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Iron Status, Dietary Practices and Related Knowledge among School Age Children and Their Caregivers in Umuahia South Local Government Area, Abia State, Nigeria

[1]O. Ukegbu Patricia and [2]R. Aderibigbe Olaide
[1]*Department of Human Nutrition and Dietetics, Michael Okpara Univeristy of Agriculture, Umudike, P.M.B. 7267 Umuahia, Abia State, Nigeria*
[2]*National Horticultural Research Institute, P.M.B. 5432 Dugbe, Ibadan, Oyo State, Nigeria*

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Corresponding Author:
O. Ukegbu Patricia
Department of Human Nutrition and Dietetics, Michael Okpara Univeristy of Agriculture, Umudike, P.M.B. 7267 Umuahia, Abia State, Nigeria

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Abstract: Iron deficiency and its anaemia is a serious and wide spread public health challenge with multifactorial causes. The present study examined the iron status, dietary practices and related knowledge among school age children and their caregivers in public primary schools in Ubakala communities, Umuahia Local Government Area, Abia State, Nigeria. A cross-sectional study design using 261 school age (5-11 years) children in three public primary schools was employed. A random sampling technique was used to select the schools and the children in each of the selected school. Validated questionnaire was used to elicit information from parents on socioeconomic characteristics, dietary practices and knowledge of iron intake. Biochemical analysis of iron was carried out on blood samples of 20% of the children using standard procedures. Thirty percent of the children were anaemic (Hb<13 g dL^{-1}); dietary intakes were adequate in terms of frequency of diets (84.7% ate thrice daily) but inadequate in terms of quality among the children. Rice, yam, garri and fufu (processed from cassava) were mostly consumed with vegetable soups; snacking was common (50%) among the children. Mothers/caregivers (36.2%) had poor knowledge. Iron deficiency anaemia prevalence was high in this community; dietary intakes were adequate in terms of frequency of diets in majority of the children but inadequate in terms of quality, especially dietary iron intake. Knowledge of dietary iron intake was low among the mothers/caregivers. There is need to scale up appropriate interventions to address iron deficiency anaemia challenge.

INTRODUCTION

Anaemia is a global public health problem, with one in four people been affected. Africa is one of the two regions with the highest risk of anaemia. Globally, 33% of school age children are anaemic (WHO and CDC, 2008). In the developing world, the prevalence among school-age children ranges from 12-60% (Hall *et al*.,

2000; WHO *et al*., 2001). Few studies have been conducted in Nigeria on the iron status of school age children. In a study, it was shown that the highest prevalence of anaemia in children in Nigeria occurs in the South East region (49.6%) (Anumudu *et al*., 2008). Unlike reported figures for protein energy malnutrition and Vitamin A deficiency which are declining, estimates suggest that anaemia prevalence rates are increasing in Nigeria (Anumudu *et al*., 2008).

School age children are at risk of iron deficiency because of an expanding red cell and muscle mass that occurs as they grow (Herbert, 1992). The consequences of iron deficiency anaemia can be severe among school age children. Studies have shown reduced physical and mental development, decreased attentiveness and lower intelligence in anaemic children (Black, 2003; Ochei and Kolhatkar, 2002). This impairment occurring at an early age may be irreversible, even after repletion of iron stores thus reinforcing the importance of preventing this condition (Black, 2003).

Anaemia prevalence is high in children and its cause is frequently multifactorial. Iron deficiency anaemia is caused by poor iron intake and low iron bioavailability (Pasricha *et al*., 2010). Some other factors like Vitamin A, Vitamin B12, hookworm and malaria infection are found associated with anemia among children (Sharman, 2000). Iron occurs in haem and non-haem forms in the diet. The haem iron in animal sources is more easily absorbed than the non-haem iron present in plant sources. Non-haem iron absorption depends on the balance between iron absorption inhibitors and enhancers in the diet (Nicklas, 2008). Iron deficiency anaemia in children can be worsened by a lack of understanding of mothers and caregivers about the value of a varied diet.

There is no known documented study on iron status determination in Umuahia South local government area of Abia state but previous study conducted in the rural communities of Abia State (Omimawo *et al*., 2010) reported a prevalence of 82.6% of anaemia among school age children. In the present study, we investigated the prevalence of anaemia, dietary practices of school age children and the knowledge related to dietary iron intake among mothers and caregivers of the school age children.

