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Biochemical Assessment of Zinc Status of Under-Five Children in Orphanages of Federal Capital Territory, Abuja, Nigeria

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Abstract: *Biochemical assessment of zinc status of under-five children in orphanages of Federal Capital Territory, Abuja, Nigeria was conducted. The objective of the study was to assess the zinc status of the under-five children in the orphanages of Federal Capital Territory using biochemical method and determine the relationship between the dietary intakes zinc with the biochemical status of the under-five children. A cross sectional descriptive study was carried out on 200 under-five orphans, between 0-5 years living in ten orphanages in Abuja, Nigeria. Blood samples were analysed to determine the zinc status of the under-five children also questionnaires were used to collect information on feeding practices of the children. The values obtained from nutrient intakes were compared with FAO/WHO recommended nutrients intake. Biochemical results from this study, revealed high prevalence of zinc deficiency (60.0%) among the under-five children, while less than half (40%) of the children had normal zinc status. It was found that zinc deficiency affected some age groups more than others. Children aged between 25-60 months had the highest prevalence (25.0%) of zinc deficiency while children between the ages of 0-6 months had the least deficiency (15.0%). Result from the chi-square analysis however, showed that there were no significant ($P<0.05$) difference between zinc deficiency and the ages of the children ($\chi^2 = 0.876$, $df=2$, $p=0.675$). The study also revealed that more females were zinc deficient than males. This study revealed a strong association between zinc and stunting. Correlation between the anthropometric results and the micronutrient deficiency of the children in the orphanages showed that there was a significant ($P<0.05$) relationship between the children that were moderately stunted and zinc deficiency. Zinc deficiency is of public health importance in Nigeria therefore more concerted effort by all the stakeholders should be put in place to minimize its menace.*

Keywords: *Assessment, Zinc Status, Under-Five Children, Orphanages*

I. Introduction

Zinc is now recognized as an essential micronutrient (trace element) of public health important (1). It is present in all body tissues and fluids. The total body zinc content has been estimated to be 30 mmol (2g) (2). Skeletal muscle accounts for approximately 60 percent of the total body content and bone mass, with a zinc concentration of 1.5–3 μmol/g (100-200 μg/g), for approximately 30 percent (3). Plasma zinc has a rapid turnover rate and it represents only about 0.l percent of total body zinc content. This level appears to be under close homeostatic control (4). Zinc is an essential component of a large number of enzymes which participates in various biochemical reactions in the body. These reactions include the synthesis and degradation of carbohydrates, lipids, proteins, DNA and RNA as well as in the metabolism of other micronutrients. Zinc stabilizes the molecular structure of cellular components and membranes and contributes in this way to the maintenance of cell and organ integrity. Furthermore, zinc has an essential role in polynucleotide transcription and thus in the process of genetic expression. Its involvement in such fundamental activities probably accounts for the essentiality of zinc for all life forms (5). It also plays an important role in fertility, conception and delivery. Zinc is important for normal growth and development of children either with or without diarrhea. It plays a role in cognitive and motor function (6).

Zinc is a trace mineral needed by human body in small quantity but of great importance for child survival. Zinc deficiency is wide spread in developing countries and the most vulnerable groups are infant, children, pregnant women and lactating mothers (7). It is marked by growth retardation or stunting. In period of rapid growth zinc requirement is normally high and where this demand is not met, problems like growth retardation may arise (8). Zinc enhances the transport of vitamin A in and out of the cells and its deficiency is thought to have a close link with iron deficiency. Zinc participates in carbohydrate and protein metabolism, DNA and RNA synthesis among other functions (9).

Globally, nutritional status is considered the best indicator of the well being of young children and a parameter for monitoring progress towards the Millennium Development Goals (MDGs). Nutrition and health status have powerful influence on a child's learning and how well a child performs in school. The nutritional status of under-five children is of particular concern because, their early years of life are crucial for future growth and development (10). Apart from chronic undernutrition experienced by under-five children, they also suffer from parasitic infections and hunger (11). Hunger is the physiological state that results due to inadequate

food to meet the energy needs. Chronic hunger leads to undernutrition, causes growth failure and weakness. Hunger reduces energy and strength; it diminishes concentration, impairs a child's ability to learn and equally affects the health of the child (12).

