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Research Article

Assessment of Some Selected Micronutrients Among Women of Reproductive Age Within Urban and Rural Settings in Kano State

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ABSTRACT

Women of reproductive age (WRA) are prone to unbalance micronutrient status due to changes associated with normal physiological conditions such as menstruation, pregnancy and lactation. This study was done to assess some selected micronutrients among women of reproductive age within urban and rural settings in Kano state, Nigeria. A community-based cross-sectional study was conducted among 192 WRA (15-49 years) in 4 randomly selected LGAs in urban and rural settings each. Samples of blood and urine were collected to determine the levels of iron, iodine, vitamin A, folate and zinc using ELISA kit. Hemoglobin concentration was also determined using an automated analyzer. From the result obtained in the present study, serum retinol was found to be significantly different (p=0.008) whereas hemoglobin concentration (p=0.200), serum ferritin (p=0.226), urine iodine (p=0.141), serum folate (p=0.924) and serum zinc (p=0.410) had no significant difference between urban and rural participants. Iron deficiency anaemia (13.5%), iodine (29.2%) and zinc (33.3%) deficiencies have higher incidences in the urban areas whereas anaemia (26.0%), iron (46.9%), Vitamin A (34.4%) and folate (46.9%) deficiencies were higher in the rural areas. Our data suggest the need for public health sensitization and enlightenment such as dietary diversity, micronutrient fortification, and supplementation to lower the likelihood of widespread micronutrient deficiencies.

Keywords: *Micronutrient Status, Deficiencies, Women of Reproductive Age, Urban, Rural*

INTRODUCTION

Micronutrients are vitamins and minerals that help the body in the synthesis of hormones, enzymes, and other substances that are important for the normal growth, development, and functionality of the body. Micronutrient deficiencies (MNDs) are a critical and significant public health problem in developing countries (Nguyen *et al.,* 2014). It is commonly known that a well-balanced diet is good for our overall health and that getting enough nourishment is essential. This is particularly true for WRA, as there is always a chance of pregnancy, and the mother's nutritional health and availability are both important factors in the embryo and fetus' optimal growth (Ramakrishnan *et al.,* 2012). WRA is more susceptible to MNDs due to inadequate dietary intake, a lack of food options, unequal food distribution within the same household, a lack of knowledge about the importance of dietary diversity, and the frequent occurrence of infectious diseases (Darnton-Hill, 2012). The danger of MNDs in this population group is increased in many developing countries where societal norms and gender-based discrimination push women to put their

families' health and nutritional requirements last (Darnton-Hill, 2012). Because of this, WRA in low- and middle-income countries frequently enter pregnancy undernourished, and the additional demands of pregnancy may make these pregnant women's MNDs worse (Grieger and Clifton, 2014).

The most common MNDs in women are those related to iron, vitamin A, iodine, folate, and zinc (Muthayya *et al.,* 2013). Iron deficiency is the primary cause of anemia during pregnancy, which accounts for 20% of all maternal and perinatal deaths and low birth weight, and it is well known to have detrimental effects on productivity and cognition in the general population (Kozuki *et al.,* 2012). Early birth and infant death can also result from vitamin A deficiency (VAD), along with immune system issues, ocular abnormalities (such as night blindness), and premature delivery (Tielsch *et al.,* 2008). Iodine deficiency affects brain function; babies born to mothers with low iodine levels lose 7.4 to 15 points on the IQ scale as a result (Zimmermann, 2016). Children who lack folate during pregnancy may have malformed neural tubes. Zinc deficiency has been identified as a risk factor with detrimental long-term effects on the development, immunity, and metabolic health of surviving kids (Brown *et al.,* 2004). The best way to diagnose MND is using a reliable biomarker. In order to identify pathogenic processes, normally occurring biological processes, or pharmacologic responses to therapeutic intervention, biomarkers are biological measurements (such as blood or urine) that are taken (Strimbu and Tavel, 2010).

Although there is a lack of precise information regarding the status of iodine, folate, and zinc in African women, the incidence of related micronutrient deficiencies due to low intakes is expected to be substantial (Harika *et al.,* 2017). The UN Sustainable Development Goals recognize the substantial nutritional burden faced by women and set a target for 2030 to address their nutritional needs as well as those of pregnant and nursing mothers (IFPRI, 2016). Data on the status of micronutrients and the prevalence of deficiencies in WRA are crucial for developing public health strategies and monitoring programs to achieve these goals. These data are largely missing and mostly out of date in Kano, Nigeria. Therefore, the purpose of this study was to assess the level of micronutrients among women of reproductive age within urban and rural settings in Kano state, Nigeria.

