Original Article

DOI: 10.7860/JCDR/2015/9811.5485

Anaemia in Relation to Body Mass Index (BMI) and Socio-Demographic Characteristics in Adult Nigerians in Ebonyi State

Community Medicine Section

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ABSTRACT

Introduction: Anaemia, a multifactorial health challenge has been found to affect every stage of human development with negative health impacts. Providing information on the factors associated with Anaemia will help in formulating mitigating strategies against this important public health problem.

Objective: To determine the prevalence of Anaemia and its relationship with body mass index (BMI) and sociodemographic characteristics in adult Nigerians in Ebonyi State, South-eastern Nigeria.

Materials and Methods: Adults (n=428) aged ≥ 18 y (mean=38.4±13.7 y) randomly selected from 130 political wards from the 13 Local Government Areas of the state were studied. Sociodemographic data was collected with questionnaire while blood samples were collected for hemoglobin determination using colorimetric cyanmethemoglobin method. Data was analysed using statistical package for social sciences (SPSS® for Windows® ver. 16).

Results: In general, 21.7% of the subjects were anemic with Anaemia prevalence of 9.9%, 15.8% and 39.8% in male, non-pregnant and pregnant female, respectively. About four percent (3.7%) of the subjects were underweight, while 37.6% had excess weight with hemoglobin concentration having no relationship with BMI and sociodemographic parameters.

Conclusion: It may be conclude that the Anaemia in adult Nigerians in Ebonyi State has no definite relationship with BMI and sociodemographic characteristics studied. Further studies are needed to document other factors that may be associated with Anaemia among adults in the State.

Keywords: Anaemia, Adults, Body mass index, Malnutrition, Nigerians, Sociodemographic parameters

INTRODUCTION

Anaemia still remains one of the public health challenges with global impacts, especially in developing countries [1] and among the vulnerable groups, such as pregnant and lactating women and children [2]. As a contributory factor to the vicious cycle of undernutrition [1], Anaemia has been found to affect every stage of human development [3] with negative impacts including maternal mortality, perinatal mortality, premature delivery (in pregnant women), weakness and diminished physical activity (in pregnant and non-pregnant individuals) and during childhood; low birth weight, impaired cognitive performance, motor development, and poor scholastic achievement [4,5].

Anaemia is affected by many factors including ethnicity, gender, age, sociodemographic status, dietary habits, physical and mental health, environment, gynecological/obstetric history, cancers, and anti-cancerous drugs and genetic make-up [6,7]. Specific risk factors for Anaemia include deficiency of iron, worm infections, repeated pregnancies, menorrhagia, postpartum hemorrhage, gastric ulcers, hemorrhoids, intake of aspirin/non-steroidal anti-inflammatory drugs, and pure vegetarian diet [6].

The association between Anaemia and body mass index (BMI); a measure of nutritional and health status of adults [8], has been controversial. While earlier studies have shown the occurrence of Anaemia in both undernourished and over-nourished individuals, representing the low and high socioeconomic classes, respectively [9-11], studies elsewhere [3,12] have associated Anaemia with low body mass index.

Although Anaemia is more prevalent in the pregnant and lactating women and children, adult males and non-pregnant women may also be at risk where there is chronic malnutrition due to inadequate food intake and frequent parasitic infections [1]. Ebonyi State is one of the states that ranked highest in malnutrition and is backward in education, health care, and infrastructure with dwellers exposed to wide range of parasites, including helminthes and schitosomes [13-16]. Hence, the present study was undertaken to determine the prevalence of Anaemia in relation to body mass index and sociodemographic data. The information provided will help in designing mitigating strategies at addressing this public health problem in the State.

MATERIALS AND METHODS

Study area

Ebonyi State is located on longitude 8°E and latitude 6°N with moderate relief of between 125 m and 245 m above sea level. The vegetation characteristics are that of the tropical rain forest with an average annual rainfall of about 1,600 mm and average atmospheric temperature of about 30°C. The State has 3 Senatorial Districts (Ebonyi South, Central and North), 13 Local Government Areas (LGAs) and 215 political wards [17].

