Vitamin A, Iron and Iodine Status of Under Five Children in Kaduna State, Nigeria

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ABSTRACT
BACKGROUND: *Micronutrient deficiency has been considered as a major risk factor for child survival in Nigeria, it increases the risk of death from common diseases that affects children.* ***OBJECTIVE****: The study assessed the vitamin A, iron and iodine status of children in Kaduna state.*
METHODS: *The study was a cross sectional descriptive survey research. Children aged 6-59 months (84 subjects) were selected using a multi- stage sampling technique. Five milliliters of blood were collected for analysis of serum retinol and hemoglobin determination. Urinary Iodine Excretion (UIE) was based on the iodine concentration in urine samples. Vitamin A as serum retinol was determined using High-performance liquid chromatography (HPLC), Hemoglobin concentration was determined using Atomic absorption spectrometry while the UIE level was analyzed using wet digestion method.*
RESULTS: *Anaemia was more common with female (35.1%) in the study area compared to male (18.93%) with various haemoglobin level. Children aged 25 – 36 months were the most deficient in anaemia (16.66%). Urinary iodine deficiency (mild) affected more female (13.09%) than male (10.7%). Children aged 13 – 24 months (10.71%) were the most affected age group on mild iodine deficiency. Vitamin A deficiency affected more male (2.38%) than female (1.19%) and the deficiency of vitamin A was found in ages 25 – 36 months only (2.38%).*
CONCLUSION*: Vitamin A, iron and iodine deficiencies were mostly observed in children between two to three years in the study area. Female children were affected most. Routine screening of children, timely supplementation and intervention will reduce deficiencies in the local government areas and communities affected in the state.*

Keywords: Iron, Iodine, Vitamin A, Under-five, Kaduna State

INTRODUCTION

In the report of WHO (3,21) one in three persons in developing nations are affected by deficiencies in micronutrients; In Nigeria, those deficiencies are mainly in iodine, iron, and vitamin A. If left unattended, micronutrient deficiencies can lead to permanent physical consequences, which is why they are looked at as major health issue needing international attention. Micronutrient malnutrition is responsible for a significant share of infant mortality (1, 2). Iodine is important for the normal growth and human body development. It is used for the production of thyroid hormones, which is essential for the development of the brain (3, 4, 5). Inadequate intake of iodine in the diet causes different types of health problems collectively known as Iodine Deficiency Disorders (IDD). The health outcome of IDD include goiters, mental impediment, growth deficit, neonatal and post-natal deaths. Reports from the 2001–2003 Nigeria Food Consumption& Nutrition Survey (NFCNS)shows that a total of 27.5 percent of children had various degrees of iodine deficiency, while 46.5 percent

had more than adequate levels (6). Iron is important for cognitive and motor development in children and for physical activity in all humans. Nutritional iron deficiency is a major health challenge in many developing countries, often goes hand in hand with iodine deficiency in the same populations. Iron Deficiency anemia (IDA) is indeed the most prevalent and widespread nutritional disorder in the world today, affecting populations in both developed and developing countries. This disease reduces the work capacity of an individual when affected, and consequently the entire population at large, resulting in severe economic consequences that hinders national development (7). The report from Maziya-Dixon's survey (6) showed that almost 20 percent of children were iron deficient and another 8 percent had depleted iron stores (8). More than 20 percent of children under five years of age suffer from vitamin A deficiency in 37 countries throughout the region (9). The prevalence of anemia is higher than 40 percent in many African countries**.** The micronutrient deficiency indicators in Nigeria reveal that 28 percent of children under five were suffering from iron deficiency anemia (IDA), 29.5 percent from vitamin A deficiency (VAD), and 29.6 percent from iodine deficiency (10, 11). Nigeria is considered one of the WHO's Category 1 countries with the highest risk of vitamin-A deficiency (11). Vitamin-A deficiency contributes to 25 percent of infant and child in Nigeria due to less resistance to protein-energy malnutrition, acute respiratory infection, measles, malaria, and diarrhea (22). The micronutrient deficiencies indicators reveal that at the national level, 4.7 percent of children under five had serum retinol concentration (< 10 μg/dl) and were suffering from severe vitamin A deficiency (clinical deficiency); 24.8 percent suffered from marginal deficiency (serum retinol concentration < 20μg/dl) and were vitamin-A deficient; and 71.5 percent of children were normal. If those who were marginally deficient are combined with those who were clinically deficient, 29.5 percent of children under five were suffering from vitamin-A deficiency (11, 12). Micronutrient deficiencies affect at least 2 billion people worldwide (13 ,14, 15). Micronutrient deficiency has been considered as a major threat for child survival in Nigeria, contributing to death from common diseases such as acute gastroenteritis, pneumonia, and measles (16, 17). This study assessed the vitamin A, iron and iodine status of children in Kaduna state