MATERIALS AND METHODS

Study Design

A community based cross-sectional comparative study was carried out among 192 WRA in urban and rural settings of Kano state, between August, 2021 and November, 2021. Women aged between 15 and 49 years only were allowed to participate.

Sample Size Determination

The sample size was determined using the formula: $n = z^2p(1-p)/d^2$, where n=the desired sample size; z=95% confidence interval or 1.96; d=degree of precision set at 0.05 P= 0.5%. A prevalence of 14% of malnutrition was used (Harika *et al.,* 2017). The minimum sample size was 185. Therefore 192 participants were recruited to account for possible drop outs.

Sampling Method

Multi-stage cluster sampling technique was used in which the first stage involved the selection of a senatorial district/zone from the three zones present in the state, by simple random sampling. All (Kano-Central, Kano-South and Kano-North) senatorial districts were selected. Then the second stage of selection involved four rural and four urban LGA, by simple random sampling. Nassarawa, Kano Municipal, Gwale and Ungogo Local Government Areas (Kano Central senatorial district) represented the urban areas. Wudil and Rano (Kano South senatorial district) and Gwarzo and Bichi Local Government Areas (Kano North senatorial district) represented the rural areas. The last stage of sampling involved the selection of one wards, from each of the selected LGAs, by simple random sampling. The study sites were the Primary Health Cares (PHCs) that were situated inside the selected wards. Consenting women meeting the inclusion criteria were enrolled into the study.

Ethical Approval

Ethical approval was granted by the Kano State Ministry of Health and ethical approval number NHREC/17/03//2018 was assigned. Written permission was also gotten from the Local Government head districts. Before the commencement of the study, informed consent from the participants was acquired. Strict confidentiality was maintained at all times during the research.

Blood and Urine Samples Collection and Processing

Approximately 5mL of venous blood was aseptically collected with the use of syringe after sterilizing the site with methylated spirit. Urine sample was also collected using urine bottles. The samples were properly labeled for biochemical analysis and transferred into an EDTA container. Hemoglobin concentration was estimated using automated analyzer from the whole blood sample. The biomarkers for iron, iodine, vitamin A, folate and zinc which includes serum ferritin, urine iodine, serum folate, serum retinol and serum zinc concentration respectively were

determined using ELISA kit and the procedures were as described by the manufacturers (Biobase Biotech, China).

Biomarkers of Micronutrient Deficiencies

Iron, iodine, Vitamin A, folate and zinc deficiencies in WRA were defined and assessed from the following biomarkers;

- *Iron:* Anaemia as Hb <12 µg/L.
- *Iron Deficiency* (ID) as Serum ferritin <15 µg/L, regardless of correction for inflammation;
- *Iron Deficiency Anaemia* (IDA) as Combination of anaemia and ID.
- *Iodine deficiency* as Urinary iodine excretion (UIE) <100 µg/L.
- *Vitamin A deficiency* (VAD) as serum retinol <200 µg/L.
- *Folate deficiency* as Serum folate <6 µg/L.
- *Zinc deficiency*: Serum zinc <70 µg/L (Harika *et al.,* 2017).

Statistical Analysis

Data were statistically described in terms of mean ± standard deviation (SD) or frequencies (number of occurrences) and percentage when appropriates. All statistical calculations were performed using SPSS (Statistical Package for Social Sciences; SPSS Inc., Chicago IL). Differences among the groups were investigated using one-way analysis followed by independent T-test comparison. P values <0.05 was considered significant.

RESULTS

Table 1 shows the comparison of micronutrient status between urban and rural setting among WRA in Kano state, Nigeria. From the present study, only serum retinol was found to be significantly different between urban and rural participants. Hemoglobin concentration, serum ferritin, urine iodine, serum folate and serum zinc were not found to be statistically significant.

Table 2 presents the incidence of micronutrient status among WRA within urban and rural setting in Kano state, Nigeria. In the urban setting, the highest incidence of anaemia was found in Gwale (33.3%), ID in Ungogo (54.2%), IDA in Gwale (20.8%), iodine deficiency in Nassarawa and Gwale (37.5%), VAD in Gwale (45.8%), folate deficiency in Nassarawa and Gwale (41.7%) and zinc deficiency in Nassarawa (41.7%). In the rural setting, the highest incidence of anaemia was recorded in Wudil (41.7%), ID in Bichi (54.2%), IDA in Bichi (16.7%), iodine deficiency in Gwarzo (33.3%), VAD in Wudil (58.3%), folate deficiency in Rano (54.2%) and zinc deficiency in Wudil, Gwarzo and Bichi (37.5%). Incidence of IDA, iodine and zinc deficiencies were found to be higher in the urban setting. Whereas, incidence of anaemia, ID, VAD and folate deficiency were found to be higher in the rural setting (Table 2).

