Assessment of Anthropometric Indices and Micronutrient Status of Children under Five in Orphanages of Kaduna Metropolis

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Abstract Children who are orphaned are faced with an increasing risk of malnutrition, which is attributed from poor feeding practices, inadequate food supply, utilization coupled with limited access to treatment facilities. In this study, the Anthropometric indices and Micronutrient status of children under five in orphanages of Kaduna metropolis, was assessed. Some standard methods were used for the sampling, anthropometric measurements and micronutrient analysis. Results revealed that the demographic characteristics of the orphan children were mostly aged between 13 to 24 months (37.93%) with the female (52.87%) and the male (47.13%). Anthropometric measurements of the children in the orphanages revealed mean z scores for Weight for Height (WHZ/Acute Malnutrition) as -1.74 ± 1.84, -2.59 ± 1.65 for Weight for Age (WAZ/Underweight) and -2.32 ± 2.23 for Height for Age (HAZ/Stunting). Prevalence of Severe Acute Malnutrition among the orphans was (36%), Severe Underweight (36.1%) and severely stunted (44.8%). Micronutrient status of the under five orphan children indicate mean concentrations of Vitamin A (26.88ug/l $\pm$ 66.54), Iron (21.78ug/l $\pm$ 12.85) and Zinc (62.65 $\pm$ 29.25 ug/dl). The orphans' micronutrient status and anthropometric indices showed significant association between the Iron and Vitamin A concentrations, WHZ and WAZ (r = 0.681) and between WAZ and HAZ (r = 0.467). The outcome of this research will contribute to improving the nutritional status and address micronutrient deficiencies among orphans in orphanages of Kaduna Metropolis.

Keywords: *orphans, micronutrients, nutritional assessment, dietary diversity*

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1. Introduction

Malnutrition refers to deficiencies, imbalances or excesses in a person's intake of energy and/ or nutrients [1], it is a problem that weakens the body's immunity and causes illness. According to [2], malnutrition is the underlying cause of more than half the deaths of children under five. It accounts for approximately 1 million deaths of 20 million children under the age of five suffering from severe malnutrition annually.

Globally, an estimated 159 million under five children, are stunted, 50 million wasted and 41 million are overweight or obese [1].

Among the factors that cause malnutrition are poor diets and infections. Infectious diseases remain the most important and immediate cause of death and disability among children worldwide. [3].

Orphanages are institutions dedicated to the care and upbringing of children who have lost their parents or have been abandoned. There is detrimental relationship between the type of institutional care provided and behavioral, cognitive, emotional and social development of orphanage children. Children in orphanage institutions have been reported to lack basic and traditionally accepted social and cultural skills to function in their societies [4]. They have lower levels of educational attainment, problem in adjusting to independence after leaving the orphanage, difficulties in relationship, lack parental skills and misplaced sense of entitlement without a parallel sense of responsibility [5].

Major common problems faced by orphans include high dropout rate from school, loss of homes, lack of access to basic health care such as immunization, exposure to child labor and sexual exploitation, drug abuse and severe malnutrition [6]. The need to take care of children particularly orphans, destitute or abandoned children through child care institutions run by government, non-governmental organizations and foster families are recognized worldwide [6].

In Nigeria, orphans receive less care as a result of poor feeding practices, inadequate food supply and utilization coupled with limited access to treatment facilities. These

may be attributed to nutrient deficiencies thereby increase chances of the children to suffer from severe acute malnutrition [7].

There is paucity of information on the nutritional status of children under five in orphanages in Kaduna state, hence this study that will aid in the implementation of effective nutrition policies to combat malnutrition among children under five in orphanages in Kaduna state in particular and Nigeria at large.

2. Materials and Methods

2.1. Materials

2.1.1. Chemicals and Reagents

All reagents and chemicals used were sourced from Sigma Co. USA.

