weighed. The foods eaten outside the home were estimated using household measures or selling weights.

The quantity of each ingredient in the women's food portions were estimated by simple proportion from the weight of the different ingredients in the recipe. The conversion factor was obtained by dividing the actual weight of food consumed by the subject by the total weight of the cooked food. Subsequently, the weight of each recipe consumed by the subject was obtained by multiplying the conversion factor by the weight of each recipe. The nutrient intakes of the respondents were then estimated by simple proportion using Food Composition Tables (10, 11) and the means of their daily nutrient intakes calculated.

### **Ethical considerations**

Ethical approval was obtained from Ethical Committee of Enugu State Ministry of Health prior to the study. Informed consent was obtained from

the women in a culturally appropriate manner after thorough explanation of what the study entailed and its purpose, with assurance of confidentiality of all information collected. [

### **Data analysis**

Data collected were analyzed using the computer software package Statistical Product for Service Solution (version 22). Descriptive statistics were carried out on the data collected. Data from weighed food intake calculations were analyzed as percentages of FAO/WHO daily nutrient requirement values for pregnant women (12, 13).

## **RESULTS**

### **Dietary patterns of the respondents**

Table 1 shows the meal patterns of the respondents. Three meals daily was practiced by 278 (72%) respondents. Majority (337 [87.3%]) of the respondents ate snacks, most (225 [66.8%]) of which constituted of pastries. Nuts and seeds were only consumed by 22 (6.5%) respondents. Fruits and vegetables were consumed more by only 47 (13.9%) respondents. It was also shown that up to 150 (44.5%) respondents who consumed snacks did so for mere pleasure. Only 60 (17.8%) respondents consumed snacks for nourishment. A few (15 [4.5%]) respondents consumed snacks when they were too busy to cook, while 7 (2.1%) respondents consumed snacks just to keep the mouth busy.

The respondents' frequency of consumption of staple foods are presented in Table 2. Cassava, cowpea and yam were the most frequently consumed staple foods, followed by rice and bambara groundnut. These foods were consumed at least once daily by higher percentages of the respondents. The staple foods least consumed were sweet potato, african breadfruit and plantain. These were occasionally consumed by 201 (52.48%), 183 (47.53%) and 171 (44.76%) respondents, respectively.

Table 3 presents the consumption pattern of sources of fruits and vegetables. Pepper was the most frequently consumed vegetable. Up to 365 (95.3%) respondents consumed it at least once daily. Green leafy vegetables, cashew apple, and

**Table 1: Meal and snack consumption patterns of the respondents**

Meal and snack patterns	No of subjects	Percentage
<i>Number of meals per day</i>		
2	35	9.1
3	278	72.0
4 – 5	50	12.9
Not regular	23	6.0
<b>Total</b>	<b>386</b>	<b>100</b>
<i>Consumption of snacks</i>		
Yes	337	87.3
No	49	12.7
<b>Total</b>	<b>386</b>	<b>100</b>
<i>Snacks eaten</i>		
Pastries	225	66.8
Fruits and vegetables	47	13.9
Soft drinks	43	12.8
Nuts and seeds	22	6.5
<b>Total</b>	<b>337</b>	<b>100</b>
<b>Reasons for eating snacks</b>		
For pleasure	150	44.5
To satisfy hunger	90	26.7
As appetizer	8	2.37
For nourishment	60	17.8
Too busy to cook	15	4.45
To keep mouth busy	7	2.08
It is light food	7	2.08
<b>Total</b>	<b>337</b>	<b>100</b>

**Table 2: Respondents' frequency of consumption of staple foods**

Staple foods	At least once daily		2 or more x weekly		Once weekly		Occasionally		Never		Total
	F	%	F	%	F	%	F	%	F	%	
Cassava	197	51.04	75	19.43	64	16.58	42	10.88	8	2.07	386
Yam	155	40.16	103	26.68	86	22.28	42	10.88	0	0	386
Maize	66	17.10	88	22.80	115	29.79	102	26.42	15	3.89	386
Rice	140	36.27	100	25.91	111	28.75	35	9.07	0	0	386
Cocoyam	78	20.20	61	15.80	89	23.06	134	34.72	24	6.22	386
Sweet potato	24	6.27	33	8.61	65	16.97	201	52.48	60	15.67	383
Cowpea	180	47.62	90	23.81	61	16.14	47	12.43	0	0	378
Bambara groundnut	119	32.78	77	21.21	91	25.07	66	18.18	10	2.75	363
Pigeon pea	62	16.62	96	25.74	104	27.88	91	24.40	20	5.36	373
African bread fruit	46	11.95	49	12.73	58	15.06	183	47.53	49	12.73	385
Plantain	50	13.09	49	12.83	72	18.85	171	44.76	40	10.47	382