Table 1. Comparison of micronutrient status between urban and rural settings among women of reproductive age in Kano State, Nigeria

Micronutrients	Biomarkers (µg/L)	Urban (n=96)	Rural (n=96)	t	*P*
Iron	Hb conc.	12.4±1.1	12.2±1.1	1.287	0.200
	Serum ferritin	15.4±2.3	15.9±2.5	-1.216	0.226
Iodine	Urine iodine	104.3±12.4	118.4±92.7	-1.478	0.141
Vitamin A	Serum retinol	255.9±78.5*	228.0±63.9*	2.700	0.008
Folate	Serum folate	6.2±1.8	6.1±1.7	0.096	0.924
Zinc	Serum zinc	761.9±193.4	787.5±235.4	-0.825	0.410

Data are presented as mean ± SD, mean values with same superscript in the same row are significantly different at p<0.05.

Table 2. Incidence of Micronutrient Status in Urban and Rural LGAs in Kano State

Settings (n=96)	LGAs (n=24)	Incidence (%) Anaemia	ID	IDA	IoD	VAD	FD	ZD
	NSR	8.3	41.7	8.3	37.5	20.8	41.7	41.7
	KMC	25.0	50.0	12.5	16.7	41.7	33.3	33.3
	GWL	33.3	37.5	20.8	37.5	45.8	41.7	25.0
	UNG	12.5	54.2	12.5	25.0	20.8	25.0	33.3
Urban		**19.8**	**45.8**	**13.5**	**29.2**	**32.3**	**35.4**	**33.3**
	WDL	41.7	41.7	12.5	20.8	58.3	45.8	37.5
	RAN	16.7	45.8	8.3	12.5	20.8	54.2	16.7
	GRZ	25.0	45.8	8.3	33.3	45.8	50.0	37.5
	BCH	20.8	54.2	16.7	12.5	12.5	37.5	37.5
Rural		**26.0**	**46.9**	**11.5**	**19.8**	**34.4**	**46.9**	**32.3**

Data are presented as frequencies (number of occurrences) and/or percentage. NSR-Nassarawa, KMC-Kano Municipal, GWL-Gwale, UNG-Ungogo, WDL-Wudil, RAN-Rano, GRZ-Gwarzo, BCH-Bichi

DISCUSSION

The present study assessed the level of some selected micronutrient among women of reproductive age within urban and rural setting in Kano State, Nigeria. Among the biomarkers only the mean of serum retinol which is the biomarker of VAD was found to be significantly higher among urban population than in the rural counterpart. The environmental setting plays a significant role in shaping the diet of women globally (Herforth, 2015). The food environment which includes availability, accessibility, affordability, desirability, convenience, marketing, and properties of food products is the space where women interact with the wider food system for food acquisition and consumption (UNICEF, 2019). Foods that are commonly available in the immediate environment have been shown to influence the eating behaviors of families (Caspi *et al.,* 2012). The limited affordability of vitamin A source foods groups in a given setting is associated with lower intake of fruit and vegetables which may affect the level of Vitamin A status in the blood and resulting in lower levels of Vitamin A in the body (Abdelmenan *et al.,* 2020). Improving availability of vitamin A-rich fruits, dark green leafy vegetables, and vitamin A-rich vegetables and roots is an important food based strategy with the aim to increase the consumption of carotene rich fruit and vegetables and to eliminate VAD (Priyadarshani, 2017).

All the means of biomarkers in both urban and rural participants were slightly above the deficiency cut-offs. The present study recorded an anaemia incidence of 19.8% and 26.0% in urban and rural settings. Harika *et al.* (2017) found that the prevalence of anemia in Nigeria ranged from 18 to 51%, which is consistent with the result of this study, however, in contrast to the present study, reported a lower prevalence of ID and VAD of 9 to 18% and 4 to 22% respectively as compared with the present study which revealed a higher incidence of ID (45.8% and 46.9% in urban and rural settings respectively) and VAD (32.3% and 34.4% in urban and rural settings respectively). ID causes anemia and interferes with the endocrine and immune systems' ability to operate properly. Because of the increased foetal growth and development requirements, ID is common during pregnancy. Early delivery, low birth weight and a slew of perinatal complications, including haemorrhage, are all associated to maternal iron deficiency. Anaemia is considered to be responsible for 20% of all maternal deaths (de Benoist *et al.,* 2008). Children born to ID mothers are more at risk to have insufficient iron stores, physical and cognitive development delay as well as weakened immune system. At the individual and national level, iron status at early life has a significant impact on human capacity (Lozoff *et al.,* 2013). Vitamin A serves a variety of roles throughout the body. It is linked to bone growth, protects skin and mucosal integrity, and aids reproductive organ function, aids immune system strength, aids in the creation and conservation of epithelial tissue and aids in the correct growth of teeth and hair (D'Ambrosio *et al.,* 2011). Since severe VAD in early pregnancy has been linked to abnormalities, adequate vitamin A levels are also essential for optimal embryonic development (Gutierrez-Mazariegos *et al.,* 2011). The possible reasons for higher incidence of anaemia, ID, VAD and folate deficiency in the rural settings may be related to rural areas' lower socioeconomic position, insufficient consumption of foods high in iron, folate, and vitamin A, lack of proper nutrition information, and higher rate of illiteracy than in urban areas (Tesfaye *et al.,* 2020).