2.1.2. Study Area

The study areas were selected orphanages located in the Kaduna metropolis, Latitude 10.5624, Longitude 7.4388 comprising of Kaduna North and Kaduna South Local Government Areas. Kaduna North is a Local Government Area with its headquarters in Doka town. It is bordered by Kaduna South, Igabi, and Chikun Local Government Areas. It has an area of 72 km² and a projected population of 492,100 as at 2016. Kaduna South is a Local Government Area in Kaduna State, Nigeria. Its headquarters are in the town of Makera. It has an area of 59 km² and a projected population of 543,600 as at 2016 (adopted from http://www.citypopulation.de).

2.1.3. Study Population

The study population was children under 5 years, found in selected orphanages within Kaduna state.

2.1.4. Inclusion Criteria

All children aged less than 59 months found in the selected orphanages were considered for the purposes of this study. The duration of stay of each orphan found in the orphanage was noted.

2.1.5. Exclusion Criteria

Children aged 60 months and above were not considered for the study. Also, children obtained by the orphanages within 1 month from the date of the survey were not considered.

Figure 1. Map of Kaduna metropolis showing major districts considered in the study (Source: https://www.researchgate.net/figure/Map-of-Kaduna-metropolis-showing-major-districts)

Table 1. Orphanages in Kaduna showing the number of children (0 – 59 months) and their caregivers

S/N	NAME OF ORPHANAGE	LOCATION	NO OF (6 – 59 MONTHS) CHILDREN	NO OF CAREGIVERS
1	Adonai Orphanage Home	Barnawa, Kaduna	2	1
2	Du Merci Orphanage Home	Narayi, Kaduna	5	2
3	Faithworks Orphanage Home	Unguwan Sunday, Kaduna	4	7
4	Jam'iyyan Matan Arewa	42 Ahmadu Bello Way, Kaduna	13	4
5	Shelter in Christ Orphanage Home	Barnawa, Kaduna	5	2
6	Easter Brook Foundation	Barnawa, Kaduna	6	2
7	Boyi Special Centre for Children	Badarawa GRA, Kaduna	7	5
8	Al Ihsan Charity Organisation Children Home	Nassarawa, Kaduna	40	13
9	The Mercy Orphanage Home	Romi, Kaduna	4	1
10	Unique Orphanage Home	Unguwan Boro, Kaduna	1	1
11	Poorest of the Poor Orphanage Home	Romi, Kaduna	7	2
12	Ministry of Women Affairs and Social Development Children's Home	Magajin Gari, Kaduna State	34	9

2.1.6. Informed Consent

Informed consent for this study was sought from the management of the orphanages and care givers or guardians.

2.1.7. Ethical Approval

Ethical approval was obtained from the Kaduna State Ministry of Health in accordance with the Helsinki declaration. The Helsinki Declaration is an established code of guidelines on ethics of human experimentation drafted by the World Medical Association in 1964. Also, applications seeking consent was submitted to the selected orphanages for permission to carry out the study.

2.1.8. Study Design

A cross-sectional, descriptive design was used to determine the micronutrient status among orphans in selected orphanages in Kaduna metropolis, Kaduna State.

Information was gathered with the aid of a semi-structured questionnaire, including the anthropometric data and micronutrient status.

2.1.9. Sampling Technique

The research covered orphanages within Kaduna metropolis. Initial checks showed that majority of the under 5 children in the orphanages are centered in few major orphanages. The Kaduna State government has placed restrictions on the intake of orphans in most orphanages hence the kids are only transferred to the Government Approved Orphanages. Therefore, a Non-probability sampling technique was used to select samples.

2.1.10. Sample Size

The sample size for this study was obtained by summing the number of children in the 3 identified orphanages housing the highest numbers of under 5 children, hence a sum total of samples identified was 87, as shown in Table 1. The orphanages picked were Jam'iyyanMatan Arewa orphanage (13), Al Ihsan Charity Organization Children Home (40) and Ministry of Women Affairs and Social Development Children's Home (34).

2.2. Methods

2.2.1. Information on Demographics

Information on Demographics was collected with the aid of a semi-structured questionnaire to obtain data on background and history of the orphans.

