

Research Article

Influence of Malnutrition on Biochemical Parameters of Primary School-Age Children in Ohaji/Egbema Local Government Area of IMO State, Nigeria

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Abstract

The nutritional status of primary school pupils in Ohaji/Egbema Local Government Area of Imo State was evaluated. Their vitamin A, total iron, total iron binding capacity, haemoglobin, serum albumin, and ferritin levels were determined using spectrophotometric method, anthropometric indices was also studied. The study subjects were selected by random sampling from four different Schools. A total of two hundred (200) pupils, from primary one to primary three. The characteristics of the pupils were tested using the student's *t*-test. Correlation between variables was determined by way of Pearson's correlation coefficient (r) and 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 and socio-economic/sociodemographic status of their parents.

Keywords: Malnutrition; Nutritional Status; Anthropometric Indices; Biochemical parameters; Haemoglobin, Iron Binding Capacity; Serum Albumin; Ferritin

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. The essential nutrients includes: vitamins, minerals, amino acids, fatty acids, and carbohydrates, as source of energy production in the body through carbohydrate metabolism. Conversely, non-essential nutrients are those that the body synthesize from other components, but they can be equally derived from the diet. There are two classes of nutrients viz: macronutrients and micronutrients. Macronutrients consist of the bulk of the diet which supply 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. All these take active part in metabolism during the process of cellular and tissue absorption and assimilation of food.

The micronutrients are essentially classified as water-soluble vitamins, fats –soluble vitamins and trace minerals [2]. Water-soluble vitamins include vitamin C and vitamin B complex components which include thiamine as vitamin B1, riboflavin (vitamin B2), niacin, pyridoxine (vitamin B6), folic acid, cobalamin (vitamin B12), biotin and pantothenic acid. Whereas, the fat-soluble vitamin includes: retinol (vitamin A), cholecalciferol (vitamin D3), and ergocalciferol (vitamin D2), alpha-tocopherol (vitamin E), phylloquinone and menaquinones (vitamin K). The essential trace minerals include: Iron, iodine, fluorine, zinc, chromium, selenium, manganese, molybdenum and copper, with exception of fluorine and chromium, each of the mineral is incorporated into an enzyme or a hormone that is involved in a metabolic process. Food nutrients are essential for life, and they are taken by humans.

Lack of essential nutrient in the body causes diseases in all ages of the human population [2]. 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

Samples for this study were collected at random from four 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, number of children in the family, parental occupation, parental educational background etc.

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Determination of haemoglobin (HB) concentration

Haemoglobin concentration was determined according to the method of Cheesbrough [3]. 20 μ l (0.02 ml) of venous blood was disposed into 4 ml Drapkin's solution test tube, mixed together with a glass rod. The test tubes were covered using a stopper tube and left at room temperature, protected from light for 5minuites. The absorbance of the content of each test tube was at 540 nm. Using a prepared table from a calibration graph, the haemoglobin values were read off.

Determination of serum iron concentration

The serum iron concentrations of pupils were determined using the Carter method as described by Carter [4]. The test tubes were labeled; 2.5 ml iron buffer was added to all the test tubes. Standard and blank solution kept aside. 5 ml of sample was added to the test tubes. 5ml of iron standard was added to the test tube labeled standard. 5 ml of distilled was added to the test tube labeled blank. Spectrophotometer was set at 560 nm with the blank reagent. Absorbance of all tube solutions were read and recorded as A₁ readings. 5 ml iron colour reagent was added to all the tubes and mixed. The tubes were placed in a heating water bath at 37°C for 10 minutes. The absorbance of all the tubes were read and recorded as A₂ reading.

Iron concentration was calculated using the formula

A2 Test - A1 Test/ A2 Std - A1 Std X Conc. of Std=Total Iron (µg/dl)

Where, A=Absorbance.

Std=Standard.