Over 140 million children under the age of 18 in the developing world have lost one or both of their parents. In sub-Saharan Africa alone there are 43 million orphans, representing more than 12% of all children (13). Sub-Saharan African countries are already struggling to eradicate extreme poverty. This unprecedented burden of orphan populations is further reducing resources within households and communities. As a result, orphans are made vulnerable to a variety of risks, including poverty, school dropout, malnutrition, micronutrient deficiency and other forms of child deprivation. For Nigerian children, the impact of the attendant challenges in the health sector especially HIV/AIDS, education and social welfare has occasioned situations of neglect of basic rights leading to increased vulnerability of over 69 million population under eighteen years in the country (14).

Infants and young children are one of the vulnerable groups in the society. They are more vulnerable when they are denied their rights to proper feeding and good nutrition. Nigeria ranks 14th in global assessment of under-five mortality rate and approximately one million children die annually in Nigeria before their 5th birthday (15). Nigeria is among the 20 countries in the world that account for 80% of undernourished children. The causes of this public health problem in Nigeria are complex and multidisciplinary. However, poor quality and quantity of foods given to children play a major role (16). There are more orphanages in the country presently than before.

A study of orphanages conducted by the Federal Ministry of Women Affairs & Social Development (FMWA & SD) in 2007 showed that over 150 orphanages exist in Nigeria and the establishment of half of these orphanages occurred over a period of 50 years (1940 – 1990). It took only 15 years (1991-2000) to establish the other half. This indicates that more orphanages were founded in recent times than previously. They are distributed across the thirty six states of the country including the Federal Capital Territory (13). Basic indicators as indicated by the Nigeria Demographic and Health Survey reveal no significant improvement on the health status of the Nigerian children between 2003 and 2008 (17,18).

About 50% of the current 138 deaths per 1000 live births could have been averted if the children were not malnourished. FCT under-five mortality rate is 152 deaths per 1000 lives birth (19). The prevalence of malnutrition among orphans and vulnerable children under-five years of age in Nigeria is as follows: 22 percent of orphans are underweight, 33 percents of them are stunted while 11 percent are wasted (18). A survey conducted by MICS (2011) showed the prevalence of malnutrition among under-five children in the FCT as follows 46.8% of the children were moderately underweight, while 22.0% of them were severally underweight. 65.1% of the children were moderately stunted while 40.5% of the children were severely stunted. On the other hand, 14.2% of them were moderately wasted while 4.8% of them were severally wasted. From field experience about 35% of children seen in rural communities of the FCT are malnourished (19).

The general objective of the study was to assess the zinc status of the under-five children in the orphanages of Federal Capital Territory using biochemical method.

This study would provide will provide data on the zinc status of the under-five children in orphanages of FCT. The generated data and information will be an evidence for strong advocacies to policy makers and stakeholder, which will subsequently inform their decisions on, appropriate nutrition intervention programmes geared towards improvement of the lives of orphans in FCT and Nigeria as a whole. It will also form a based line data for other researchers that would want to work on under-five nutritional status especially among orphans and vulnerable children.

II. Materials And Methods

Study area

The study was carried out in Federal Capital Territory (FCT) Abuja, North Central Nigeria. FCT has a rapid population growth which is facilitated by the expansion of the satellite towns in the sub-urban areas. The census population of FCT is 1.4 million (20). It has a growth rate of 9.5%. it has an estimated population of about two million, one hundred and ninety one thousand, nine hundred and ninety three persons (2, 191, 993) for the year 2011 and under five children in FCT for year was 438, 399 (20). FCT is made up of six area councils namely: Abaji, Abuja municipal area council (AMAC), Bwari, Gwagwalada, Kuje and Kwali area councils. FCT has 10 registered orphanages distributed in three Area Councils namely; Abuja municipal area council which has 50% of the total orphanages, Gwagwalada and Kwali area councils. One of the orphanages is owned by the government and the remaining 9 are owned by private individuals, organizations and non-governmental organisation (NGOs).