2.2.2. Determination of Anthropometric Indices (0 – 59 months)

Weight and Height measurements were obtained using the guidelines as described in the Food and Nutrition Technical Assistance Guide [8]. Weight measurement was taken with minimal clothing without shoes with the aid of a digital weighing scale. Height measurements were taken to the nearest 0.1cm with the use of a standiometer. The age of the children were obtained using the demographic questionnaire. Weight for Height/Length (Wasting), Weight for Age (Underweight) and Height/Length for Age (Stunting) were calculated from the data obtained.

2.2.3. Determination of Mid Upper Arm Circumference (MUAC) (0 – 59 months)

Mid upper arm circumference was measured using a MUAC tape. Measurements < 11.5 cm indicates Severe Acute Malnutrition, those from 11.5 to < 12.5cm indicate Moderate Acute Malnutrition while measurements ≥ 12.5cm indicate no acute malnutrition [9].

2.2.4. Blood Sample Collection

Blood samples were obtained using standardized parameters as reported by [10] and carried out by a Phlebotomist. Exactly 0.5ml of venous blood sample was obtained and transferred into an element free collecting tube. The blood was centrifuged for 15 minutes at 3000 rpm and frozen at -20°C for subsequent assays.

2.2.5. Determination of Serum Iron and Zinc

A SHIMADZU ICPE-9000, ICPE Mass Spectrophotometer was used for the analysis with an Eppendorf Model 5702 Centrifuge used for the preparation of serum ultra filtrates. Using the method of [11], an aliquot of 25 µL of serum was mixed with 225 µL of magnesium chloride solution (0.2 M) and allowed to stand at room temperature for 20

min. The solution was then ultra-filtered with a centrifugal force of 14,000g for 10 min. The filtrate was then treated with 200 µL of magnesium chloride solution (0.5% formic acid) and centrifuged at 14,000 g for 10 min. The filtrate was then digested in 4% nitric acid in microwave before elemental analysis.

2.2.6. Determination of Vitamin A

Vitamin A (retinol) analysis was assessed by the use of a High Performance Liquid Chromatography (HPLC). The blood sample was extracted by measuring 0.125µl of blood serum into a set of clean test tubes which was previously made up to 500µl in volume with ultra- pure water. 10g/l of ascorbic acid was added as an antioxidant after which the sample was vigorously mixed for 15minutes using a vortex mixer. Exactly 400µl of acetonitrile and hexane was added respectively to the sample, the mixture was centrifuged for 2minutes at 8000 rpm. After which, the supernatant was collected for Vitamin A (Retinol) determination on HPLC [12].

2.2.7. Statistical Analysis

The Data obtained was statistically analyzed using SPSS for windows version 21 and WHO Anthro software version 3.2.2. The mean, standard deviation and analysis of variance (ANOVA) was calculated and differences between means were separated using Duncan Multiple Range Test with significant differences determined at P≤ 0.05.Descriptive statistics was used to display data in means ± standard deviation (SD), frequencies, and percentages. Pearson correlation coefficient was used to determine the relationship between variables.

3. Results

3.1. Demographic Characteristics of Orphans in Orphanages in Kaduna Metropolis

Table 2 shows the demographic characteristics of orphans in the orphanages sampled in Kaduna metropolis. Majority are female with 52.87% frequency while male is 47.13%. Most (37.93%) of the children were within the age range of 13-24 months and those within age range of 48-59 months had the lowest population (8.05%) whereas children under 6 months had a population of 9.20%. More than half of the children (55.17%) have stayed up to 12 months in the orphanages.

3.2. Anthropometric Parameters of Children (under 5) of Orphanages in Kaduna Metropolis

Table 3 shows the prevalence of acute malnutrition by sex based on weight for height z-scores and oedema (wasting). Result indicates 36% of the children were severely wasted and 27.5% of those wasted were boys and 43.5% girls. Moderate acute malnutrition was recorded to be prevalent in 16.3% of the children where 15% boys and 17.4% girls. The global acute malnutrition prevalence was 52.3% and oedema was prevalent in 4.7% of the sampled children.