MATERIALS AND METHODS

Sample selection: This was a cross-sectional study conducted among school age children in Ubakala communities in Umuahia South Local Government Area of Abia State, Nigeria. Ubakala is a semi-urban community. The population of the study was drawn from three public primary schools randomly selected out of the twelve public primary schools in Ubakala. The schools were Umuosu Community School with a total population of 516 pupils and 46 teachers, Ubakala Central School with a total population of 125 pupils and 19 teachers and Ubakala Community School with a population of 156 pupils and 26 teachers. Proportionate calculation was used to determine the number of respondents to be selected from each school. A total of 216 school age school children were randomly selected from the three schools.

Data collection: Trained research assistants (community health workers, health extension workers, nurses and laboratory technologists) assisted in data collection. A total of 261 validated questionnaires were administered to mothers and caregivers of the school age children. The questionnaire included questions on socio-demographic data, dietary practices and nutrition knowledge of mother/caregivers.

Assessment of knowledge: The nutrition knowledge of mothers and caregivers were classified by assigning a score of 20% to each of the five questions to give a total score of 100%. Those who scored ≤40% were classified as having poor knowledge while those who scored >40-60 and >60% were classified as having moderate and good knowledge, respectively.

Assessment of iron status indices: Iron status was determined by measurement of hemoglobin, PCV and serum ferritin. The 5 mL of veinous blood was collected using 5 mL disposable syringe. About 2.5 mL of the blood sample was stored in the centrifuged bottle and transported chilled to the laboratory while the remaining 2.5 mL was left in the syringe for sedimentation and coagulation.

Haemoglobin was analysed using Cyanmethaemoglobin method (Zwart *et al*., 1996). 0.02 mL of blood sample was added to Drabkins solution in a test tube (1:250 dilution). This was thoroughly mixed, allowed to stand for 10 min. The absorbance colorimetrically was read at 540 nm until Drabkin-S solution was black.

Serum ferritin was analysed using spectrophometric method. Ferritin kit calibration standards was prepared by Bio-Rad and was matched to the latest production lot of NIBSC/WHO International Human Liver Ferritin Standard. This standard material consists of 9.7 μg/ampule purified human liver isoferritin which when reconstituted with 1.0 mL of water, yields 9.1 μg mL^{-1} ferritin. NIBSC standards were diluted to 0.91, 9.1, 91 and 910 ng mL^{-1}. Serum results are expressed as nanograms of ferritin per milliliter of serum (ng mL^{-1}) (Carter, 1971).

Serum iron was analysed using spectrophotometric method (Carter, 1971). The 2 mL of serum and 2 mL of protein precipitant solution was added to a 15 mL centrifuge tube and allowed to stand for 5 min. This was centrifuged at 1500 g for 10 min and 2 mL of the clear

supernatant was transferred to a test tube as same test. The 1 mL of standard solution and 1ml of protein precipitant solution was added to another test tube marked standard, it was then mixed and allow to stand for 5 min. To the test tube marked blank 1 mL of water and 1 mL of protein precipitant solution was added, mixed and allow to stand for 5 min. About 2 mL of chramogen solution was added to all test tubes, mixed and allowed to stand for 5min. Absorbance of test and blank standard were measured. Packed Cell Volume (PCV) was determined using microhaematocrit method. The 2 mL of blood was centrifuged using heparinized blood in a capillary tube, a lighter was used to seal off one end of the tube and waited for 5 min at 10,000 RPM (Rotation Per Minute). The level of the sedimented blood was taken using a capillary reader (Carter, 1971).

Erythrocyte Sedimentation Rate (ESR) was determined by Westergren method (Ochei and Kalhatkar, 2000). About 0.5 mL of 3.8% sodium citrate was put in a small test tube. The 2 mL of venous blood was collected and thoroughly mixed with the sodium citrate. The blood was aspirated into the Westergren tube to the top mark (0). The tube was allowed to stand vertically in a stop rack with spring clips that held the lower end of the pipette tightly against a rubber mat in a vertical position. This was left for 1 h. Readings were taken preferably at 15 min intervals for one hour in order to get an indication of the sediment rate. The level of red cells was noted from zero.

Ethical permission: Ethical approval was sought for from the ethical committee of the Federal Medical Centre Umuahia, Abia State. Informed consent was obtained from the parents/caregivers of participating children.

Statistical analysis: All statistical analyses were performed using Statistical Package for Social Sciences (SPSS) Version 18. Descriptive statistics such as, mean, frequencies and percentages were used to show the distribution of the subjects according to the variables of interest. A $p = 0.05$ was accepted as statistically significant.

