Iron Deficiency Negatively Affects Nutritional Status and Anthropometric Indices of Primary School Pupils in Ohaji/Egbema Local Government Area of Imo State, Nigeria

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Abstract
A study on the nutritional status and anthropometric indices of primary school pupils in Ohaji/Egbema Local Government Area of Imo State was evaluated. Their total iron, total iron binding capacity, haemoglobin, and ferritin levels were determined using spectrophotometric method, anthropometric indices was studied using the standardized method of WHO and UNICEF. The study subjects were selected by random sampling from four (4) different Schools and a total of two hundred (200) pupils, from primary one (Elementary 1) to primary three (Elementary 3) The characteristics of the pupils were tested using the student’s t-test and ANOVA. Correlation between variables was determined by way of Pearson’s correlation coefficient (r). The level of significance was set at p<0.05. Results obtained showed that there was significant difference between age and the nutritional status of primary school pupils of Ohaji/Egbema L.G.A. A significant difference between gender and the nutritional status of same pupils. Inadequate nutritional status of these pupils was found to be attributable to limited or low consumption of high quality food as a result of the socio-economic/ sociodemographic status of their parents.

Keywords: Iron deficiency; Nutritional status; Anthropometric indices; Total iron; Haemoglobin; Spectrophotometric method; Iron binding capacity

Introduction
Nutrition is the sum total of the processes involved in taking nutrients, assimilating and/or utilizing them in the body for good health of an individual. The science of nutrition deals with nutrient in food, their metabolic effects and the consequences of the intake of food inadequacy. Nutrients are chemical components of food that need to be absorbed properly in the body for optimal utilization [1].

There are essential and non-essential nutrients, all of which are harnessed by the body's metabolic system for the provision of energy and tissue maintenance. There are two classes of nutrients viz: macronutrients and micronutrients. Macronutrients consist of the bulk of the diet which supplies the energy and the essential nutrients for body growth, maintenance and activity. It includes carbohydrate, fats including essential fatty acids, proteins, macro minerals and water.

Biologically, iron is a trace element which exists in two main valency states; the divalent and trivalent, as Fe²⁺ (ferrous ion) and as Fe³⁺ (ferric ion). It undergoes two reactions; oxidation and reduction reaction [2]. Iron is a necessary mineral for body function and good health. Every red blood cell in the body contains iron. It is essential for the regulation of cell growth and cell differentiation. Iron is incorporated into the heme complex. Heme is an essential component of cytochrome protein which mediates redox reaction and oxygen carrier protein such as haemoglobin and myoglobin [2].

Lack of essential nutrient in the body causes diseases in all ages of the human population. For proper utilization of food, efforts are geared towards food planning strategies that are effective to sustain maximum growth and maintenance of the body cells and tissues, in order to avoid a disease state. Food requirement is also obvious for all forms of life including plant, birds and insects without food, the growth of individuals in all life ramification form will be morbidly obstructive, especially in the growing child and during the senescent period of life.

Thus, nations must plan effectively for food in order to sustain national food adequacy for human utilization or consumption.

Materials and Methods
Study samples were collected at random from four (4) different primary schools in Ohaji/Egbema local government area (LGA) in Imo State.

Data collection
At enrolment, structured questionnaire was administered to each participating pupil, which was taken home for completion and returned on the day of sample collection. Complete and strict anonymity of the respondents was maintained. The questionnaires elicited sociodemographic/socio-economic information such as age, feeding habit, nature of food (including quality/quantity), number of wives in the family, number of children in the family, parental occupation, and parental educational background.

Collection and treatment of blood samples
The blood samples used for the determination of iron (total iron and total iron binding capacity (TIBC)) and Haemoglobin (Hb) were collected using a 5ml syringe and a 23G needle, 5 ml of blood was collected from a single vein of each pupil, 1ml was put into an EDTA

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bottle to avoid haemolysis and was used to run Hb test. 4 ml of blood was separated by centrifugation at 10,000 g for 10 mins. The serum was collected and stored frozen at -2°C until the analyses for serum iron and ferritin were carried out.

**Determination of haemoglobin (Hb) concentration**

Haemoglobin concentration was determined according to the method of Cheesbrough [3].

**Determination of serum iron concentration**

The serum iron concentrations of pupils were determined using the Carter method as described by Carter [4].

**Determination of serum ferritin level**

Ferritin level was determined using enzyme immunoassay method as described by Halliday [5].