Presented in Table 4 is the prevalence of acute malnutrition by age based on weight for height z-scores and oedema (wasting). Children between the age of 0 to 12 months (46.3%) were severely wasted, 20.4% moderately wasted, and 4.7% had oedema. Children between 13 to 24 months indicates 11.8% were severely wasted, and 17.8% moderately wasted. On the overall, 31.4% of the children were severely wasted, 16.3% moderately wasted, and 7.4% had oedema.

Table 5 shows the distribution of acute malnutrition and oedema based on Weight-for-Height z-scores. Marasmic kwashiorkor was recorded in 1.1% of the children, 3.4% of the children had kwashiorkor and 32.2% of the children had marasmus.

Table 6 shows the prevalence of acute malnutrition by sex based on weight for age z-scores (underweight). Result obtained showed 36.1% of the children were severely underweight and 43.3% were boys and 29.5% girls. Moderate underweight was recorded in 25.3% of the children with 17.9% boys and 31.8% girls affected. The underweight prevalence on the overall (61.4%) where those affected showed 61.5% are boys and 61.4% girls.

Table 7 presents the prevalence of acute malnutrition by age based on weight for age z-scores and oedema (underweight). For children between the age of 0 to 12 months, 49% were severely underweight, 29.4% were moderately underweight while 7.8% had oedema. Children between 13 to 24 months showed 23.5% were severely underweight and 23.5% moderately underweight. Those children between 25 to 36 months, 14.3% of the children are severely underweight and 28.6% are moderately underweight. On the overall, 36.1% of the children showed severe underweight, 25.3% were moderately underweight and 4.8% had oedema.

The result on prevalence of acute malnutrition by sex based on height for age z-scores (stunting) is shown on Table 8. This indicates 44.8% of the children were severely stunted with 58.5% of boys and 32.6% girls stunted. Moderate stunting was recorded to be prevalent in 13.6% of the children where 14.6% were boys and 13.0% were girls. The overall stunting prevalence was 58.6% and of these stunted children 73.2% are boys and 45.7% girls.

Table 2. Characteristics of under 5 Children of Orphanages in Kaduna Metropolis

Characteristics	Frequency (N=87)	Percentage
Sex		
Male	41.0	47.13
Female	46.0	52.87
Age Distribution (months)		
0 – 5	8.0	9.20
6 – 12	17.0	19.54
13 – 24	33.0	37.93
25 – 36	10.0	11.49
37 – 48	12.0	13.79
49 – 59	7.0	8.05
Duration of stay in Orphanages (months)		
0 – 12	48.0	55.17
13 – 24	19.0	21.84
25 – 36	10.0	11.50
37 – 48	6.0	6.90
48 – 59	4.0	4.59

Table 3. Prevalence of Acute Malnutrition by sex based on Weight-for-Height Z-Scores (and/or oedema)

	All n = 86 Frequency (%)	Boys n = 40 Frequency (%)	Girls n = 46 Frequency (%)
Prevalence of global acute malnutrition (<-2 z-score and/or oedema)	45 (52.3)	17 (42.5)	28 (60.9)
Prevalence of moderate acute malnutrition (<-2 z-score and >=-3 z-score, no oedema)	14 (16.3)	6 (15.0)	8 (17.4)
Prevalence of severe acute malnutrition (<-3 z-score and/or oedema)	31 (36.0)	11 (27.5)	20 (43.5)

The prevalence of oedema is 4.7 %
95% Confidence Level
Reference: Child Growth Standards, (WHO 2006)

Table 4. Prevalence of Acute Malnutrition by Age, Based on Weight-for-Height Z-Scores and/or Oedema

Age (mo)	Total no.	Severe wasting (<-3 z-score) Frequency	Percentage %	Moderate wasting (>= -3 and <-2 z-score) Frequency	Percentage %	Normal (> = -2 z score) Frequency	Percentage %	Oedema Frequency	Percentage %
0-12	54	25	46.3	11	20.4	14	25.9	4	7.4
13-24	17	2	11.8	3	17.6	12	70.6	0	0.0
25-36	7	0	0.0	0	0.0	7	100.0	0	0.0
37-48	7	0	0.0	0	0.0	7	100.0	0	0.0
49-59	1	0	0.0	0	0.0	1	100.0	0	0.0
Total	86	27	31.4	14	16.3	41	47.7	4	4.7

Reference: Child Growth Standards, (WHO 2006).