Methods

This study was part of a larger study intended to correlate some toxic metal contents of foods and waters in Ebonyi State with their levels in blood of residents and associated biochemical consequences. Briefly, by random sampling, ten (10) wards were selected from each of the 13 local Government Areas. In all, 130 wards were involved in the study. Inclusion criteria were being resident in the selected wards and aged 18 years and older, and apparently healthy, without history of recent trace element supplementation in the last six months. Exclusion criteria include history of chronic diseases, including liver and renal diseases, diabetes, malignancy, sickle cell Anaemia; or seropositive to Human Immunodeficiency Virus (HIV). First, advocacy about the study was made. The leaders of the different churches and trade unions were consulted and the

Parameters	Male (n=111)	Non-pregnant Female (n= 184)	Pregnant Female (n= 133)	Total (n = 428)
BMI (Kg/m^2)	23.3 (3.5)^a	24.7 (3.5)^b	25.1 (3.9)^c	24.4 (4.3)
HBC (g/dl)	14.6 (2.0)^a	13.2 (1.8)^b	12.4 (2.0)^c	13.3 (2.1)
No. anemic (%)	11 (9.9)^a	29 (15.8)^b	53 (39.8)^c	93 (21.7)

[Table/Fig-1]: Body mass index, hemoglobin concentration and Anaemia prevalence according to gender, *BMI: Body Mass Index; HBC: Hemoglobin Concentration. ; Values are expressed as mean (SD). Values with different superscript along the row are significantly (One-Way ANOVA; p < 0.05) different*

Parameters	Body Mass Index Groups				
	Underweight (n=16)	Normal (n=252)	Overweight (n=118)	Obese (n=31)	Morbidly obese (n=11)
HBC (g/dl)	14.0 (1.4)	13.4 (1.9)	13.1 (2.4)	13.2 (2.3)	14.0 (2.0)
No. anemic (%)	0 (0)	57 (22.6)	26 (22.0)	7 (22.5)	3 (27.3)

[Table/Fig-2]: Mean hemoglobin concentrations and anaemia prevalence among adult residents of ebonyi state according to body mass index,
PCV: Packed Cell Volume; HBC: Hemoglobin Concentration. Values are expressed as mean (SD)

rationale for the study was communicated to them. Some churches allowed members of the study team to address the congregation on the need for the study, while others relayed the message as explained to them with members of the study team on hand to ascertain the clarity of the information passed. The various village heads and councils were notified and news passed across to their subjects during their town meetings. At all these meetings eligible ward members were encouraged to come out at a designated central location on a set date for enrolment into the study with assurance that every eligible volunteer will be allowed to participate at no cost. To facilitate coverage, a centre was mapped out and volunteers were asked to assemble at the centre on appointed date.

At each study centre those in attendance were given a health talk on environmental pollution with specific reference to toxic metals (arsenic, cadmium and lead) and zinc by the team Physicians. The rationale and study objectives were explained to the subjects and consent requested thereafter. Volunteers gave written consent to participate in the study after which their socio-demographic characteristics were collected using structured questionnaire administered by one of the study team members in the native language of the participants. After that, medical examination was carried out on each participant. Height and weight measurements were taken with the subjects in light clothing without shoes, caps or head tie using a standard calibrated meter rule affixed to a wall perpendicular to a flat smooth surface floor, while the body weight was measured using a digital weighing scale (Seca, Harmburg, Germany). The body mass index (BMI) was calculated as a ratio of the weight in kilogram (Kg) and square of height in meter (m^2). Blood sample for the determination of hemoglobin concentration was collected in EDTA bottle. Hemoglobin concentration was determined by cyanmethemoglobin method as previously described [18]. Intra individual variability was minimized by ensuring that samples were analysed in duplicates and the mean taken as the final reading while inter-individual variation was removed by ensuring that the same person analysed the whole samples.