**Determination of anthropometric indices (BMI)**

Anthropometric measurements were used based on the standardized method of WHO and UNICEF as modified by Hashizume et al. [6] for the evaluation of BMI of the pupils.

**Data analysis**

The characteristics of the pupils were tested using the student’s t-test and ANOVA. Correlation between variables was determined by way of Pearson's correlation coefficient (r). Statistical analysis was done with Statistical Program for Social Sciences (SPSS 13.0) computer soft ware and the level of significance set at p<0.05.

**Results and Discussion**

In Table 1, the UN classification was employed in order to classify the pupils' according to their BMI status (UN ACC/SCN, 1992). The result showed that 9 (9.7%) out of 92 male pupils sampled had a low BMI while 46 (50%) had a normal BMI value. A total of 38 (41.3%) had total iron deficiency out of 92 male pupils, 51 (55.4%) recorded normal total iron level with (0%) above normal (AN) value. 2 (2.1%) were deficient in TIBC, 30 (32.6%) had normal TIBC levels and 61 (66.3%) above normal values. 74 (80.4%) had low Hb level (anaemia), 1 (14.2%) had normal Hb level and 55 (59.7%) had levels above normal value. 92 (100%) recorded normal level of ferritin with 0% deficiency level and 0% above normal level. Hb was significantly low at (P<0.05).

In Table 2, overall result showed that 71% of female subject were...

The prevalence of iron deficiency was significantly (p<0.05) higher in the females (93.4%) than in the males (98.2%), among the age group 8-10 years and 11-12 years. This is as a result of inadequate iron uptake by the body to balance the losses during menstrual bleeding and/or through sweating during strenuous or intense work/exercise, elevated needs associated with rapid growth in early childhood stage could have been a contributory factor too [5]. The total iron binding capacity (TIBC) level of these pupils were observed to be slightly above the normal values though 2.8% in males and 15.9% deficiency in females were recorded. This finding substantiates the view that TIBC is usually increased in children with iron-deficiency anaemia. The deficiency in TIBC level among these pupils could be suggestive of acute or chronic infections (as a result of increased catabolism) [6]. Overall result showed that 80.4% of the male pupils were anaemic. In the female counterpart, overall incidence of anaemia was 69.4%. The male pupils recorded a higher incidence of anaemia than female students, owing to insufficient haemoglobin level as a result of inadequate balance in the intake of nutritional foods [5]. A strong significant relationship (r=0.811 and 0.968 respectively) was observed between the age/gender and the mean haemoglobin of these pupils (p<0.05), while the ferritin levels of both male and female pupils were seen to be good and adequate for all age groups as no records of deficiencies or increased levels were observed.

In the Table 3, the male subject recorded a lower overall prevalence of iron deficiency 41.3% than that of the female counterpart 49%. Results obtained were statistically significant at P<0.05. A relationship (r=0.720 and 0.935, respectively) existed between the age/gender and the mean total iron/prevalence of iron deficiency.

Pupils between the ages of 6-12 years are particularly vulnerable to iron deficiency as a result of the increased demand for iron [7]. From the present study, it was observed that 93.4% iron deficiency was recorded in the male pupils. Age group 6-7 years recorded 32.8%; age group 8-10 years recorded 32.1% while age group 11-12 years recorded 28.5%. In the female counterpart, the overall iron deficiency was recorded 98.2%. Age group 6-7 years had 33.2%; age group 8-12 years had 35.0% while the female counterpart, the overall iron deficiency was recorded 98.2%.

Table 3: The mean Total iron and prevalence of Iron Deficiency.

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<thead>
<tr>
<th>Gender</th>
<th>Age (Yrs)</th>
<th>N</th>
<th>Range(µg/dl)</th>
<th>Mean±S.d*</th>
<th>%Deficiency</th>
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<tr>
<td>M</td>
<td>6-7</td>
<td>28</td>
<td>17.3-133.6</td>
<td>68.1±2.91</td>
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<td>8-10</td>
<td>57</td>
<td>53.5-104.1</td>
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<td>Overall</td>
<td>92</td>
<td>17.3-104.1</td>
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<td>F</td>
<td>6-7</td>
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<td>13.8-145.4</td>
<td>76.3±3.49</td>
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<td>8-10</td>
<td>70</td>
<td>19.6-133.6</td>
<td>67.5±2.83</td>
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<td>Overall</td>
<td>108</td>
<td>13.8-145.4</td>
<td>71.0±1.83</td>
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*Values with superscript showed statistical significant at P<0.05 => ANOVA used
Age: Overall (0.720) for males Pearson's correlation (r) used.
Overall (0.935) for females

Table 4: Summary Table Showing the Mean Total Iron and Prevalence of Iron Deficiency According To Socio-economic/ demographic Status of Pupils.