RESULTS

A total of 261 questionnaires were administered and returned, however, only 254 were completely filled. Therefore, the data presented in this study is for 254 school age children. Table 1 shows the sociodemographic characteristics of the study population. More than half (58.3%) of the children were males while 41.7% were females. The age range for the study was 5-11years with pupils of 7 years of age having the highest percentage (24.4%), followed by those of 8 years (18.1%). Majority (96.1%) of the respondents were Christians while 3.1% were traditional worshipers. The 30% (30.3%) of the fathers were traders and 17.3% were unemployed as at the time of this study. Half of the mothers (50%) were traders, 24.8% were farmers, 13.8% were civil servants, 6.7% were artisans (such as hair dressers, tailor etc.), while 4.7% were unemployed. In terms of educational attainment, 46.5% of the fathers attained secondary education, 20.8% primary, 17.3% tertiary while only 15.4% had no formal education. Slightly more than half (56.3%) of the mothers had up to secondary education, 15.4% and 18.5% were those who had tertiary education or did not attempt any formal education, respectively, while only 10.2% of them had primary education.

Table 1: Sociodemographic characteristics of respondents (n = 254)

Variables	Frequencies	Percentage
Sex (children)		
Male	148	58.3
Female	106	41.7
Age of children (years)		
5.00	9	3.5
6.00	26	10.2
7.00	62	24.4
8.00	46	18.1
9.00	41	16.1
10.00	33	13.0
11.00	37	14.6
Religion		
Christianity	246	96.9
Traditional	8	3.1
Mother's occupation		
Trader	127	50.0
Farming	63	24.8
Civil servant	35	13.8
Artisan (hair dressers, tailors)	17	6.7
Unemployed	12	4.7
Mother's educational level		
Primary	26	10.2
Secondary	143	56.3
Tertiary	38	15.0
None	47	18.5
Father's educational level		
Primary	53	20.9
Secondary	118	46.5
Tertiary	44	17.3
None	39	15.4
Household size		
<4	51	20.1
4-6	80	31.5
7-8	60	23.6
>9	43	24.8
Monthly household income		
₦ <20,000	114	44.9
₦ 20,000-40,000	83	32.7
₦ 40,000-60,000	30	11.8
₦ 60,000-80,000	11	4.3
₦ 80,000-100,000	13	5.1
₦ >100,000	2	0.8

About one third (31.5%) had family size of 4-6, 24.8% had ≥9, 23.6% had 7-8 while 20.1% had <4 persons in the household. On the result for monthly income, the average monthly income of 44.9% of the respondents was <₦20,000, 32.7% earned between >₦20,000-₦ 40,000; 11.8% earned >₦40,000- ₦60,000;

Table 2: Distribution of school age children according to their iron status parameters (n = 50)

Iron status indices	Frequencies	Percentage	Mean
Hb			14.11±2.66
Normal (13-16 g dL^{-1})	35	70.0	
Mild anaemia (10-12 g dL^{-1})	12	24.0	
Moderate anaemia (7-10 g dL^{-1})	2	4.0	
Severe anaemia (<7 g dL^{-1})	1	2.0	
Serum ferritn			12.19±1.82
Normal (≥12 µ g dL^{-1})	50	100.0	
ESR			9.51±4.35
Normal (5-15 mmol)	35	70.0	
Anaemic	15	30.0	
Serum iron			30.92±30.88
Normal (50-120 mg dL^{-1})	50	100.0	
PVC			42.76±8.22
Low (<35%)	10	20.0	
Normal (35-49%)	40	80.0	

4.3 and 5.1% earned >₦60,000- ₦80,000 and ₦ 80,000-₦100,000, respectively while 0.8% earned income > ₦100,000.

Table 2 showed that the mean values of hemoglobin (14.11±2.66 g dL^{-1}), serum ferritin (12.19±1.82 ng dL^{-1}), ESR (9.51±4.35), serum iron (30.90±3.08) and mean PCV (42.76±8.22) of the children were within the normal range. The 30% of the children were anaemic (mild-severe) according to Heamoglobin concentration (Hb<13 g dL^{-1}). Packed cell volume of 80.0% of the respondents were within the normal range while 20.0% were outside the normal range, thus, abnormal. Also, ESR levels of 70.0% of the respondents were normal while 30% of the subjects had abnormal. Strikingly, ferritin (100%) and serum iron levels of all the subjects (100%) were normal.

Table 3 shows the result for the dietary practices of the children. Majority of the children (84.7%) ate thrice a day and 11.8% twice daily. About half (54.7%) insisted they never missed any meals while 4.3%, 16.1%, 24.8% missed breakfast, lunch and dinner, respectively.