Anaemia was defined in accordance with WHO [19] criteria as hemoglobin concentration <12.0g/dl (non-pregnant women), <11.0g/dl (pregnant women) and <13.0g/dl (men). Subjects were categorized into underweight (BMI= <18.5 Kg/m^2), normal weight (BMI = 18.5-24.9 Kg/m^2), over weight (BMI = 25-29.9 Kg/m^2) obese (BMI= 30-34.9 Kg/m^2) and morbidly obese (>35 Kg/m^2) [20].

Ethical consideration

The Ethics and Research Committee of Federal Teaching Hospital, Abakaliki, Ebonyi State approved the protocol for the study. The approval was on the agreement that patient anonymity must be maintained, good laboratory practice/quality control ensured, and that every finding would be treated with utmost confidentiality and for the purpose of this research only. All work was performed according to the international guidelines for human experimentation in clinical research [21]. Subjects having serious medical condition were referred to the nearest hospital or to the Federal Teaching Hospital, Abakaliki for further assessment and management.

Parameters	No. Examined	Hb. Conc.	No. Anemic (%)	95% CI
Educational status				
None	83	13.1±2.1^a	17 (20.5)	11.2-28.8
Primary	153	13.3±2.2^a	41 (26.8)	19.8-34.2
Secondary	152	13.3±1.9^a	27 (17.8)	11.8-24.2
Tertiary	40	14.1±2.2^b	8 (20.0)	7.0-33.0
Total	428	13.3±2.1	93 (21.7)	18.0-26.0
Occupation				
H/W/Retired	35	12.5±1.6a	9 (25.7)	11.0-41.0
Civil servant	77	13.6±2.1^b	16 (20.8)	12.0-30.0
Artisan	124	13.3±2.1^a	30 (24.2)	16.3-31.7
Farming	192	13.4±2.1^b	38 (19.8)	12.0-30.0
Total	428	13.3±2.1	93 (21.7)	18.0-26.0
Age-groups (yrs)				
≤ 30	144	12.9±2.1^a	42 (29.2)	21.4-36.6
31-40	123	13.2±2.1^a	31 (25.2)	17.2-32.8
41-50	69	13.8±2.1^b	8 (11.6)	4.2-19.8
> 50	92	13.7±1.9^b	12 (13.0)	6.0-20.0
Total	428	13.3±2.1	93 (21.7)	18.0-26.0

[Table/Fig-3]: Prevalence of Anaemia in relation to sociodemographic characteristics, *Values with different superscript along the column are statistically significant (One-Way ANOVA; p<0.05)*

STATISTICAL ANALYSIS

Data was be analysed using Statistical Package for Social Sciences (SPSS®) for Windows® version 16 (SPSS Inc., Chicago, IL, USA). Values were expressed as mean ± standard deviation. Comparison was done using One-way Analysis of Variance (One-way ANOVA) with level of significance set at $p < 0.05$. Correlation was determined by Pearson correlation analysis.

RESULTS

Although 443 participants were enrolled into the study, data was complete for 428 (96.6). Sociodemographic data showed that Level of illiteracy is still high in the State, with 19.6% (84/428) of the residents without formal education while 9.8% (42/428) had tertiary education. About 47 percent (200/428) of the study population had farming as their occupation while civil servants accounted for 18.2% (78/428) of the population.

Results also showed that only about 1.9% (8/428) of the adult population had access to tap water while 43.5% (186/428) relied on bore-hole as their primary source of water for domestic activities and drinking. Again, 36.2% (155/428) of the residents consume alcohol while about 11.9% (51/428) smoke tobacco (data not shown).

In general, Anaemia prevalence of 21.7% was observed among adult Nigerians in Abakaliki with values of 9.9%, 15.8% and 39.8% in male, non-pregnant female and pregnant female, respectively. Anaemia prevalence was significantly higher in pregnant female than their non-pregnant counterparts, while, the females in general had significantly higher prevalence of Anaemia than the males [Table/Fig-1].