Table 5. Distribution of Acute Malnutrition and Oedema based on Weight-for-Height z-scores

	<-3 z-score	>= -3 z-score
Oedema present Frequency (Percentage)	Marasmic kwashiorkor 1 (1.1 %)	Kwashiorkor 3 (3.4 %)
Oedema absent Frequency (Percentage)	Marasmic 28 (32.2 %)	Not severely malnourished 55 (63.2 %)

Reference: Child Growth Standards, (WHO 2006).

Table 6. Prevalence of Underweight based on Weight-for-Age z-scores by Sex among under five Children of Orphanages in Kaduna Metropolis

	All n = 83 Frequency (%)	Boys n = 39 Frequency (%)	Girls n = 44 Frequency (%)
Prevalence of underweight (<-2 z-score)	51 (61.4)	24 (61.5)	27 (61.4)
Prevalence of moderate underweight (<-2 z-score and >=-3 z-score)	21 (25.3)	7 (17.9)	14 (31.8)
Prevalence of severe underweight (<-3 z-score)	30 (36.1)	17 (43.6)	13 (29.5)

Reference: Child Growth Standards, (WHO 2006).

Table 7. Prevalence of Underweight by Age, based on weight-for-age z-scores among under five Children of Orphanages in Kaduna Metropolis

Age (months)	Frequency	Severe underweight (%)	Moderate underweight (%)	Normal (%)	Oedema (%)
0-12	51	49.0	29.4	21.6	7.8
13-24	17	23.5	23.5	52.9	0.0
25-36	7	14.3	28.6	57.1	0.0
37-48	7	0.0	0.0	100.0	0.0
49-59	1	0.0	0.0	100.0	0.0
Total	83	36.1	25.3	38.6	4.8

Reference: Child Growth Standards, (WHO 2006).

Table 8. Prevalence of Stunting based on Height-for-Age z-scores and by Sex among under five Children of Orphanages in Kaduna Metropolis

	All n = 87 Frequency (%)	Boys n = 41 Frequency (%)	Girls n = 46 Frequency (%)
Prevalence of stunting (<-2 z-score)	51 (58.6)	30 (73.2)	21 (45.7)
Prevalence of moderate stunting (<-2 z-score and >=-3 z-score)	12 (13.8)	6 (14.6)	6 (13.0)
Prevalence of severe stunting (<-3 z-score)	39 (44.8)	24 (58.5)	15 (32.6)

Reference: Child Growth Standards, (WHO 2006).

Table 9 indicates prevalence of acute malnutrition by age based on height for age z-scores and oedema (stunting). For children between the age of 0 to 12 months, 50.9% were severely stunted and 9.1% were moderately stunted. Children between 13 to 24 months, 29.4% were severely stunted and 17.6% were moderately stunted while for those between 25 to 36 months, 71.4% of them were severely stunted and 14.3% are moderately stunted. Ages in ranges of 37 to 48 months showed 14.3% severely stunted and 42.9% were moderately stunted. Overall, 44.8% of the children showed severe stunting and 13.8% were moderately stunted.

Table 10 shows the prevalence of acute malnutrition by sex based on MUAC. Result revealed that 32.2% of the children were severely wasted and 31.7% of those affected were boys and 32.6% girls. Moderate wasting was recorded to be prevalent in 14.9% of the children where 9.8% were boys and 19.6% were girls.

Table 11 shows the prevalence of acute malnutrition by age based on MUAC. Children between the age of 0 to 12 months, 45.5% were severely wasted, 16.4% were moderately wasted, only 38.2% were normal while 7.3% had oedema. Children between 13 to 24 months, 11.8% were severely wasted and 23.5% were moderately wasted. Children between 25 to 36 months, 14.3% were severely wasted. In total, 32.2% of the children showed severe wasting, 14.9% were moderately wasted and 4.6% had oedema.