Materials and Methods

The study was carried out in Kaduna, Kaduna State, North Western Nigeria. Kaduna lies between longitudes of 30°C East of the Greenwich Meridian and also between latitude 0.900 and 11.30" North of the equator. The study used is a cross – sectional survey design. The respondents are parents and caregivers of under five children in Kaduna state. Kaduna state has a population of more than 6,066,562 million based on 2006 population census (18) A sample size of 420 respondents was arrived at using Yamane formula (19) and a subset of 20% (84) respondent for biochemical analysis by balloting.

The selection of respondents for the cross-sectional survey was done using a multi- stage sampling technique. The first stage involved simple random sampling of the senatorial districts housing the Local Government Areas; two Local Government Areas were selected from each of the three senatorial districts. Giving a total of 6 Local Government Areas. The second stage involved compilation of all the names of the communities within the selected Local Government Areas. This was done with the assistance of the workers at each Local Government Areas Headquarters. Purposive sampling was used in selecting two communities from each of the local government areas (a total of 12 communities) because they have similar characteristics. At the third stage, number of children aged 6-59 months was selected using proportionate sampling technique, 420 children were used and they were selected randomly (Based on the 2013 immunization data in Kaduna State) followed by selecting mother - child pair randomly from the 12 communities, respectively to give a total of 420 children. The Houses were listed to ensure systematic sampling and adequate coverage of the community as outlined by Pope and Mays; Lameshow and Robinson (20). Where a scheduled household has no suitable subject (mother-child pair), the next household after it, was used to replace it. Mothers with children aged 6 - 59 months were eligible in a mother/child pair. In the absence of the biological mother, the person considered as the child's primary caregiver was eligible. Sub- samples of 20% (84) subjects for the biochemical analysis were selected by balloting.

Five milliliters of blood from cubital vein was collected from each of the study participants in the morning between 9 to 11am for analysis of serum retinol and hemoglobin determination. The sample was immediately centrifuged for 5 min at 3000 rpm and the serum were kept in a

box with ice covered and then transported to the laboratory at Ahmadu Bello University teaching Hospital (ABUTH) Zaria, where all the biochemical analyses were conducted as stated below. Serum Vitamin A was determined by measuring (sample) 0.125ul of blood serum into a clean test tubes, which was made up to 500ul in volume with altral pure water.10g/l of ascorbic acid was added as an antioxidant and the samples shaken for about 15 minutes. Another 400ul of acetonitrile and hexane was also added to the samples and centrifuged for 2mintues at 800rpm.Thereafter the supernatant was collected for vitamin A (Retinol) determination on Vitamin A as serum retinol was determined using High-performance liquid chromatography (HPLC) (21). Vitamin A deficiency was determined as serum retinol. < 10 g/ l (deficient), < 20g/l as marginal deficiency.

Haemoglobin Determination: determination was based on a sample of 0.02ml of blood was diluted with 5.0ml Drabkin's solution in a test tube (1:250 dilutions). It was mixed well and left to stand for ten (10) minutes at room temperature (25.012°C) for full colour development to take place. Absorptiometer using 5ml of Drabkin's solution as a blank was used to measure the absorption at 540 manometers. This compensates for the yellow colour of the solution. The standard solution of Cyanmethemoglobin was read in the same way. The calculation done thus: Haemoglobin (gm/dl) = Reading of test ÷ reading of standard X dilution factor X concentration of standard (mg/100ml) ÷ 1000 Principle behind the analysis: The children were classified as anaemic if the concentration of haemoglobin was below 11.5g/dl (11,6). For diagnosis of anemia, hemoglobin (Hb 11.00g/*dl* for children from 6 months to 6 years is an indication of anemia, <8.00g/dl = severe anemia; 8.00 -9.99g/dl = moderate anemia; 10.00 – 10.9g/dl =mild anemia and > 11.00g/dl= normal.