From [Table/Fig.-2], 3.7% (16/428) of adult Nigerians in Ebonyi State was underweight, while 37.6% (161/428) had excess weight (overweight, obese and morbidly obese).There was no significant difference ($p>0.05$) in hemoglobin concentration among the BMI groups. Except for the underweight subjects which had no Anaemia, no significant difference was found in the prevalence of Anaemia among other BMI groups.

[Table/Fig-3] shows the hemoglobin concentration and Anaemia prevalence in relation to age groups and sociodemographic characteristics of the subjects. Hemoglobin concentrations were significantly higher in older age groups, civil servants and those with tertiary education. However, prevalence of Anaemia was found to be significantly ($p < 0.05$) higher among age groups ≤ 30 y and 31-40 y in comparison to older age groups. Furthermore, educational status and occupation had no effect on Anaemia prevalence. Body mass index (BMI) was not correlated with hemoglobin concentration ($r=0.000$; $p = 0.985$).

DISCUSSION

The present study showed Anaemia prevalence of 21.7% among adult Nigerians in Ebonyi State, with pregnant women and younger age groups being more at risk of Anaemia with sociodemographic characteristics having no significant effect on Anaemia prevalence. Also 3.7% of the subjects were underweight, while 37.6% had excess weight (overweight, obese and morbidly obese). Except in the underweight subjects, where Anaemia was not observed, no significant difference ($p>0.05$) was found in the prevalence of Anaemia among other BMI groups.

Anaemia prevalence of 21.7% observed in the present study is lower than 70.1 % and 53.2%, respectively among adult females and males, aged 20-50 y reported by Pratima et al., [22] in North Indian population. The present value is also lower than 60.2% reported by Bhattacherjee and colleagues [1] among adults 20-70 y in rural communities of North Bengal. The World Health Organization population coverage of Anaemia prevalence between 1993 and 2005 showed that the global prevalence of Anaemia was 48.8% with 41.7% prevalence for Africa [23]. These values are higher than the present figure of 21.7%. Data on Anaemia prevalence in Nigeria have been dominated by figures from pregnant women [24], pre-school age children [25-27], and critically ill children [28]. However, the study by Olayemi and Halim [29] among apparently healthy adults Nigerians documented Anaemia prevalence of 51.8%, a value higher than the present figure of 21.7%. The disparity in the values may be related to subjects.

Although the prevalence of Anaemia in the present study was lower than global prevalence, it has important public health implications. On one hand, the sample size (428) of the present study is high enough to detect significant difference where it truly exists. It is therefore a true representation of the population of the state and may therefore be generalized; meaning that Anaemia among the adults in the state is lower than the global prevalence. Also, Anaemia has been found to affect both the health and socio-economic development of the affected individuals [5,30].

In underprivileged population, although iron deficiency is the leading cause of Anaemia, other multiple causes exist independently or co-exist with iron deficiency [22]. Inhabitants of Ebonyi State like all underprivileged population are backward in education, health care, and infrastructure with high prevalence of infections, including malaria, helminthes and schitosomes [14]. Also, reports show that malnutrition including micronutrient deficiencies is prevalent in the state [12,31]. Both infections, especially parasitic infections and malnutrition have been associated with high prevalence of Anaemia [32-34]. Although infection was not assessed in the present study, it may be inferred that the level of Anaemia in the present study may be partly attributed to high burden of worm infections and not due to malnutrition as only 3.7% of the population was malnourished. For instance, hookworms contribute to Anaemia by inducing iron deficiency through chronic intestinal blood loss [32]. Also, it has been found that *Ancylostoma duodenale* and *Necator americanus* cause about 0.2 ml and 0.15 ml blood loss per day, respectively and high intensity of *trichuris trichura* and Ascaris infections have been associated with nutritional deficiencies [34]. Hence, it may be argued that the Anaemia in the present study may be due to iron deficiency as a result of parasitic infections as prevalence of Anaemia has often been used as a proxy for iron deficiency Anaemia [22].