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*Values with superscript showed statistical significant at p<0.05 => ANOVA used
1. Overall age in years.
2. Total number of subjects.
3. Mean ± Standard deviation.
4. Percentage iron deficiency (µg/dl)
5. Parental occupation of pupils (a=Artisan; b=Civil servant; c=Farmer; d=Student; e=Teacher; f=Trader; g= Total % Iron deficiency).
6. Parental educational background of pupils (a=None; b=Primary; c=Secondary; d= Tertiary; e=Total % Iron deficiency).
7. Pupils feeding habit (a=Once; b=Twice; c=Thrice; d=Total % Iron deficiency).
8. Number of children in the home (a=< 3; b= 3-5; c= >5; d= >7 or =7; e= >7 or =10; f= >10; f= Total % Iron deficiency).

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age group 11-12 years recorded 30%. This prevalence was significantly (p<0.05) higher in the females (93.4%) than in the males (98.2%), among the age group 8-10 years and 11-12 years. This is as a result of inadequate iron uptake by the body to balance the losses during menstrual bleeding and/or through sweating during strenuous or intense work/exercise, elevated needs associated with rapid growth in early childhood stage could have been a contributory factor too [5]. However, the mean BMI had no significant (p>0.05) effect on level of iron deficiency and no correlation (r=0.168) was found in the male pupils while in the females counterpart, that was a correlation (r=0.790) existing between the mean BMI and the level of iron deficiency. Government agencies and non-governmental agency (NGO) programmes to reduce nutrients deficiency in children in developing countries have so far yielded little fruit, owing to low compliance due to inadequate motivation, low motivation of health personnel, and inadequate supplies of supplement tablets [8].

Another possible reason for this may stem from dietary practices of relying on staple food crops which characterize people of developing countries [8]. In Nigeria especially Ohaji/Egbema LGA Imo State as in other predominantly farming communities in the south-east Nigeria, starch and vegetables form the major dietary staple food, the inhibitory constituents such as fibers, polyphenolics, phosphates, and organic acids commonly present in such diet can prevent dietary iron absorption [6]. Habit of eating pica (consumption of non-nutritive substances) has been associated with iron deficiency [6] and this may be another contributory factor here.

In this study, parental occupation was not identified as a significant risk factor for the prevalence of iron deficiency in the male pupils thus, no significant difference was detected. In the female counterpart, parental occupation was identified as significant risk factor thus, significance was seen. The highest incidence of iron deficiency was recorded among pupils whose parents were farmers. Their mean total iron level was (413 ± 0.69 μg/dl) which were also seen as the lowest mean. Reasonable explanation to this is not far fetched. The economic status of the parents is inadequate to supply balanced meals for these pupils.

Furthermore, parental educational background of both subjects was a significant (p<0.05) risk factor for the prevalence of iron deficiency as seen in Table 4. Overall, parents with no formal education recorded the highest incidence of iron deficiency (p<0.05). Uneducated parents lack basic knowledge of nutritional science and this has been reported to be a contributory factor in prevalence of iron deficiency among children in the rural areas [9]. The pupils feeding habit and the number of children in the homes of these pupils were also a significant risk factor for the prevalence of iron deficiency and as such a strong relationship existed between these factors and the incidence of iron deficiency. Undoubtedly, the number of children living in a home has an impact on monthly income by increased sharing of family resources.

### Conclusion

The findings in this study showed that there was a significant difference between age and the nutritional status of the primary school pupils in Ohaji/Egbema LGA, and a significant difference between gender and the nutritional status of same pupils. The present state of iron deficiency among primary school pupils in Ohaji/Egbema is attributed to poor socio-economic background, poor dietary intake due to poverty and lack of knowledge of the simplest facts of nutrition. Other factors responsible for their poor nutritional profile may be low literacy status of head of households and other members of the family, large families with high dependency ratio and occupational status of parents such as small land-hold farmers or having jobs with low monthly income. Therefore, the need for educational awareness should be conducted frequently to keep parents/guardians abreast on the importance of nutrition.

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### References