Reasons given by the mothers as to why the children missed meals showed that 22.8% missed meals because of late cooking, 27.2% missed meals because of none availability of food, 19.6% was due to other reasons (such as dislike of food, over addition of salt, pepper, scolding from parents, etc.), while 15.0 and 15.4% missed a meal due to inadequate time to eat and sleep, respectively.

Furthermore, the result revealed that majority (66.5%) of the children consumed cereals (such as pap, golden morn, etc.) for breakfast. Beverages like tea were consumed by 16.2% while tubers (e.g., yam, potatoes) were consumed by 15.7% for breakfast. For in-between snacks, 50% of the children ate baked products (such as cake, biscuits) as their in-between snack, 25.6% ate fruits (such as apple, banana, etc.), 16.9% drank beverages such as milo, bournvita while 31.9% ate other foods such as suya. For lunch, 49.2% consumed cereals (like rice, wheat), 43.3% ate tuber (yam, potatoes), 6.3 and 1.6% drank beverages and some (1.2%) ate other things. Snacks eaten in between lunch showed that 49.6% took baked products. About 22% (21.9%) took beverages, 19.3% took fruits while 9.4% ate African salad as in-between meals before dinner.

Meals eaten for dinner showed that 46.5% and 47.2% took cereals and tubers, respectively. About 4% (4.7%) drank beverages such as tea and ice cream for dinner while 1.6% noted that they ate other foods such as spaghetti and okpa for dinner. Some (45.7%) consumed

Table 3: Dietary habits of the children

Variables	Frequencies	Percentage
Child's meal		
Twice	30	11.8
Thrice	215	84.7
≥four times	9	3.5
Meal child usually miss		
Breakfast	11	4.3
Lunch	41	16.1
Dinner	63	24.8
None	139	54.7
Reason for missing such meal (n = 115)*		
No time to eat	14	12.2
No available food	29	25.2
Late cooking	38	33.0
Sleeping	14	12.2
Others (no money to buy food, dislike, over addition of salt)	20	17.4
Breakfast		
Beverages	41	16.2
Cereal	169	66.5
Tubers	40	15.7
Others	4	1.6
In-between snacks[1]		
Beverages	52	16.9
snacks (meat pie, doughnut)	127	50.0
Fruits	65	25.6
Others	10	3.9
Lunch		
Beverage	16	6.3
Cereal	125	49.2
Tuber	110	43.3
Others	3	1.2
In between snack[2]		
Beverages	55	21.7
Snacks (egg roll, fish roll)	126	49.6
Fruits	49	19.3
Others	24	9.4
Dinner		
Beverage	12	4.7
Cereal	118	46.5
Tuber	120	47.2
Others	4	1.6
In between snack[3]		
Beverages	92	36.2
Snacks (biscuit, cake)	116	45.7
Fruits	44	17.3
Others	2	0.8

The 1-3 represents in-between snacks taken after breakfast, lunch and dinner; *Responses for 115 children

Table 4: Knowledge of dietary iron intake among mothers/caregivers

Variables	Frequencies	Percentage
Have you heard about iron rich foods	196	77.2
Yes	41	16.1
No	17	6.8
Undecided	254	100.0
Total		
Have you heard about deficiency anaemia		
Yes	103	40.6
No	151	54.4
Total	254	100.0
Source of iron you know		
Vegetable	171	67.3
Meat	54	21.3
Plantain	29	11.4
Total	254	100.0
Iron can be gotten from poultry and vegetables		
True	136	53.5
False	116	46.5
Total	254	100.0
Iron deficiency can be caused by inadequate dietary intake		
True	212	83.5
False	42	16.5
Total	254	100.0
Iron deficiency is common in rural area		
True	186	73.2
False	68	26.8
Total	254	100
Pregnant mothers and children are prone to anaemia		
True	203	79.9
False	51	20.1
Total	254	100.0

baked products such as bread for in-between dinner, 36.2% took beverages such as ice cream, 17.3% ate fruits like pineapple while 0.8% drank pepper soup.

Table 4 represents the result for the nutrition knowledge of mothers/caregivers. From the result, majority of the respondents (77.2%) have heard about iron rich food while some (16.1%) have not. Also, 40.6% of the respondents had heard about iron deficiency anaemia, 54.4% have not.

Some of the respondents (67.3%) were of the opinion that vegetable is the main source of iron, 21.3% chose meat while 11.4% chose plantain. About half of the mothers (53.5%) agreed that iron can be gotten from poultry and vegetables while 46.5% disagreed. Majority (83.5%) agreed that iron deficiency can be caused by inadequate dietary intake while 16.5% disagreed. The result showed that 73.2% of the respondents agreed that iron deficiency was common in rural areas while 26.8% said it was not true.