Table 9. Prevalence of Stunting by age based on Height-for-Age z-scores among under five Children of Orphanages in Kaduna Metropolis

Age (months)	Total no.	Severe stunting (<-3 z-score)		Moderate stunting (>= -3 and <-2 z-score)		Normal (> = -2 z score)	
		Frequency	Percenatge	Frequency	percenatge	Frequency	percenatge
0-12	55	28	50.9	5	9.1	22	40.0
13-24	17	5	29.4	3	17.6	9	52.9
25-36	7	5	71.4	1	14.3	1	14.3
37-48	7	1	14.3	3	42.9	3	42.9
49-59	1	0	0.0	0	0.0	1	100.0
Total	87	39	44.8	12	13.8	36	41.4

Reference: Child Growth Standards, (WHO 2006).

Table 10. Prevalence of Acute Malnutrition by sex based on MUAC cut off's (and/or oedema)

	All n = 87 Frequency (%)	Boys n = 41 Frequency (%)	Girls n = 46 Frequency (%)
Prevalence of global malnutrition (< 125 mm and/or oedema)	41 (47.1)	17 (41.5)	24 (52.2)
Prevalence of moderate malnutrition (< 125 mm and >= 115 mm, no oedema)	13 (14.9)	4 (9.8)	9 (19.6)
Prevalence of severe malnutrition (< 115 mm and/or oedema)	28 (32.2)	13 (31.7)	15 (32.6)

Reference: Child Growth Standards, (WHO 2006).

Table 11. Prevalence of Acute Malnutrition by Age, based on MUAC cut off's and/or Oedema

Age (mo)	Total no.	Severe wasting (< 115 mm)		Moderate wasting (>= 115 mm and < 125 mm)		Normal (> = 125 mm)		Oedema	
		Freq	Percenatge	Freq	Percenatge	Freq	Percenatge	Freq	Percenatge
0-12	55	25	45.5	9	16.4	21	38.2	4	7.3
13-24	17	2	11.8	4	23.5	11	64.7	0	0.0
25-36	7	1	14.3	0	0.0	6	85.7	0	0.0
37-48	7	0	0.0	0	0.0	7	100.0	0	0.0
49-59	1	0	0.0	0	0.0	1	100.0	0	0.0
Total	87	28	32.2	13	14.9	46	52.9	4	4.6

Reference: Child Growth Standards, (WHO 2006).

Table 12. Mean z-scores of Anthropometric Parameters for the orphans in Kaduna Metropolis

Indicator	N	Mean z-scores ± SD	z-scores not available*
Weight-for-Height	82	-1.74±1.84	4
Weight-for-Age	83	-2.59±1.65	4
Height-for-Age	87	-2.32±2.23	0

* contains for WHZ and WAZ the children with edema.
Reference: Child Growth Standards, (WHO 2006).

Table 12 presents the mean z-scores of anthropometric parameters of children of orphanages in Kaduna metropolis. The average z-scores for weight for height is -1.74±1.84, average z-scores for weight for age is -2.59±1.65 while for height for age is -2.32±2.23.

3.3. Micronutrient Status (Iron, Zinc and Vitamin A) of the Children (Under 5) of Orphanages in Kaduna Metropolis

Table 13 shows the distribution of mean values of micronutrients in under five children of orphanages in Kaduna metropolis. Mean Vitamin A was found to be highest in children at MagajinGari Orphanage with 144.06±79.94 ug/l and lowest in those at Jamiyyar Matan Arewa Orphanage with mean value of 97.21±28.43 ug/l. Iron was recorded highest in children at MagajinGari Orphanage with mean value of 25.99±15.40 ug/l and it was lowest in children at JamiyyarMatanArewa Orphanage with mean value of 17.82±8.78 ug/l. Zinc levels in children at Al-Ihsan Orphanage recorded the highest value of 70.22±34.39 ug/dl whereas children from MagajinGari had the lowest with value of 58.25±20.62 ug/dl. There was no significant difference (P=0.05) in the concentrations of the micronutrients analyzed between the orphanages.