Determination of Vitamin A concentration

Vitamin A concentration was estimated using Carr–Price method as described by Kasper [5]. To each test tube was added 1 ml of serum and a drop of absolute ethanol corked and shook vigorously. The mixture spinned at 10,000 g in a centrifuge for 10 minutes. 1ml of the supernatant was decanted into a separate test tube and placed in a water bath and evaporated to dryness at 56°C. The residue was dissolved in 5ml of chloroform. A drop of acetic anhydride was added following which 1ml of Carr–Price reagent was added and absorbance read at 620 nm within 15 seconds and vitamin A concentration was read off from a standard curve.

Determination of serum albumin level

The serum albumin level was determined using Bromcresol Green (BCG) method as described by Young [6]. A measured amount $(10 \ \mu$ l)

of Bromcresol Green reagent was added only to the tube labeled test, 10 μ l of standard/R4 was added to the tube labeled standard. To all tubes, 2000 μ l of serum was added and shook vigorously, left for 5minutes at 20°C The color was stable for 60 minutes thereafter, the absorbance was read against the blank at 630 nm.

Determination of serum ferritin level

Ferritin level was determined using immunoturbidimetry method as described by Halliday [7]. To all the test tubes, 50 µl buffer solution (R_1) was added. Measured 50µl distilled water to test tube labeled blank, Added 50 µl sample to test tube labeled test. 50 µl standard solution was added to test tube labeled standard, shook vigorously and left to stand at room temperature for 10 minutes. 50 µl Sensitizing latex reagent (R_2) was added to all tubes and Read the absorbance at 570 nm.

Determination of anthropometric indices (BMI)

Anthropometric measurements were used based on the standardized method of WHO and UNICEF as modified by Hashizume [8] for the evaluation of BMI of the pupils.

The weights and heights were measured with the aid of a portable weighing balance and graduated meter rule. The arm, wrist and abdominal circumference were determined too with the aid of a tape measure. The BMI was calculated the two parameters, weight and height. Using the formula shown below, the BMI of each pupil was calculated.

BMI=weight (kg) /Height (m2)

Data analysis

The characteristics of the pupils were tested using the student's t-test. 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

Table 1 shows the mean BMI and prevalence of malnutrition in relation to vitamin A total iron, TIBC, haemoglobin serum albumin and ferritin percentage (%) level of deficiency. There was no significant pattern of relationship with the mean BMI and incidence of malnutrition $\{(r)=0.326 \text{ in males}\}$ and $\{(r)=0.001 \text{ in females})$ in relation to vitamin A deficiency, as there was 0% vitamin A deficiency (P<0.05).

The vitamin A level of these pupils both male and females, were good

| Deficiency % | | | | | | | | | | | | |
|--------------|------------|------------|----------------------------|---------------|------|--------|----------|------|------|-------------|---------|--|
| Gender | Age (Yrs) | N | Range (kg/m ²) | Mean ± S.d | % | Vit. A | Tot. Ir. | TIBC | Hb | Ser.Albumin | Ferritn | |
| М | 6-7 | 28 | 8.33-18.18 | 14.23 ± 0.37 | 7.1 | 0 | 42.8 | 0 | 75 | 14.2 | 0 | |
| | 8-10 | 57 | 7.62-18.25 | 14.80 ± 0.43 | 8.7 | 0 | 42.1 | 1.7 | 85.9 | 12.2 | 0 | |
| | 11-12 | 57 | 6.97-19.54 | 16.00 ± 1.60 | 28.5 | 0 | 28.5 | 14.2 | 57.1 | 0 | 0 | |
| | Overall 92 | 6.97-19.54 | 14.76 ± 0.20 | 50 | 0 | 41.3 | 2.1 | 80.1 | 11.9 | 0 | 0 | |
| | 6-12 | | | | | | | | | | | |
| F | 6-7 | 28 | 5.47-18.83 | 15.56 ± 0.20* | 57.1 | 0 | 39.2 | 0 | 75.0 | 14.2 | 0 | |
| | 8-10 | 70 | 8.46-19.15 | 16.04 ± 2.06 | 81.4 | 0 | 55 | 2.8 | 72.8 | 11.4 | 0 | |
| | 11-12 | 10 | 12.95-18.12 | 15.95 ± 0.91* | 40 | 0 | 30 | 0 | 30 | 10 | 0 | |
| | Overall | 108 | 5.47-19.15 | 15.96 ± 1.32* | 71 | 0 | 49 | 1.8 | 69.4 | 12 | | |
| | 6-12 | | | | | | | | | | | |

P<0.05=> Pearson's correlation (r) used

Table 1: The mean BMI and Prevalence of malnutrition in relation to vitamin A, total iron, TIBC, haemoglobin serum albumin and ferritin percentage (%) level of Deficiency.