Key: x: times      F: frequency      %: percentage

**Table 3: Respondents' consumption frequency of fruits and vegetables**

	At least once daily		2 or more x weekly		Once weekly		Occasionally		Never		Total
	F	%	F	%	F	%	F	%	F	%	
Carrot	76	21.05	69	19.11	49	13.57	136	37.67	31	8.59	361
Green leafy vegetables	190	49.22	84	21.76	70	18.13	42	10.88	0	0	386
Paw paw	138	35.75	90	23.32	96	24.87	62	16.06	0	0	386
Mango	104	26.94	54	13.99	93	24.09	129	33.42	6	1.55	386
Pepper	365	95.30	4	1.04	0	0	9	2.35	5	1.31	383
Tomato	110	28.50	97	25.13	140	36.27	36	9.33	3	0.77	386
Cashew apple	173	45.17	52	13.58	66	17.23	90	23.50	2	0.52	383
Avacado pear	48	12.80	76	20.27	116	30.93	97	25.87	38	10.13	375

**Table 4: Respondents' frequency of consumption of animal foods**

Food sources	At least once daily		2 or more x weekly		Once weekly		Occasionally		Never		Total
	F	%	F	%	F	%	F	%	F	%	
Milk	19	5.07	21	5.60	25	6.67	117	31.20	193	51.47	375
Liver	36	9.68	38	10.22	52	13.98	185	49.73	61	16.40	372
Egg	44	12.19	55	15.24	74	20.50	180	49.86	8	2.22	361
Beef	58	15.89	45	12.33	71	19.45	177	48.49	14	3.84	365
Fish	228	61.62	73	19.73	52	14.05	17	4.59	0	0	370
Crayfish	279	76.44	55	15.07	31	8.49	0	0	0	0	365
Snail	8	2.20	23	6.32	48	13.19	105	28.85	180	49.45	364
Goat meat	23	6.32	36	9.89	49	13.46	234	64.29	22	6.04	364
Poultry Meat	17	4.52	38	10.11	74	19.68	242	64.36	5	1.33	376

paw-paw were the next frequently consumed. Tomato and avocado pear were consumed weekly by 140 (36.27%) and 116 (30.93%) respondents, respectively, while carrot and mango were occasionally consumed by 136 (37.67%) and 129 (33.42%) respondents, respectively.

Table 4 presents the respondents' frequency of consumption of animal foods. Most of the animal foods (milk, liver, egg, beef, goat and poultry meats) were occasional foods for greater percentages of the respondents, and snail was

never consumed by up to 180 (49.5%) respondents. Fish and crayfish were consumed at least once daily by 228 (61.6%) and 279 (77.4%) respondents, respectively.

#### Respondents' nutrient intakes

Table 5 presents the mean daily nutrient intakes of the respondents expressed as percentages of FAO/WHO daily nutrient requirement values. The respondents' energy, protein, carbohydrate, iron and calcium intakes were adequate (100.8%, 114.1%, 102.5%, 95.4% and 93.9%, respectively). The respondents' intakes of fat,

**Table 5: Mean daily nutrient intakes of respondents their percentages of FAO/WHO requirement values (FAO, 2001; FAO/WHO/UNU, 1985)**

	Ener- gy (Kcal)	Pro- tein (g)	Fat (g)	CHO (g)	Iron (mg)	Vita - min A (RE)	Thia - min (mg)	Ribo- Flavin (mg)	Niacin (mg)	Ascor- bic acid (mg)	Cal- cium (mg)
Mean intake	2570 ±531	67.3 ±7.0	77.1 ±9.4	356.8 ±67.2	26.7 ±3.8	1401.2 ±258	1.5 ±0.34	0.95 ±0.08	12.2 ±2.7	155.3 ±6.1	938.7 ±176
FAO/WHO Requirements	2550	59*	53.5	348	28	800	1	1.5	16.8	55	1000- 1200
Intake as % of Requirement	100.8	114.1	144.1	102.5	95.4	175.2	150	63.3	72.6	282.4	93.9

\*Protein requirement for average net protein utilization (NPU) of 60 and 70.