Table 1: FCT orphanages, locations and number of under- five children.

s/n	Name of Orphanages	Location	Under- five children
1	Unity orphanage home	Gwagwalada Area Council	34 children
2	Abuja children's home	Abuja Municipal Area Council	20 children
3	Mother Theresa children's home	Abuja Municipal Area Council	33 children
4	City of refuge orphanage	Abuja Municipal Area Council	20 children
5	Bema Home for less privileged	Abuja Municipal Area Council	10 children
6	Hope of survival	Abuja Municipal Area Council	20 children
7	Poorest of the poor Anawi	Gwagalada Area Council	7 children
8	Christ treasured orphanage	Kwali Area Council	20 children
9	Centre for destitute empowerment	Kwali Area Council	21 children
10	Holy family sister of the needy	Gwagwalada Area Council	15 children
Total no of under five children in the orphanages			**200 children**

Source: Federal Capital Territory Administration Social Development Secretariat

Study design

The study is a cross-sectional descriptive study.

Population of the study

The population for the study was all the 200 under-five children in the registered orphanages of FCT as at the time of the study.

Sample for the study

All the 200 under-five children in the orphanages were used for the study. Males were 96 under-five children while females were 104 under-five children living in ten orphanages. They were purposively selected and recruited for this study (21). Thus they served as the sample size for the survey. A sub sample consisting of 20% of the sample (40subjects) were used for biochemical analysis. This number was drawn from the orphanages using random sampling by balloting without replacement.

$$\frac{20}{100} \times 200 = \textbf{40 children}$$

Ethical clearance and consent form

Before the implementation of the project, extensive consultation was undertaken between the researcher, and the management of the orphanages. This was made possible with the help of introductory letters from department of Home Science, Nutrition & Dietetics University of Nigeria Nsukka and the department of child's welfare, Social Development Secretariat Federal Capital Territory. The study was approved by Federal Capital Territory, Health Research Ethics Committee. All ethical issues were adhered; informed verbal consent was obtained from the management of the orphanage prior to the commencement of the study. Neither children nor workers/management of the orphanage, were paid to participate in the study, participation was voluntary.

Data collection instruments and methods

Questionnaire

A well-structured validated and pre-tested questionnaire was used in this study to collect background information of the orphanage, staff/caregivers and children which includes child's sex, age, number of children, staff strength, educational background of caregivers, and child care practices. Other health demographic and socioeconomic characteristics (such as funding, water supply, electricity) which may affect the nutritional status of the under five children were also included in the questionnaire.

Collection of blood sample and preparation

The process of blood samples collection was conducted with consideration for the health and safety of both collector and subjects as recorded (22) A soft tubing tourniquet was tired around the upper arm (above the elbow) of each child by a phlebotomist and medical laboratory scientist. The cubical fossal (puncture site) was cleaned with a clean cotton wool and 70% alcohol and then allowed to dry. With the assistance of health workers/caregivers in the orphanages the child was held and positioned to prevent excessive movement. A venepuncture was made with the needle directed upwards in the line of the vein and the plunger of the syringe pulled gradually to allow in blood (23).

Serum was subsequently prepared in the laboratory by centrifuging the clotted blood samples at 500 revolutions per minutes for 7minutes and later collected into a legibly labelled serum bottles. It was thereafter transported under dark cover in a giostyle. The temperature inside the giostyle was maintained at $4^{o}C$ with frozen ice packs and presented for serum analysis at the Department of Chemical Pathology University College Hospital (UCH) Ibadan, Nigeria. The serum samples were run in triplicates for zinc after which the average was taken

III. Biochemical Analysis

Zinc analysis was determined using atomic absorption spectrometry model number Buck 210/11 (24)

Apparatus: Extraction/digestion tubes (50ml), block digester, fume hood, weighing balance, precision syringe, beakers, volumetric flask, shaker and centrifuge.

Reagents: ultra-pure water, nitric acid, pyloric acid, H_2SO_4 and catalyst

Procedure: about 0.5ml of serum was digested with concentrated H_2SO_4, 5ml of pyloric acid and nitric acid. The digestion took place at a temperature of 105^oC for 45 minutes. After digestion the sample was made up to 100ml volume with deionized water. Atomic absorption spectrometry model number Buck 210/11 was used with a zinc lamp to detect serum zinc. A reading between 80-120µg/dl is recorded as normal. Zinc deficiency was defined as a reading below 80µg/dl (25).