IDA, iodine and zinc deficiency were all found to be more common in urban areas. Nigeria's population is growing and the country is rapidly urbanizing. As a result, dietary problems and the remedies needed to correct them may differentiate between urban and rural food systems. For instance, compared to the rural, the urban rely more on food purchases and have a more varied diet. Given their purchasing capacity, this may suggest better access to high-quality food and minerals, but because the urban rely on markets for their food, they are more vulnerable to price and other market shocks, which increases their risk of undernutrition. (Mohiddin *et al.,* 2012). In contrast to rural homes, urban households consume more processed foods and eat food away from home (Kengne *et al.,* 2017), making them more sensitive to health hazards associated with food consumption (de Brauw and Herskowitz 2018). This is because processed food consumption, combined with insufficient physical activity, has been related to an increase in rates of overweight and obesity (FAO *et al.*, 2017). Although urbanization is widely regarded as a driver of progress and development, if not carefully managed, it can lead to urban health concerns. Evidence reveals that Nigerian urbanization has resulted in urban health problems such as insufficient and reliable source of clean water, filth and shanty towns, sanitation, solid waste management, a double burden of illness, and an unsafe, clogged transportation system (Aliyu and Amadu 2017). IDA in pregnancy is caused by two known factors: the woman's iron reserves at conception and quantity of absorbed iron during pregnancy. The evidence that anemia is common during pregnancy in developing countries suggests that natural iron

levels are often insufficient and that pregnancy's physiological adjustments are inadequate to meet the growing needs. (McMahon, 2010). Iodine deficiency is among the most common micronutrient deficits worldwide. Iodine is a critical microelement in human physiology, as it is essential for normal physical growth during pregnancy and childhood. It is a vital component of the thyroid gland's hormones, and its absence or insufficient levels can result in serious clinical consequences such as a higher risk of stillbirths, miscarriages, perinatal mortality, inborn abnormalities, cretinism and stunted growth (Lazarus, 2014). Iodine deficiency disorders is all of the consequences of iodine shortage in a population that can be prevented by consuming enough of it (Biban and Lichiardopol, 2017). Because the body lacks a specialized zinc storage system, a daily sufficient intake is required. However, millions of individuals in underdeveloped nations are deficient in zinc because they have restricted access to zinc-rich foods like animal products, oysters and shellfish due to economic, cultural, and religious reasons (Gupta *et al.,* 2020). Whole grains, nuts, and beans are all good sources of zinc from plants. Zinc absorption in such sources, however, is dependent on the zinc level of the soil. Aside from the amount consumed, zinc absorption from the diet is another significant issue to consider. It is well established that the presence of several inhibitors, including phytic acid, calcium, and maybe polyphenols, has a substantial impact on the bioavailability of zinc (Brnic *et al.,* 2014).

CONCLUSION

The present study shows that among the biomarkers of micronutrient deficiency only serum retinol was found to be significantly different between the urban and rural population. IDA, iodine and zinc deficiencies have higher incidences in the urban areas whereas anaemia, ID, VAD and folate deficiencies were higher in the rural areas. This evidence suggests that a proportion of women in Kano state of childbearing potential have lower than currently-recommended blood concentrations of the micronutrients iron, iodine, Vitamin A, folate and zinc. To further guide the implementation of public health programs and regularly assess their effectiveness, statistics on micronutrient intake of iron, vitamin A, iodine, zinc, and folate in WRA are desperately needed. These initiatives should concentrate on boosting dietary diversity and fortifying widely available, affordable food items in order to increase micronutrient intake. For WRA, supplements programs also need to be scaled up. This study suggests the need for public health sensitization and enlightenment such as dietary diversity, micronutrient fortification, and supplementation to lower the likelihood of widespread micronutrient deficiencies.

AUTHORS' CONTRIBUTIONS

SMA conceptualized and supervised the research, AS designed and collected data for the study. All authors participated in the analysis and interpretation of data. AS drafted the manuscript and substantively revised it. All authors read, corrected and approved the submitted version

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CONFLICT OF INTEREST

The authors declare no conflict of interest

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