Urinary Iodine Excretion (UIE)was based on the iodine concentration in urine samples. Casual on-the-spot urine samples (0.5 to 1.0 mL) were collected from the children using plastic bottles with caps. All urine samples were sent promptly to the laboratory in ABUTH. The urine samples were stored in a refrigerator at 4°C until analysis. The urinary iodine excretion (UIE) level was analyzed by the wet digestion method. The result was expressed as mcg iodine/dL urine. (Mcg/dL), UIE levels of 10 mcg / dl and above were considered normal while <5.0–9.9 mild and 2.0–4.9 severe UIE (8, 9, 10 ,11).

The data obtained was analyzed using the statistical package for social Science (SPSS) version 16.0. Frequency distribution and percentages were used to present and describe result.

Informed consents were obtained from respondents after explaining the reasons and importance of the research and confidentiality assured

Result: Micronutrient Status of the Children in Kaduna State

Table 1: shows the micronutrient status of the children in Kaduna State. A few (28.6%) had mild urinary iodine excretion level (UIE), 1.2% had severe UIE while 70.2% had normal UIE. About 22.6% of the children had mild anaemia, 15.5% had moderate anaemia, 15.5 % severe anaemia and 46.4 % had normal Hb level. Majority (96.4%) of the children had normal vitamin A status, only 3.6% were deficient.

Fig 1.1 shows hemoglobin status of the children according to sex and age. About 14.9% of females had mild anaemia, 11.9% had moderate anaemia while 8.3% had severe anaemia, the males, 8.33% had mild anaemia, 3.5% had moderate anemia and 7.1% had severe anaemia. Deficiency was more common with females than males; there were more normal female (27.3%) than male (19.0%). while hemoglobin status of the children according to age reveal Children between 25 – 36 months were most affected with mild anaemia (10.71%), moderate (4.76%) and severe (1.19), while 49 -59 months were least affected.

Figure 1.2 shows the distribution of children by age on urinary iodine excretion. Children between Ages 13 – 24 months were most affected with 10.71% mild UIE and between age 25 – 36 months, 1.19% had severe UIE.

Figure 1. 3 shows the distribution of children by sex on urinary iodine excretion. Female children (13.09%) were more affected than male (10.70%) for mild urinary excretion. About 1.19% of female had severe urinary iodine excretion.

Figure 1.4 shows vitamin A status (serum retinol) of children according to age and sex. Vitamin A status of the children indicates (1.19%) of females and (2.38%) of males were vitamin A deficient. Age range 25 – 36 months was affected. Males were more affected than the female

Table 1: Micronutrient Status of the Children in Kaduna State

Variables	Frequency	%
Urinary Iodine Excretion level (UIE)		
Mild	24	28.6
Severe	1	1.2
Normal	59	70.2
Total	84	100.0
Hemoglobin status (anaemia)		
Mild	19	22.6
Moderate	13	15.5
Severe	13	15.5
Normal	39	46.4
Total	84	100.0
Vitamin A status (Serum retinol)		
Deficient	3	3.6
Normal	81	96.4
Total	84	100.0

Cut-off point of biochemical measurement

Hemoglobin status =<8.0g/dl = severe anaemia; 8.0 -9.0g/dl = moderate anaemia; 10.0 – 10.9g/dl = mild anaemia and > =11g/dl= normal)
UIE levels of 10 mcg / dl and above were considered normal while <5.0–9.9 mild and 2.0–4.9 severe UIE. (8, 9, 10 ,11
Serum retinol = Serum retinol =≤ 20.0μg/dl marginal deficiency, <10ug/dl deficiency