Table 14 presents the distribution of mean values of micronutrients of orphans in the orphanages in Kaduna metropolis. Exactly 77.01% of the children were severely deficient of vitamin A and 20.69% of them were moderately deficient. Zinc severe deficiency was recorded in 50.88% of the children and 24.14% of them were moderately deficient. For Iron, 32.19% of the children were found to be severely deficient and 67.81% were moderately deficient.

3.4. The Relationship between Micronutrient Status and Anthropometric Parameters of Orphans in Orphanages in Kaduna Metropolis

Table 15 shows the relationship between micronutrient status and anthropometric parameters of orphans in orphanages in Kaduna metropolis. Vit. A had a positive correlation with iron at P=0.01 where iron was positively correlated with Weight for Age Z-scores (WAZ) at P=0.05. Zinc showed a positive correlation with Height for Age Z-scores (HAZ) at P=0.01. Weight for Age Z-scores was positively correlated with Iron (P=0.05), HAZ and Mid Upper Arm Circumference (MUAC) (P=0.01). Weight for Height Z-scores (WHZ) had a negative correlation with HAZ (P=0.05) while it was positively correlated with WAZ and MUAC (P=0.01). MUAC was positively correlated with WAZ, WHZ and HAZ at P=0.01, P=0.01 and P=0.05 respectively.

Table 13. Distribution of Mean Values of Micronutrients in Under Five Children of Orphanages in Kaduna Metropolis

Orphanage	Vit A ug/l	Iron ug/l	Zinc ug/dl
JamiyyarMatanArewa	97.21 ± 28.43[a]	17.82 ± 8.78[a]	59.48 ± 32.76[a]
MagajinGari	144.06 ± 79.94[a]	25.99 ± 15.40[a]	58.25 ± 20.62[a]
Al- Ihsan Orphanage	139.37 ± 91.26[a]	21.54 ± 14.37[a]	70.22 ± 34.39[a]
Mean ± SD	126.88 ± 66.54	21.78 ± 12.85	62.65 ± 29.25

* Values are mean ± SD. Values with different superscript down the column are significantly different (P<0.05).

Table 14. Distribution of Micronutrients Deficiencies by Age among under five children of Orphanages in Kaduna Metropolis

Micronutrient	0 – 12	13 – 24	25 – 36	37 – 48	49 – 59	TOTAL (%)	Reference Values
VITAMIN A							
Severely Deficient	49.42	16.09	4.60	6.90	0.0	77.01	<200ug/l***
Moderately Deficient	12.64	2.30	3.45	1.15	1.15	20.69	
Normal	1.10	0.60	0.20	0.0	0.40	2.30	
ZINC							
Severely Deficient	35.63	8.05	2.30	4.60	0.0	50.58	<65ug/dl**
Moderately Deficient	14.94	4.60	3.45	0.0	1.15	24.14	>65 – 79 ug/dl
Normal	1.05	4.48	12.23	4.45	3.07	25.28	>80 – 120ug/dl
IRON							
Severely Deficient	22.99	4.60	1.15	3.45	0.0	32.19	<12.0 ug/l*
Moderately Deficient	40.23	14.94	6.90	4.60	1.15	67.81	
Normal	0.0	0.0	0.0	0.0	0.0	0.0	

* http://www.who.int/vmnis/indicators/serum_ferritin. pdf
*** http://www.who.int/vmnis/indicators/retinol.pdf
** http://www.who.int/elena/titles/zinc_stunting/en/

Table 15. Pearson's Correlation Matrix between Micronutrient Status and Anthropometric Parameters of the orphans in orphanages of Kaduna metropolis

	VITA	IRON	ZINC	WAZ	HAZ	WHZ	MUAC
VIT A	1	0.500**	0.138	-0.153	0.055	-0.160	-0.007
IRON	0.500**	1	0.025	0.023*	-0.132	-0.101	0.042
ZINC	0.138	0.025	1	0.071	0.694**	0.038	0.158
WAZ	-0.153	0.023*	0.071	1	0.467**	0.681**	0.324**
HAZ	0.055	-0.132	0.694**	0.467**	1	-0.241*	0.242*
WHZ	-0.160	-0.101	0.038	0.681**	-0.241*	1	0.321**
MUAC	-0.007	0.042	0.158	0.324**	0.242*	0.321**	1

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
WAZ Weight for Age Z scores, HAZ Height for Age Z scores, WHZ Weight for Height Z scores. MUAC Mid Upper Arm Circumference.