Recruitment and orientation of research assistance:

Two community health extension workers (CHEWs) who had participated in previous nutrition survey were recruited as research assistance for this study. The researcher explained the objectives of the study to them. They were trained on administration of questionnaires required for data collection.

Data analysis

Administered questionnaire were checked for accuracy, completeness and consistency. The questionnaire was coded and analysed using the computer programme, statistical package for social sciences (SPSS) for window version 16.

IV. Results

Background Information of the Orphanages

Table 1: Characteristics of the orphanages

	Frequency	Percentage
Ownership		
Government	1	10.0
Private	6	60.0
NGOs	2	20.0
Faith-based	2	20.0
Total	**10**	**100.0**
Income level per month (₦)		
100,000-300,000	2	20.0
301,000-500,000	5	50.0
501,000-700,000	1	10.0
>700,000	2	20.0
Total	**10**	**100.0**
Source of funding		
N= multiple response		
Self-sponsorship	7	70
Donation by government	5	50
Donations by private organizations	4	40
Donation by individual	6	60
Sources of electricity		
N= multiple response		
Government only	2	20.0
Generator only	4	40.0
Both	7	70.0
Access to health care		
First aid	8	80.0
Availability to functional health facility	2	20.0
Total	**10**	**100.0**
Recreational activities		
Available	8	80.0
Not available	2	20.0
Total	**10**	**100.0**

Table 1 shows the characteristics of the orphanages. More than half (60.0%) of the orphanages were privately owned, 20.0% were owned by non-governmental organizations (NGOs) and faith-based organizations while only 10.0% were government owned. Half (50.0%) of the orphanages received income within the ranges of N301,000 and N500,000. Twenty percent (20.0%) received funds within N100,000 and N300,000 while

20.0% of them received funds, above N700,000. Ten percent (10%) received funds between the range of N501,000 and N700,000. Majority of the orphanages (70%) got their income through self-sponsorship, 60% of the income were from private individuals, while half (50%) were from government, a little below half (40%) got their income from private organization. Majority (70.0%) of the orphanages got their electricity from both government and generator (private) sources, 40.0% got from generator only while 20.0% got from government source only. A greater percentage (80.0%) of the orphanages had first aid as their only access to health care while 20.0% had no access to functional health facility. Majority (80.0%) of the orphanages had recreational activities while 20.0% of them had no recreational activities.

Table 1b: Characteristics of orphanages

	Frequency	Percentage
Staff strength		
1-10	3	30.0
11-20	6	60.0
>20	1	10.0
Total	**10**	**100.0**
Toilet system		
Water system	9	90.0
Pit latrine	1	10.0
Total	**10**	**100.0**
Source of water		
N= multiple response		
Pipe borne water	6	60.0
Borehole	7	70.0
Well	2	20.0
Water vendors	4	40.0
Source of obtaining children		
N= multiple response		
Police	5	50.0
Social welfare	8	80.0
Parents/relative	4	40.0
Streets, dustbins, bush	3	30.0

Table 1b shows the characteristics of the orphanages. More than half (60.0%) of the orphanages had 11-20 staff, 30.0% had 1-10 staff while 10.0% had 20 staff and above. Majority (90%) of the orphanages had water system as their toilet facilities while 10% of them used pit latrine. More than half (70.0%) of the orphanages used borehole as source of water, 60% rely on government for their water supply, 40% of them buy water from water vendors while 20% got their water from well. Majority (80.0%) of the orphanages obtained children from social welfare, 50.0% of them obtained children from police, 40.0% of them obtained from parents/relatives and 30.0% of them obtained children from streets, dustbins and bush.

Table 2: Background characteristics of the children in the orphanages

	Frequency	Percentage
Sex of the children		
Male	96	48.0
Female	104	52.0
Total	**200**	**100.0**
Age distribution (in months)		
0-6	15	7.5
7-24	87	43.5
25-60	98	49.0
Total	**200**	**100.0**
Education		
No of eligible children receiving education	98	100.0
No of eligible children not receiving education	0	0.0
Total	**98**	**100.0**

Table 2 shows the background characteristics of the children in the orphanages. More than half (52.0%) were females while 42.0% of them were males. Slightly less than half (49.0%) of the children fell within the

age range of 25-60 months, 43.5% fell within 7-24 months while 7.5% fell within 0-6 months. All (100%) eligible children are receiving education/attending school.