NPU 60 = staple cereal diet with few other sources of protein (use these values for diets based on starchy roots and tubers).

NPU 70 = mixed cereal-legume diet with small amounts of animal foods.

vitamin A, thiamin and ascorbic acid were much higher than the requirements (144.1%, 175.2%, 150% and 282.4%, respectively). However, their riboflavin and niacin intakes were lower (63.3% and 72.6% of the requirements, respectively).

#### **Contribution of food groups to nutrient intakes of the respondents**

Table 6 shows the percentage contributions of food groups to the daily mean nutrient intakes of the respondents. Starchy roots and tubers made

**Table 6: Percentage contributions of food groups to daily mean nutrient intakes of the respondents**

	Ener- gy (Kca)	Pro- tein (g)	Fat (g)	CHO (g)	Iron (mg)	Vita - min A (RE)	Thia - min (mg)	Ribo- flavin (mg)	Nia - cin (mg)	Ascor- bic acid (mg)	Cal- cium (mg)
Mean intake	2570	67.3	77.1	357	26.7	1401	1.5	0.95	12.2	155	939
Starchy roots and tubers	591	6.5	0.6	124	4.1	4.63	0.21	0.12	1.6	28.1	58.4
% contribution	23	9.7	0.8	34.7	15.4	0.3	14	12.6	13.1	18.1	6.2
Legumes	586	35.2	7.1	117	11.2	0.8	0.8	0.27	4.05	0	223
% contribution	22.8	52.3	10.1	32.8	41.9	0.1	53.3	28.4	33.2	0	23.8
Cereals	356	9.8	4.4	69.6	2.5	0	0.34	0.13	1.97	0	11.8
% contribution	13.9	14.6	5.7	19.5	9.4	0	22.7	13.7	16.1	0	1.3
Fruits & vegetables	69.8	6	0.78	9.58	4.56	302	0.11	0.3	2.2	121	317
% contribution	2.7	8.9	1	2.7	17.1	21.5	7.1	31.6	18	77.7	33.8
Nuts and seeds	152.7	4.73	10.7	5.93	3	0.1	0.02	0.09	0.29	0	49.8
% contribution	5.9	7	13.9	1.7	11.2	0	1.3	9.5	2.4	0	5.3
Palm oil	534	0	49.3	0	0	1076	0	0	0	0	0
% contribution	20.8	0	63.9	0	0	76.8	0	0	0	0	0
Animal foods	31.6	5.3	0.65	0.2	1.14	9	0.02	0.02	1.42	0	258
% contribution	1.2	7.9	0.2	0.1	4.3	0.6	1	2.5	11.6	0	27.5

the highest contribution to energy (23%) and carbohydrate (34.7%) intakes of the respondents. Legumes made the highest contribution to respondents' intakes of protein (52.3%), iron (41.9%), thiamin (53.3%) and niacin (33.2%). They also made substantial contribution to energy (22.8%), carbohydrate (32.8%), riboflavin (28.4%) and calcium (23.8%) intakes of the respondents. Cereals contributed substantially to energy (13.9%), protein (14.6%), carbohydrate (19.5%), thiamin (22.7%) and niacin (16.1%) intakes of the respondents. Fruits and vegetables made the highest contribution to riboflavin (31.6%), ascorbic acid (77.7%) and calcium (33.8%) intakes of the respondents. Fruits and vegetables also made substantial contribution to iron (17.1%) and vitamin A (21.5%) intakes of the respondents. Nuts and seeds accounted for 13.9% and 11.2% of fat and iron intakes of the respondents, respectively. Palm oil made the highest contribution to respondents' fat (63.9%) and vitamin A (76.8%) intakes. It also contributed substantially to energy (20.8%) intake of the respondents. Animal foods made very little contributions to most of the respondents' nutrient intakes except for calcium (27.5%) and niacin (11.6%).