4. Discussion

The characteristics of orphans indicate that Female orphans were higher than the male orphans in the orphanages. This is similar to the report by [13]. The age ranges between 12 to 23 months were much more than any other age group in the orphanage. This brings to light how critical it is to ensure that they are fed well and catered for properly.

Anthropometric assessment of the children under five in orphanages in Kaduna metropolis showed the prevalence of different levels of malnutrition among the children. As regards wasting using Weight for Height Z-scores (WHZ) and Mid Upper Arm Circumference (MUAC) indicators, this study recorded global acute malnutrition (wasting), moderate acute malnutrition (moderate wasting) and severe acute malnutrition (severe wasting) which were higher than the findings of the National Nutrition and Health Survey [14] of 7.0%, 5.5% and 1.5% respectively which was higher than the National Demographic and Health Survey [15] results of global wasting, moderate wasting and severe wasting. This was not in agreement with the findings of [16]. The mean Z-score for Weight for Height was lower than the mean Z-score recorded in the findings of [14] of -0.50. For underweight using the Weight for Age Z-scores (WAZ) indicator, the study recorded prevalence of underweight (61.4%), moderate underweight (25.3%) and severe underweight (36.1%) which were above the percentages recorded in the findings of [14] which are 19.9%, 14.8% and 5.1% respectively. Stunting in this study recorded higher prevalence with exception of moderate stunting as compared to the findings of [14] which was similar to results reported by [17]. The reason for the higher prevalence of wasting, underweight and stunting recorded in the children in the orphanages in Kaduna metropolis may be due to poor feeding practices, low nutritional knowledge, poor water treatment and handling processes and low educational level of the caregivers. Malnutrition is a vicious cycle, and to break this cycle the government and other private sectors must collaborate on providing more nutritious food to orphanages, train the caregivers on best feeding practices, basic concepts of nutrition, exclusive and continued breastfeeding, sanitation and providing clean drinking water [18].

This study recorded that boys had lower global, moderate, severe wasting and were moderately underweight than girls which was not with agreement with [14] and [15] reports and also [13]. It was also observed that boys were more severely underweight, moderately and severely stunted than girls which was in agreement with the findings of [14] and [15]. The percentages were far higher than the findings of both [14] and [15] which reported that male children are more likely to be wasted compared to female children. It means the female child underdeveloped mentally and less productive and result to vicious cycle of malnutrition (Omilola, 2010). Oedema was found to be higher than that recorded in the finding of the [14] of 0.1%.

Prevalence of wasting, stunting and underweight of the orphans in orphanages in Kaduna metropolis showed the age groups of 0 to 12 months, 13 to 24 months and 25 to 36 months were more wasted, stunted and underweight than the other age groups. Although the percentages are higher than the findings of [15] but the trend of the lower age groups been more wasted, stunted and underweight were in agreement with report of the [15] but disagrees with report by [19].

The mean levels of vitamin A, zinc and iron were far below the reference values of [20]. This might be due to varied feeding practice. The study also reported that over two thirds of the children in the orphanages were severely deficient of Vitamin A with about half of the children severely deficient of Zinc and majority of the children moderately deficient of iron. This situation clearly indicating that the children are seriously at risk of hidden hunger and poor nutritional status [21]. The poor micronutrient status observed might be attributed to the fact that the children in the orphanages are mostly given staple foods and have a low tendency of eating fruits and vegetables.

5. Conclusion

The children under five in orphanages in Kaduna metropolis are exposed to malnutrition at different levels. Orphanages are in urgent need of nutritional interventions to address glaring malnutrition as highlighted by the prevalence of severe acute malnutrition in this study.

This research will contribute to improving the nutritional status and address micronutrient deficiencies among orphans in orphanages of Kaduna Metropolis.

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