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and adequate in all age groups. No significant relationship {(r)=0.168} existed between the mean BMI and incidence of malnutrition (P<0.05) in relation to total iron deficiency in the male subjects. Thus, overall BMI malnutrition % in males recorded 50.0% and 41.3% total iron deficiency. In the female counterpart, a significant relationship {(r)=0.790} existed between BMI and incidence of malnutrition.

Pupils between the ages of 6-12 years are particularly vulnerable to iron deficiency as a result of the increased demand for iron [8]. 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 8-19 years had 35.0% while 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 [7]. 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's efforts alongside World Health Organization (WHO's) invention programmes to reduce nutrients deficiency in children in developing countries have so far yielded little fruits. Possible reasons for this have been given to include low compliance due to inadequate motivation, low motivation of health personnel, and inadequate supplies of supplement tablets [9].

Another possible reason in this case may come from dietary practices of relying on staple food crops which characterize people of developing countries [10]. In Nigeria especially Ohaji/Egbema LGA Imo State as in other predominantly farming communities in the southeast Nigeria, starch and vegetables form the major dietary staple food, the inhibitory constituents such as fibres, polyphenolics, phosphates, and organic acids commonly present in such diet can prevent dietary iron absorption [11]. Habit of eating pica (consumption of nonnutritive substances) has been associated with iron deficiency [11] and this may be another contributory factor here.

Vitamin A appears to facilitate the metabolism of iron storage sites to the developing red blood cells for incorporation into haemoglobin, the oxygen carried [12]. However, vitamin A level being sufficient in these pupils may not imply that the total iron level will be sufficient too but insufficient vitamin A level will indicate insufficient level of total iron. Children progress through stages of iron deficiency beginning with iron depletion, whereby the amount of iron in the body is reduced while the red blood cells and some other biochemical parameters remain constant [13]. However result obtained showed that vitamin A played no role in the prevalence of iron deficiency among these pupils.

No significant relationship $\{(r)=0.269 \text{ and } < 0.001, \text{ respectively}\}$ existed between the mean BMI and TIBC (P<0.05) in the male subjects. Overall BMI malnutrition % in males was 50.0% and 2.11% TIBC deficiency. In the females, no significant relationship existed between mean BMI and TIBC as well thus, overall BMI malnutrition % in the females was 71% and TIBC deficiency % was 1.8%.

The total iron binding capacity (TIBC) level of these pupils was 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 [14]. The deficiency in TIBC level among these pupils could be suggestive of acute or chronic infections (as a result of increased catabolism) [15].

A significant relationship $\{(r)=0.983\}$ existed between the mean BMI and haemoglobin in the males. Overall BMI malnutrition % was 50% and 80.1% haemoglobin deficiency. In the females, a significant relationship $\{(r)=0.964\}$ existed between mean BMI and haemoglobin. Overall BMI malnutrition % recorded 71% and haemoglobin % was 69.4%.

The result of this finding showed that prevalence of anaemia continues to increase among pupils in Nigeria without intervention from the government. 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 [16]. 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).

No significant relationship {(r)=0.08 and 0.483 respectively} existed between the mean BMI and serum albumin (p<0.05) in both genders. Overall BMI malnutrition % in the males was 50% and serum albumin deficiency level was 11.9%. In the females, overall BMI malnutrition % was 71% and 12% serum albumin deficiency level was recorded.