Similarly, 79.9% agreed that pregnant mothers and children are prone to anaemia while 18.1% said it was not true. Table 5 shows the categorization of the level of knowledge of the mothers and caregivers. From the result,

Table 5: Nutrition Knowledge of mothers/caregivers

Nutrition knowledge score	Frequencies	Percentage
Poor knowledge (0-40)	92	36.2
Moderate knowledge (41-60)	73	28.7
Good knowledge (61-100)	89	35.0

Table 6: Distribution of children according to their use of worm expellers

Variables	Frequencies	Percentage
Child use of worm expeller		
Yes	148	58.3
No	106	41.7
Frequency of use		
every 3months	70	27.6
every 6 six months	41	16.1
every 9 months	20	7.9
Yearly	17	6.7
Did not use	106	41.7

36.2% of the respondents had poor knowledge, 35% had good knowledge while only 28.7% had moderate knowledge of dietary iron intake.

Table 6 represents the distribution of school children according to their use of worm expellers. Most of them (55.1%) took worm expellers while 44.9% did not take worm expeller.

DISCUSSION

The present study examined the iron status and dietary practices of school age children and the knowledge of dietary iron intake among their mothers and caregivers.

Using haemoglobin level of <136 g dL^{-1} as the cut off, only 30% of the children were anaemic. This is in contrast to the study conducted by Onimawo *et al*. (2010) which reported a prevalence of 82.6% among school age children in Abia State, Nigeria. In that study, the very high prevalence was partly attributed to high incidence of warm infestation. In the present study, children used worm expeller (58.3%) and this could be linked to the regular deworming exercise usually carried out by the primary health care department services in the local government which has thus made mothers/caregivers to imbibe the culture of deworming their children. The mean ESR (9.51±4.35 mmol) was high in 30% of the children as well. It is possible that those children with high ESR could be those suffering from enteric fever, pyrexia or malaria, helmentic or parasitic infections. Children with high ESR need to be further investigated since it is likely that 30% of the anaemic children (abnormal Hb levels) could be those that have high ESR (30%).

Children used in this study had adequate dietary intake going by the number of children who ate three times a day. However, the most commonly consumed foods by the children were rice, yam, garri and fufu (processed from cassava), these were consumed with soup made with melon seeds, ogbono, achi and vegetables. Regular consumption of haem sources of iron was not

common among the children. In congruent with this result (Onimawo *et al*., 2004) reported that carbohydrates dominated the diet of Nigerians. It is established that dietary iron intake and bioavailability are determinants of iron status in populations (Zimmermann *et al*., 2005); the low intake of haem iron from animal sources may have contributed significantly to the high prevalence of anaemia. Though, the number of children who missed breakfast were low (4.3%), it should not be encouraged as there is a consensus that children should eat breakfast every morning and that children who eat breakfast have healthier overall nutrition and lower BMI and breakfast consumption as well may enhance academic achievement (Gleason and Dodd, 2009).

The level of knowledge of dietary iron intake was low among the mothers/caregivers. Though, most the mothers agreed that inadequate dietary intake could lead to iron deficiency majority did not agree that meat was a rich source of iron. They generally agreed that vegetable was the rich source of iron. Iron available in plant sources is not readily available for absorption because they exist in the non-haem form. Plants also contain inhibitors of iron that could further reduce iron bioavailabity (Moretti *et al*., 2013). With the number of people that had poor knowledge of nutrition, these children could be predisposed to anaemia if care is not taken. WHO. (1992) reported that lack of knowledge of healthy eating and dietary guidelines could lead to faulty food selection. Therefore, it is important to increase women's knowledge of iron rich foods especially the haem iron and the dietary constituent that enhance the nutritional status of a child (Gupta *et al*., 2014).

CONCLUSION

The prevalence of anaemia was high in the study area, children had good dietary practices going by the number of meals consumed, however, iron rich sources were not adequately consumed. In addition, the level of knowledge of anaemia was also low among mothers and caregivers. There is need for the parents especially mothers to be encouraged through nutrition education to properly plan their menu as to give their children an adequate diet that will contain iron rich foods especially haem iron sources such as, meat, fish, poultry, dark green vegetables and foods that help in iron absorption (especially foods that are rich in ascorbic acid). Iron fortification of foods and regular iron supplementation in all the primary schools in Umuahia South Local Government Area of Abia State is required to reduce the prevalence of anaemia.

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