## DISCUSSION

The high consumption of pastries as snacks (66.8%) in contrast to low consumption of fruits and vegetables (13.9%), nuts and seeds (6.5%) gave credence to earlier report that pregnant women in developing countries consumed diet with low contents of minerals and vitamins (7). The consumption of snacks for mere pleasure by higher percentage of the respondents was due to poor nutrition education. The consumption of snacks due to time factor confirmed earlier observation that proper feeding required time for meal preparation and consumption (7). Lack of time might lead to dependence on snacks - a commonly observed phenomenon among housewives who work long hours outside the home. Snacks in general might not meet nutrient requirements.

The high consumption of cassava, cowpea, yam,

rice and bambara groundnut followed by pigeon pea, maize and cocoyam observed in this study agreed with the results of an earlier study carried out in Nigeria (9). The high consumption of bambara groundnut was however, opposed to its low consumption found among students in Nigeria (14, 15). The high consumption this legume could be attributed to nutrition education usually received by mothers in ante-natal clinics. The low consumption of plantain and african breadfruit was attributed to high cost. This could indicate that these foods were not staple foods for the population as were cassava, cowpea, yam, rice and bambara groundnut. The foods consumed more frequently may be either preferred or were much more available and affordable; hence they are of great importance to the people's nutrition and food security.

The frequent consumption of green leafy vegetables, paw-paw and cashew apple demonstrated that these foods were available to the respondents within the study period. These results were in contrast with another report that fruits and vegetables were not essentially part of a typical diet among Nigerians (16). Vegetables are used in preparation of many dishes and sauces used in eating staple foods in Enugu State. The daily consumption of pepper by almost all (95.1%) of the respondents affirmed that most of the dishes eaten by the respondents were prepared with pepper as was common in the study area. Similarly the high consumption of locust bean was due to the fact that it is normally used in preparing soups for foo-foo in the study area. Weekly consumption of tomato by greater percentage of the respondents, and much lower consumption of carrot by the respondents were associated with cost and availability. Occasional consumption of mango and carrot by greater percentages of the respondents were due to seasonality and poor nutrition education, respectively.

The high consumption of crayfish and fish as the major sources of animal protein was due to their availability and lower cost compared to other animal foods. Liver, egg, beef etc. were

occasional foods for greater percentages of the respondents due to cost. These results supported earlier reports that the diet of South-eastern Nigerians/Igbo indigenous people were plant-based, and animal foods were consumed frequently only by the rich (17, 8). It was also reported that milk and milk products were generally consumed by the affluent, the sick, and in very small quantity, by children due to high cost (8). The very low consumption of snails among the respondents further confirmed that food taboos were still practised among pregnant women as earlier reported (7, 8). Food taboos appear to be a common problem as similar results were noted in recent studies in other places (18, 19). Food taboos can adversely affect nutritional status of pregnant women, and are often passed from mother to daughter (5).

The adequate energy intake of the respondents based on FAO/WHO requirements was at variance with an earlier report of low energy intake among pregnant women in Nigeria (20). It however, agreed with another report of 93% energy intake among adult females in Ohusu community in Edo State, Nigeria (21). The adequate energy intake observed in this study was attributed to high carbohydrate intake from starchy roots and tubers, legumes and cereals, as well as high fat intake from palm oil.

The adequacy of protein intake of the respondents was in agreement with an earlier report of adequate protein intake among mothers in Igbo culture area in Nigeria (8), but in contrast with 46 – 48% protein intake among cassava producers and consumers in Ohusu area of Edo State, Nigeria (21). The adequacy of protein intake observed in this study was due to high consumption of legumes and cereals which respectively, contributed up to 52.3% and 14.6% to their total protein intake. This observation agreed with earlier report that legumes serve as source of protein, especially in poor countries of the world (22, 23). The adequacy of protein intake confirmed that plant protein could sustain growth if these plant proteins were well mixed such that each source complements the other.

The adequacy of iron intake that met 95.4% of FAO/WHO requirement far exceeds 65% intake earlier reported among pregnant women in Nigeria (20). However, it gave credence to other reports of adequate intake of iron among mothers in Igbo culture area in Nigeria (8, 24). The adequate iron intake observed in this study was attributed to high consumption of legumes, green leafy vegetables and nuts and seeds which featured very prominently in the diets of the respondents. Bambara groundnut pudding, "ayaraya oka" (mixture of ground whole maize, legume and green leafy vegetables) and other traditional dishes containing legumes and vegetables were frequently consumed by the respondents. In addition, most staple foods are consumed in the study area with sauces that are made with vegetables and seed flours.