The serum albumin level of both genders was observed to be good and adequate for all age groups, though 11.9% deficiency in the males and 12% deficiency in the females were recorded. This is suggestive of malnutrition, 3.2% was recorded above normal value of serum albumin in the males while in the females, 11.1% was recorded. This could have resulted from high intake of protein diets [16].

No significant relationship $\{(r)=0.096 \text{ and } 0.050\}$ existed between the mean BMI and ferritin (p<0.050) in both subjects. Overall BMI malnutrition % in male subjects was 50.0% and in the females 71% was recorded with 0% ferritin deficiency level in the subjects.

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.

From the result of these findings in Table 2, the prevalence of malnutrition was affected significantly (p<0.05) by the predisposing factors tested. Age, parental occupation, feeding habit and the number of children living in the home were significant predisposing factor to the prevalence of malnutrition.

However, significant relationship (p<0.05) existed between the above mentioned predisposing factors and the mean BMI values of the subjects. The effect of age on the mean BMI in the male subjects increase as their ages increased, but no significant relationship (r=0.420) was detected. In the female counterpart, the age group 8-10 years had the highest prevalence of malnutrition. This could be as a result of insufficient nutrients to meet the body's demand due to rapid growth in these pupils within same age group.

Parental occupation had a significant (r=0.874) impact on the mean BMI of these pupils. Pupils whose parents were farmers and artisans showed significantly (p< 0.05) lower mean BMI than those whose parents were civil servants, students, teachers and traders. This

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| Gender | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|--------|---------------------------|---|----|-----|-----------------------|-----------------|--------|--------|
| NA | 6-12 14.76 ± 0.20 | | 92 | 9.7 | a=1.7 | a=1.3 a=4.2 a=0 | | |
| IVI | | | | | b=1.3 | b=3 | b=2.8 | b=1.6 |
| | | | | | c=2.6 | c=5.4 | c=2.7 | c=0.9 |
| | | | | | d=1.2 | d=0 | d=9.7 | d=2.8 |
| | | | | | e=1.5 | e=9.7 | | e=4.4 |
| | | | | | f=1.4 | | | f=9.7 |
| | | | | | g=9.7 | | | |
| F | 6-12 108 15.96 ± 1.3271.2 | | | | a=17.5 a=24.6 a=0 a=8 | | | |
| | | | | | b=13.8 | b=32.1 | b=0 | b=0 |
| | | | | | c=16.6 | c=8.7 | c=71.2 | c=10.2 |
| | | | | | d =10.1 | d=5.8 | d=71.2 | d=19.7 |
| | | | | | e= 5.8 | e=71.2 | | e=33.3 |
| | | | | | f=7.4 | | | f=71.2 |
| | | | | | g=71.2 | | | |

p<0.05 =>Pearson's Correlation (r) used.

- 1. Overall age in years.
- 2. Total number of subjects.
- 3. Mean \pm Standard deviation.
- 4. Percentage malnutrition (kg/m²)
- Parental occupation of pupils (a=Artisan; b=Civil servant; c=Farmer; d=Student; e=Teacher; f=Trader; g= Total % malnutrition).
- Parental educational background of pupils (a=None; b=Primary; c=Secondary; d= Tertiary; e=Total % malnutrition).
- 7. Pupils feeding habit (a=Once; b=Twice; c=Thrice; d=Total % malnutrition).
- 8. Number of children in the home (a= < or =3; b= >3 or =5; c= >5 or =7; d= >7 or =10; e= >10; f= Total % malnutrition).

Table 2: Summary Table Showing The Mean BMI and Prevalence of Malnutrition According To Socio-economic/ demographic Status of Pupils.

is because parents, who are farmers and artisans in rural area, may have a lower economic status than the others [17].

Furthermore, the male pupils whose parents had post primary (Secondary) education recorded the highest prevalence of malnutrition while in the female counterpart, parents who had primary education recorded the highest prevalence. However, this socioeconomic factor had no significant effect on the mean BMI, no correlation (r=0.387) was found with the prevalence of malnutrition in this finding.

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 malnutrition 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. This therefore, calls for high public concern. However, the need for educational awareness cannot be over-emphasized.

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