Background information of staff of the orphanages

Table 3: Background information of the staff

	Frequency	Percentage
Level of Education		
Primary education	25	20.5
Secondary education	37	30.3
OND/NCE & Diploma	29	23.8
HND & B.Sc	19	15.6
PGD/Masters	12	9.8
Total	**122**	**100.0**
Age (in years)		
25-34	21	17.2
35-44	34	27.9
45-54	42	34.4
>54	25	20.5
Total	**122**	**100.0**
Position of staff		
Admin staff	17	13.9
Health workers	9	7.4
Caregivers/nannies	40	32.8
Cooks	16	13.1
Security men	11	9.0
Cleaners	19	15.6
Drivers	10	8.2
Total	**122**	**100.0**

Table 3 shows the background information of the staff. About 30.3% of the caregivers had secondary education, 20.5% had primary education, 23.8% had OND/NCE & Diploma Certificates, 15.6% had HND and B.Sc certificates and 9.8% had PGD/Masters education. Less than a half (34.4%) of the staff fell within the age range of 45-54 years, 27.9% fell within 35-44 years and 20.5% were above 54 years. However, only 17.2% fell within 25-34 years. About 33.0% of the staff were caregivers/nannies, 15.6% were cleaners and13.9% of them were administration staff. About 13.0% were cooks, 9.0% were security men and 8.2% were drivers. The least (7.4%) were health workers.

There were 40 caregivers for 200 children in the orphanages. This is in the ratio of 1:5.

Table 4: Health care practices of the children

	Frequency	Percentage
Immunization		
Completely immunized	179	89.5
Not completely immunized	21	10.5
Total	**200**	**100.0**
Various Antigens received. N= Multiple responses		
OPV	200	100.0
DPT	150	75.0
HBV	200	100.0
Yellow fever	200	100.0
Measles	185	92.5
Children that slept under Insecticide Treated Nets (ITN)		
Slept under ITN	158	79.0
Did not sleep under ITN	42	21.0
Total	**200**	**100.0**

Keys:
OPV: oral polio vaccine DPT: Diphtheria pertussis tetanus
HBV: Hepatitis B vaccine

Table 4 shows the health care practices of the children. Majority (89.5%) of the children had completed immunization in accordance with their age and a few (10.5%) were yet to complete immunization. All (100.0%) eligible children received antigens of oral polio vaccine (OPV), hepatitis B vaccine (HBV) and yellow fever.

About 93.0% received antigens of measles while 75.0% received diphtheria pertussis tetanus (DPT). Majority (79.0%) of the children slept under insecticide treated nets (ITN) and 21.0% did not sleep under ITN.

Table 5: Morbidity pattern of the children

Morbidity	Frequency	Percentage
Malaria		
Yes	109	54.5
No	91	45.5
Total	200	100.0
Fever		
Yes	21	10.5
No	179	89.5
Total	200	100.0
Diarrhea		
Yes	126	63.0
No	74	37.0
Total	200	100.0
Vomiting		
Yes	21	10.5
No	179	89.5
Total	200	100.0
Cough		
Yes	137	68.5
No	63	31.5
Total	200	100.0
Measles		
Yes	25	12.5
No	175	89.5
Total	200	100.0
Child with HIV		
Yes	12	6.0
No	188	94.0
Total	**200**	**100.0**

Table 5 shows the morbidity pattern of the children within a period of six months. Majority (68.5%) had cough, 63.0% had diarrhea, 54.5% had malaria, 12.5% had measles, 10.5% had headache and vomiting and 6.0% were HIV positive.

Table 6: Biochemical assessment result of the children

Biochemical test	Frequency	Percentage
Serum zinc		
Zinc deficient	24	60.00
Normal	16	40.00
Total	**40**	**100.00**

Cut off point of the biochemical measurements
Serum zinc = ≤80 µg/dl
Table 6 shows that about 60% of the children were zinc deficient and 40% had normal zinc status.