However, the adequacy of protein and iron intakes of the respondents needs careful interpretation. This is because the diets of the respondents, in line with report of similar study (8, 24), were mostly plant based and their protein and iron contents are prone to low digestibility and bioavailability. Beef, egg and organ meats and other animal foods which are rich sources of more bioavailable protein and iron (haem iron) were expensive that the poor could not afford them. Crayfish and fish, which were more frequently consumed, might have served as sources of haem iron if they were consumed in adequate quantities. Unfortunately, the very low percentage contributions of animal foods to the nutrient intakes of the respondents confirmed that these foods were consumed in little quantities as was earlier reported (25).

The high vitamin A intake of the respondents was in agreement with an earlier report (8), and was attributed to consumption of meals regularly prepared with palm oil, red or yellow pepper, and most often, with green leafy vegetable. These foods are rich sources of provitamin A carotenoids with high vitamin A activity (26). However, some of the provitamin A carotenoids contained in these foods might be destroyed by

prolonged cooking (30). Fortunately, some vitamin A-rich fruits consumed raw were available during the study period (April to July). Most of these foods were home produced, especially in the rural areas, as such, were available for consumption, and even affordable for urban dwellers because of the seasonality.

The adequate intake of calcium and thiamin, and low intakes of riboflavin and niacin were similar to earlier report (8), although there was low consumption of milk and its products by the respondents due to high cost. Legumes and vegetables were the major contributors of calcium intake of the respondents. The adequate thiamin intake was associated with high consumption of whole maize based traditional dishes- "ayaraya oka" and "igbangwu oka" (whole maize and leafy vegetable pudding).

The low intakes of riboflavin and niacin as against their requirements were due to low consumption of milk and meat which are rich sources of these nutrients. Legumes and dark green leafy vegetables were the major contributors of these nutrients. This confirms that dark green leafy vegetables might be important contributors of riboflavin if regularly eaten (27).

The high ascorbic acid intake of the respondents confirmed another report of high (135.5%) ascorbic acid intake among mothers in Igbo culture area in Nigeria (8). The high intake of ascorbic acid observed in this study was attributed to the respondents' high intake of green leafy vegetables which was in abundance during the study period (rainy season). Green leafy vegetables contributed up to 77.7% to the total ascorbate intake.

The high intakes of some of the nutrients such as vitamin A, thiamin and ascorbic acid showed that foods of vegetable origin were consumed in developing countries in quantities which could supply some of the essential nutrients in excess of individual requirements. However, the high ascorbate intake, in line with vitamin A intake, should be interpreted with caution because losses abound during cooking and processing. The

ascorbic acid-rich foods consumed by the respondents were mainly green leafy vegetables and starchy roots and tubers which were not consumed raw, but boiled or steamed.

### **Conclusion and recommendations**

Staple foods mostly consumed by the respondents were cassava, cowpea, yam, rice, and bambara groundnut, followed by pigeon pea, maize and cocoyam. Respondents consumed varied nutrient sources (mostly plant-based) which led to adequate intakes of most of the nutrients. This affirms that Nigerian plant-based foods, when well mixed to complement one another and with proper preparation techniques to conserve water soluble, air, light and heat sensitive nutrients can provide adequate amount of nutrients.

Niacin and riboflavin intakes were below the requirements due to low consumption of animal foods. Since nutrient intakes were mainly from plant sources; hence, some nutrients such as iron may not be highly bioavailable, and some other nutrients consumed in high amounts such as ascorbic acid and vitamin A were prone to losses in cooking.

Promotion of traditional dishes with proper food processing techniques to conserve sensitive nutrients are therefore, imperative; hence, the need for nutrition education of women. Nutrition education should also be used to enlighten women on the need for consumption of iron bioavailability enhancers such as ascorbic acid-rich fruits with meals. Animal foods should be made more available at much affordable cost through government subsidization. Effective interventions must be intersectorial involving health, education, agriculture and information/media sectors.

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