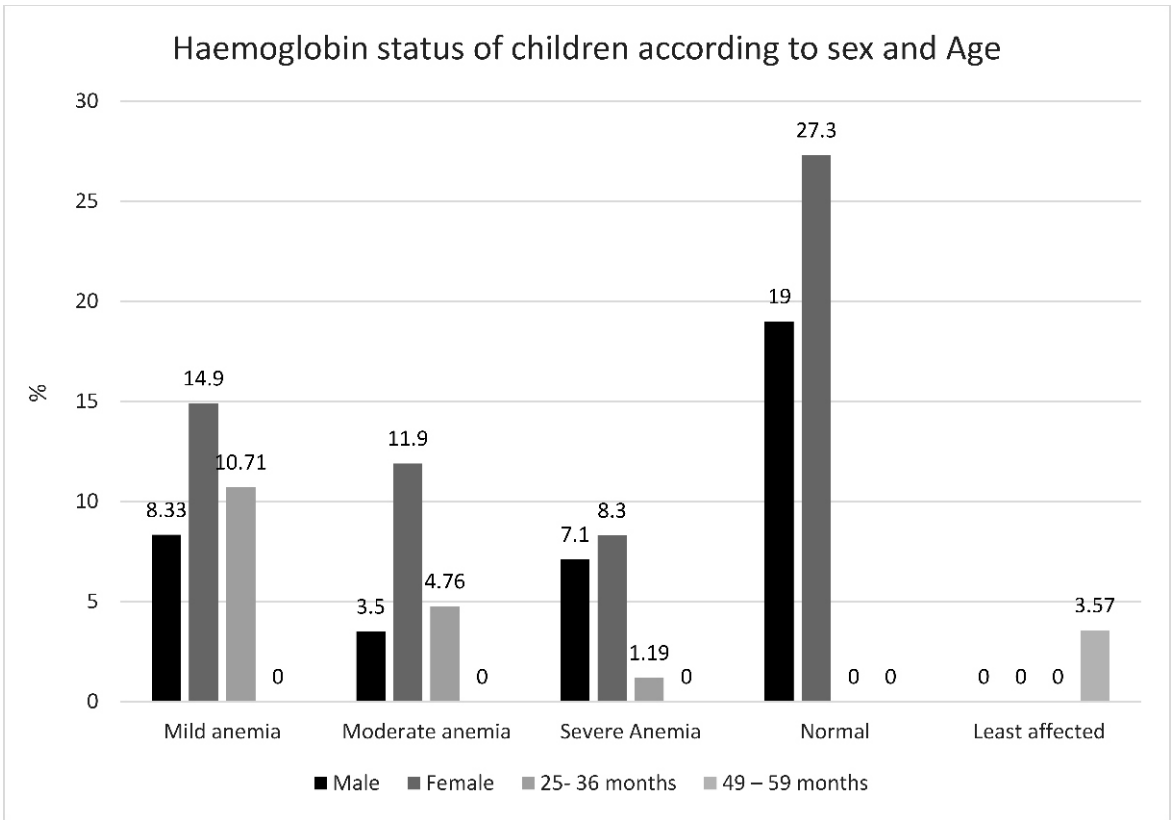

Figure: 1.1 Hemoglobin Status of Children According to Sex and Age

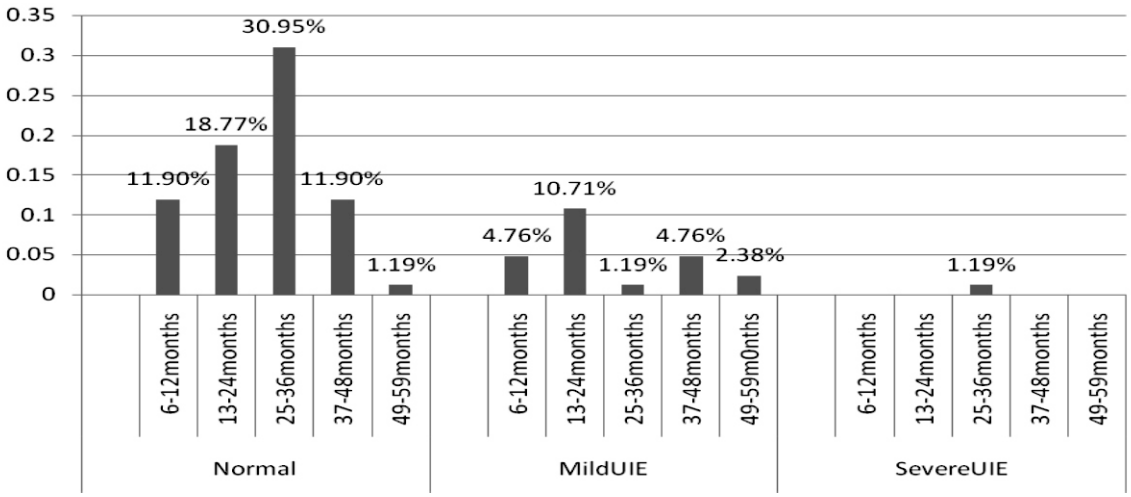

Figure 1. 2 Distribution of Children by Age on Urinary Iodine Excretion

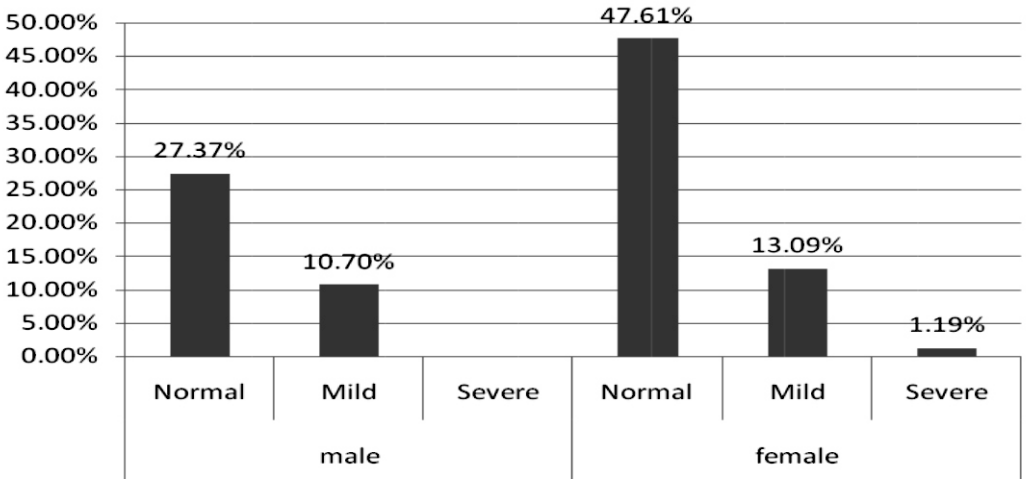

Figure 1.3 Distribution of Children by Sex on Urinary Iodine Excretion

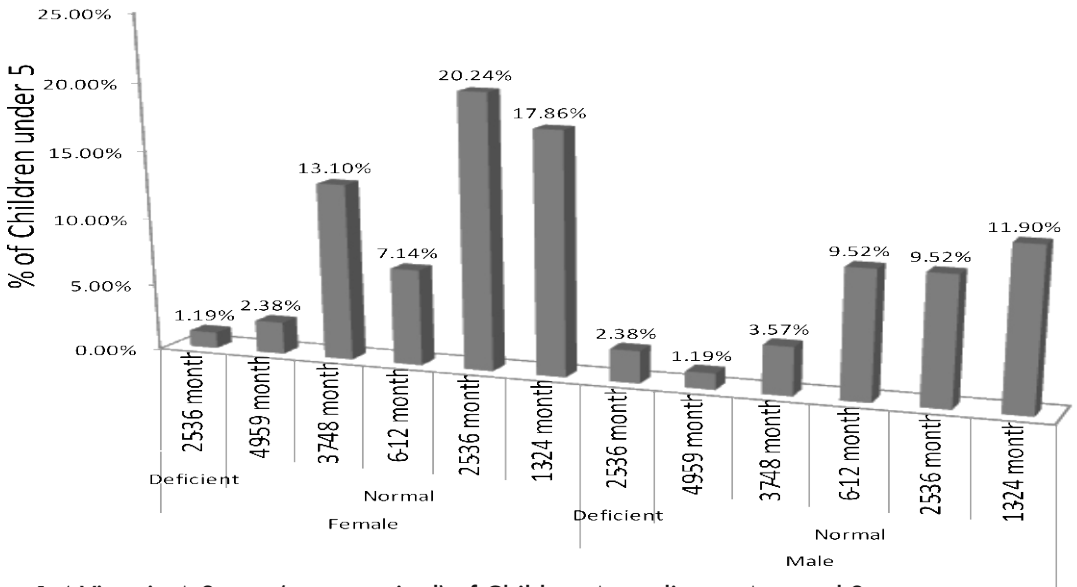

Figure 1.4 Vitamin A Status (serum retinol) of Children According to Age and Sex

Figure 1. 2 Distribution of Children by Age on Urinary Iodine Excretion.

Figure 1. 3 shows the distribution of children by sex on urinary iodine excretion. Female children (13.09%) were more affected than male (10.70%) for mild urinary excretion. About 1.19% of female had severe urinary iodine excretion. Figure 1.3 Distribution of Children by Sex on Urinary Iodine Excretion Figure 1.4 shows vitamin A status (serum retinol) of children according to age and sex. Vitamin A status of the children indicates (1.19%) of females and (2.38%) of males were vitamin A deficient. Age range 25 – 36 months was affected. Males were more affected than the female.