Table 7: Mean biochemical measurements of deficient children.

Biochemical test	Serum zinc(µg/dl) ≤80.0
Serum zinc	
Zinc deficient	56.87±10.86
Normal	94.52±9.25

Table 7 shows the mean biochemical measurements of the children. Children with zinc deficient had a mean zinc value of 56.87±10.86

Table 8: Mean biochemical measurements of the normal children according to age

Age (months)/Sex	Serum zinc(µg/dl) ≥80.0
0-6 months	
Male	87.98±1.23
Female	83.47±1.07
7-24 months	
Male	90.13±1.14
Female	91.65±0.57
25-60 months	
Male	81.26±0.76
Female	85.67±0.57

Table 4.19 shows the mean biochemical measurements of normal children according to age. Children within the age ranges (7-24 months) had Serum zinc value (90.13±1.14
and 91.65±0.57for male and female respectively).

V. Discussion

The aim of this cross-sectional descriptive study carried out in the orphanages of Federal Capital Territory, Nigeria is the need to biochemically assess the zinc status of the under-five children in these institutions, so as to provide evidence based data that will inform nutrition/health interventions for the under-five orphans.

Background information of the orphanages

This section presents information on characteristics of the orphanages, children and staff as well as their socioeconomic status. Private individuals (60.0%) owned the largest number of orphanages. This finding is similar to a survey conducted by Federal Ministry of Women Affairs and Social Development (26) on orphanage situation in Nigeria, which showed that private individual owned majority of the orphanages (48.6%) in Nigeria.

wenty percent (20.0%) were owned by non- governmental organizations (NGOs) and Faith based organization (FBO). This was surprising because, with so many NGOs and FBOs emerging lately, it would have been expected that most of them would have ventured into running orphanages since orphans are more vulnerable than non-orphans. Only 10.0% of the orphanages were owned by government, this revealed that government is declining in management of orphanages. Government is concentrating more on regulatory and supervisory work, leaving the management in the hands of private individuals, philanthropies NGOs and FBOs. Previous study carried out on orphanages in Nigeria reported that 27.0% of the orphanages were owned by NGO and FBO while 24.2% of them were owned by government (26).

Majority of the orphanages (70.0%) got their electricity from both government and generator sources. They rely more on generator (40.0%) than national electricity (20%). This was attributed to the irregular source of energy from government, which led to majority of the orphanages having generator to complement electricity supply from government. A greater percentage (80.0%) of the orphanages had first aid boxes as their only access to health care and also recreational facility, respectively as compared to 20.0% of them that had no access to functional health facility and recreational equipment. These findings are in line with the FMWA&SD, 2007 survey on situation of orphans and vulnerable children in Nigeria, where it stated that 83.2% of the orphanages had available first aid boxes and another 81.8% had recreational facility (26). Half (50.0%) of the orphanages received funds within the ranges of ₦301,000 and ₦500,000, while 20.0% received funds more than ₦700,000.

The orphanages source of income (70.0%) were mainly self-sponsored especially those that were privately owned, while 60.0% were from private philanthropic individuals. According to Social Development Secretariat, Federal Capital Territory Administration, it is government responsibility to provide monthly subventions to the orphanages, which should be the major source of income for the orphanages. Contrary to their opinion half of the orphanages (50.0%) claimed they had received government subventions, at one point but it was quite irregular.

Majority of the children that had nutritional problems were from low income orphanages. Aggarwal *et al*. reported that an increase in household income is associated with improved nutritional status of children (27). Income influenced the nutritional status of the children in this study. Majority (80.0%) of the orphanages obtained children from social welfare. Half of the orphanages (50.0%) recorded that the children in their homes were brought in by the police. These findings were in line with the FMWA&SD survey where it stated that social welfare department and police were the highest source of obtaining children in the orphanages. Forty percent of the orphanages obtained children from parents/relatives (14). This was attributed to high level of poverty in Nigeria (28), which makes it difficult for parents to successfully take care of their children. Federal Ministry of Women Affairs and Social Development revealed that most parents and relatives take their children to orphanages when it becomes difficult to provide necessary care to their children (26).