The lower prevalence of underweight recorded in the present study is in contrast to the report of high prevalence of malnutrition in the state [13]. On the contrary, excess weight, including overweight, obesity and morbid obesity were found in 37.6% of the population. This reaffirms that the Anaemia observed in this population was due to iron deficiency. It also supports the lack of relationship between Anaemia and body mass index observed in the present study.

Again, the present prevalence of Anaemia may further be associated with higher number of women in the studied population {317/248 (74.1%)} as high prevalence of Anaemia has been associated with maternal short inter-pregnancy intervals and menstrual losses [30,35]. Also, low intakes of iron, poor absorption of iron from diet with high phytate or phenolic compounds are known risk factors for Anaemia [22]. Regrettably however, nutrient intake was not assessed in the present study. Apart from infections and inadequate iron intake, Anaemia has been associated with metal toxicity, such as lead poisoning as previous study in the state reported high levels of blood lead among pregnant women [36]. Lead causes Anaemia not only by displacement of metal ions such as zinc, calcium and iron from their natural co-factors but also by massive inhibition of enzymes (δ-amiolevulinic acid dehydratase and ferrochelatase) involved in heme synthesis [37]. High heavy metals contents have previously been reported in Uburu salt lake in Ohaozara LGA in Ebonyi South Senatorial District of the State [38].

The lack of effects of sociodemographic characteristics on Anaemia prevalence observed in the present study is in contrast with previous studies [30,39], where unfavourable sociodemographic factors were found to be associated with high prevalence of Anaemia [39]. Although the reason for the disparity in their findings and that of the present study is not known, we speculate that it may be due to the fact that inhabitants of the state are equally exposed to the same environment in terms of infections, including intestinal infections and malaria. Another possibility is that women form majority of the study population and may have comparable exposure to risks of developing Anaemia. However, higher prevalence of Anaemia in younger age groups as compared to older age groups observed may not be unconnected to the higher demand for iron by the younger age groups as a result of higher activities.

The comparable Anaemia prevalence among body mass index (BMI) groups observed in the present study suggests that Anaemia in this population is not related to BMI. This is in contrast with studies elsewhere [1,40,41]. In Chinese women from Jiangsu Province, an inverse association was found between overweight, obesity, central obesity and Anaemia [40]. Similarly, a negative association between hemoglobin concentration and BMI has been observed in medical students of Himalayan Institute of Medical Sciences [41]. Among adults from rural communities of North Bengal hemoglobin concentration was found to be significantly associated with BMI [1].

Although overweight or obesity may not decrease red cell survival or impair erythropoiesis, it has been speculated that obesity might result in hypoferemia through hepcidine or other mediators [42]. Thus it may be inferred that being overweight or obese, which is an ongoing inflammatory problem, may lead to release of hepcidine, a known inhibitor of dietary iron absorption.

CONCLUSION

We therefore conclude that though undernutrition is low in adult Nigerians in Abakaliki, Anaemia is prevalent and is neither related to sociodemographic characteristics nor body mass index. In the absence of a definite relationship of Anaemia and sociodemographic characteristics, further studies are needed to document factors that may be associated with Anaemia among adults in the State.

ACKNOWLEDGEMENT

This project was funded by Ebonyi State University-Tertiary Education Trust Fund (EBSU-TEDFUND) 2012 Research Grant (GRANT NO.: EBSU/TETFUND GRANT APPL/012/2012). The authors are grateful to Prof. Dr. Jonny Ogunji, Dr. Jesse C. Uneke, and Prof. Egwu U. Egwu for logistic support.

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FINANCIAL OR OTHER COMPETING INTERESTS: As declared above.

Date of Submission: **Apr 30, 2014**
Date of Peer Review: **Oct 02, 2014**
Date of Acceptance: **Oct 06, 2014**
Date of Publishing: **Jan 01, 2015**