Figure 1.4 Vitamin A Status (serum retinol) of Children According to Age and Sex

Discussion:

The average iron content in a healthy body is 3 – 4g, yet, this small quantity is very important. Iron deficiency occurs when ingestion or absorption of dietary iron is inadequate to meet iron losses or requirements as a result of growth.

Prevalence of anaemia was high (53.6%) affecting more than half of the children with various degrees of deficiency. The finding is in agreement with survey conducted by Maziya et., al (12) on hemoglobin status of under- five children at the national level.

Up to 45.4% of the under five children had anemia. Maziya et., al reported that a high prevalence (35.3%) of under five children were anaemic among children in Nigeria. Low hemoglobin level is the most prevalent form of iron deficiency in the world. It affects populations in both developed and developing countries. Iron deficiency affects children under five- years of age more than any other group. This is because iron stores are exhausted between 4 months and 6 months after which the child needs iron supplementation in the diet (12). The risk of low hemoglobin deficiency increases during periods of rapid growth, notably in infancy, adolescence, and pregnancy. The consequences of low hemoglobin(deficiency) include reduced work capacity, impaired body temperature and regulation, impairments in behavior and intellectual performance, and decreased resistance to infections. Anaemia (deficiency) results when ingestion or absorption of dietary iron is inadequate to meet iron losses or Iron requirements imposed by growth or pregnancy. Low hemoglobin can occur as a result of inadequate intake, inadequate absorption, or excessive demand. The effect of anemia on child growth and cognitive responses and efficiency justifies intervention Programme. it is critical that Nigeria and the global community pay attention to adequate dietary intake of iron

Urinary iodine excretion level was 29.2% among the under – five children studied in Kaduna state. The finding of the study is similar to the report by The International Institute of Tropical Agriculture (IITA) which gave iodine deficiency in Nigeria to be 27.8% for children, 30.7% for mothers and 10% for pregnant women. It is also consistent with data from the 2001–2003 NFCNS which revealed that a total of 27.5 percent of children suffered various degrees of iodine deficiency, while 46.5 percent had more than adequate levels (Maziya-Dixon 2004). The deficiency was severe in 4.2 percent, moderate in 8.7 percent, and mild in 14.6 percent of children. Only 26 percent of children had optimal levels of iodine. The finding of the study is a bit lower compare with Alozie (22) which reported that 33% of children in Akwa Ibom State had various degree of iodine deficiency. Iodine deficiency disorders (IDD) constitute the single greatest cause of preventable brain damage in the fetus and infant, and of retarded psychomotor development in young children. IDD remains a major threat to the health and development of populations worldwide, but particularly among under -five children. (22, 23, 24). It results in goiter, stillbirth, and miscarriages, but the most devastating toll involves mental retardation, deaf-mutism, and impaired educability. Iodine is required for proper brain development.

Vitamin A deficiency is very low (3.6%) compared to the under-five study conducted nationwide on food consumption and nutrition survey in Nigeria (25, 16). The study showed that the prevalence of Vitamin A deficiency was 31.3% in the dry savanna, 24.0% in the moist savanna, and 29.9% in the humid forest compared to the present study which showed very few 3.6% as vitamin A deficient (12). This recent development may be as a result of nationwide vitamin A supplementation using a mega dose (200,000I. U) going on in Nigeria including all the community health center's in the north (11). Vitamin A is important for normal growth and deficiency can be a cause for concern.

Anaemia was more common with females in the

study area compared to males with various degree of haemoglobin level. Children aged 25 – 36 months had the most deficiency while the least affected children aged 49 – 59 months. Urinary iodine excretion (UIE) deficiency also affected more females as compared to male. Children aged 13 – 24 months were the most affected age group on iodine deficiency. Vitamin A deficiency showed more males were affected as compared to the girls and deficiency of vitamin A is found only in ages 25 – 36 months.

This could be due to Vitamin A supplementation that is ongoing in the state and fortification of some foods with vitamin A, for example, Dangote sugar, flour, Pasta etc.

Conclusion

Vitamin A, iron and iodine deficiencies were mostly observed in children between two and three years old in Kaduna State. Female children were more affected.

Routine screening of children, timely supplementation and awareness creation will reduce deficiencies in the Local government areas and communities affected in the state.

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