Most (60.0%) of the orphanages had 11-20 staff, 30.0% had 1-10 staff while only 10.0% had 20 staff and above. The caregiver-to-child ratio of 1:5 observed in this study was not adequate. This is because the same caregivers took of older children that are not part of this study. It was not possible to disaggregate the ratio of caregivers to under-five children from the ratio of caregivers to all the children. The study showed that orphanages with staff strength of 1-10 had the highest rate of malnutrition (24.5% of the children were underweight, 32.5% of them were stunted while 28.0% were wasted) while those orphanages with staff strength of greater than 20 had the least rate of malnutrition (8.5% of the children were underweight, 10.0% were stunted while 7.0% were wasted).

A research on the impact of caregiver-to-child ratio in day care centers, revealed that reducing the caregiver-to-child ratio from five children per caregiver to three children per caregiver significantly (P>0.05) improved the quality of the caregiver-child interaction and nutritional status particularly for infants (29). Another study revealed that orphanages which had one caregiver to one child (1:1) and those having one caregiver to two children (1:2) provided adequate care than those that had one caregiver to four or more children (1:4/10) (26). Very few staff had HND/B.Sc certificates (15.6%) and PGD/Masters (9.8%) education, respectively as compared to 30.3% and 20.5% that had secondary and primary education, respectively. The level of literacy was higher among the management cadre than the junior workers.

About 34.4% of the staff fell within the age range of 45-54 years, another 27.9% were within 35-44years. These groups are mostly nannies/caregivers. The study revealed that only 17.2% of the staff were between 25-34years. This could be attributed to the peculiarity of the job description, caring for a child that is not biologically yours. It requires compassion and patient to be able to take up an orphanage work more than other circular jobs. Therefore even with the high rate of unemployment in Nigeria (28) younger people tend to shy away from working in orphanages. The study showed that there were more female (104) than male (96) in the orphanages. Majority of the children fell between the age ranges of 25-60 months. The caregivers claimed that all eligible children were receiving education.

Nutrition intervention programmes, child health and morbidity pattern of the children

National Primary Health Care Development Agency (NPHCDA) provides vaccines and technical support to protect children against vaccine preventable childhood illnesses such as tuberculosis, poliomyelitis, diphtheria pertussis and tetanus (DPT), hepatitis B, measles and yellow fever. UNICEF provides vitamin A supplementation and other child survival interventions. The full benefits of childhood immunization are best achieved when all the prescribed immunization is given before the age of one year (15). This study revealed that more than half (89.5%) of the children completed their immunization before one year. Vitamin A supplementation (84.5% of children 6-59months received vitamin A capsule) and deworming (79.0% of the children received albendazole) were the only nutrition intervention currently carried out in the various orphanages. This was attributed to the fact that these interventions were among the packages delivered during the Maternal Newborn Child's Heath Week (MNCHW) carried out bi-annually in Nigeria (30). The study recorded a high level of morbidity pattern for diarrhea (63.0%), cough (68.5) and malaria (54.5%) among the children. This is similar to a previous result of national survey on under-five children in Nigeria conducted by Maziya-Dixon *et al*., they reported that malaria was the most (71.3%) reported illness the children had, followed by diarrhoea and cough (25).

The orphanages recorded a high (79.0%) usage of insecticide treated net (ITN). This could be because of awareness and ITN distribution campaign which has been on going recently in Nigeria. UNICEF (2012) reported that less than half (42.0%) of households in Nigeria has at least one ITN, while 29.0% of under-fives children sleeps under ITN (31). The 79.0% of the children that slept under ITN recorded for this study is an improvement compared to 6.0% of under-five recorded in a National survey who slept under ITN in Nigeria (18). That notwithstanding, the high level of malaria morbidity (54.4%) even with high ITN usage (79.0%) could be attributed to poor usage of ITN (18).

High diarrhoea morbidity could be attributed to poor feeding practices and living conditions as 7.5% of caregivers still bottle feed the children. Even though 75.0% of caregivers claim they soak and wash feeding utensils one can deduce that they might not be sterilizing the utensils as they claimed because of high diarrhoea morbidity recorded in this study. Only 6.0% of the children had confirmed HIV. This is contrary to popular opinion (13, 26, 32) that HIV/AIDS is among the leading cause of orphanhood. In this study, the children's biological mothers were not available to ascertain the level of HIV exposure among the orphans. Research has shown that HIV confirmed cases are usually lower than HIV exposed infants (infants born of HIV mothers) (13) one can easily extrapolate that children exposed to HIV in this study were be much more higher than the 6.0% HIV confirmed children and whose parents would have died as a result of the disease thereby making them orphans.

Zinc status of the under-five children

In this study zinc deficiency was defined as a reading below 80ug/dl. (33). Biochemical results from this study, revealed high prevalence of zinc deficiency (60.0%) among the under-five children, while less than half (40%) of the children had normal zinc status. The prevalence of zinc deficiency (60.0%) recorded in this study is higher than what was observed from previous studies. A study recorded 41.5% of under-five children having zinc deficiency (34). At the national level, 20% of children under- five were zinc deficient (25). It was found that zinc deficiency affected some age groups more than others. Children aged between 25-60 months had the highest prevalence (25.0%) of zinc deficiency while children between the ages of 0-6 months had the least deficiency (15.0%). Result from the chi-square analysis however, showed that there were no significant ($P<0.05$) difference between zinc deficiency and the ages of the children ($\chi^2 = 0.876$, df=2, p=0.675). The study also revealed that more females were zinc deficient than males. This study revealed a strong association between zinc and stunting. Correlation between the anthropometric results and the micronutrient deficiency of the children in the orphanages showed that there was a significant ($P<0.05$) relationship between the children that were moderately stunted and zinc deficiency. Zinc is important for normal growth and development in children. Growth retardation especially in children is one of the consequences of zinc deficiency (33).

VI. Conclusion

This study have been able to x-ray the zinc status of under-five children in orphanages of Federal Capital Territory, Abuja, Nigeria. Findings from this survey call for more attention to the provision of adequate nutrition during infancy and early childhood which is a basic requirement for the development and promotion of optimum, health and behaviour of the child. This study recorded high prevalence of zinc deficiency among the under-five children in FCT orphanages. Malnutrition recorded was also linked to faulty feeding practices, low socio-economic status, caregiver's ratio and nutrition education. The consequences of faulty feeding practices and malnutrition among these children are growth retardation or cessation, low cognitive responses, poor productivity and development. Malnutrition also puts these children at risk of morbidity severity and mortality of several infections.

VII. Recommendations

- The high level of zinc deficiency recorded in this study underline the urgent need for nutritional interventions in the orphanages such as micronutrients deficiency control, growth monitoring and nutrition education.
- Breastfeeding is the most effective child survival strategy for infants and young children. The current National guideline on re-lactation of foster mother or caregivers for orphans to be breastfed is not practised as none of the orphans were breastfed. There is need for the development of "Human milk bank" in the country where lactating mothers can donate breast milk which will be screened and subsequently used for the orphans and other children who might not get breast milk from their biological mothers.
- Nutrition education directed at caregivers, health workers and managements of the orphanages is imperative. This will help improve the feeding practices, hygiene and nutritional status of the children. From field experience during this study, some health workers from these orphanages were recommended to benefit from a National training of Infant and Young Child Feeding Practices held in Abuja. This should be sustained and extended to other caregivers in various orphanages in Nigeria.
- There should be increased advocacy for dietary diversification so as to increase consumption of micronutrients rich foods by these children. The orphanages can embark on Agriculture extension/food security programmes. This will help increase dietary diversification, food security as well as generate income into the orphanages rather than rely on charity donations or government subventions.
- Urgent attention should be paid to the issue of zinc deficiency in Nigeria. Zinc should be supplemented routinely to the entire vulnerable groups not just in the clinical management of diarrhea as is currently practiced in Nigeria. It should be included in the national food fortification programme as a medium and long term strategy to prevent its deficiency among the vulnerable groups. There is research needs to develop food vehicles for zinc fortification
- Multiple mix supplementations should be promoted and adopted. For example, micronutrients of public health importance such as iron, zinc, iodine and vitamin A can be integrated and effectively delivered to the vulnerable children in a single dose.

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