

Anthropometric and Iron status of Adolescents in Afikpo North Local Government Area, Ebonyi State, Nigeria

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ABSTRACT

Background: Obesity is prevalent among adolescents who are also prone to anaemia due to growth demands and menstruation in females. There is need to evaluate the relationship between these variables to establish basis for interventions.

Objective: This study assessed the prevalence of thinness, overweight, obesity and anaemia among adolescents in Afikpo North LGA of Ebonyi State, Nigeria. It also evaluated the relationship between anaemia and body mass index, and waist circumference.

Methods: A cross-sectional study was conducted among 490 adolescents in households within Afikpo North LGA selected using a 4-stage sampling technique. Data collection methods were questionnaire, measurements of weight, height, waist circumference and haemoglobin (using Healthy-Q MULTI). Statistical Product and Service Solutions (SPSS, version 22) was used in data analysis and significance was set at $p < 0.05$.

Results: Majority (54.3%) of the respondents were females; 99.2% were in-school adolescents with 93.6% in secondary schools. About 42.0% consumed fast foods daily; 27.4% consumed these foods at least once a week. Prevalence of obesity was 6.3%; 17.3% were overweight and 38.7% were thin. Only 3.5% had abdominal obesity. Prevalence of anaemia was 80.0%. Few (16.7%) who had severe anaemia were obese. About 97.0% who had normal haemoglobin had normal waist circumference. These relationships were not significant ($P > 0.05$).

Conclusion: This study showed high prevalence of anaemia. Thinness, overweight and obesity were also public health problems. The relationships between anaemia and body mass index, and waist circumference were not significant. There is need to educate adolescents on adequate nutrient intake for good health status.

Keywords: Body mass index, abdominal obesity, anaemia, adolescents, Nigeria.

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INTRODUCTION

Adolescence is a transitional phase from childhood to adulthood. As defined by the World Health Organization (1), adolescents are a group of persons within the ages of 10 and 19 years; it is a phase characterised by rapid physical, physiological, psychological, and social changes. Adolescents in low- and middle-income countries such as Nigeria may be more at risk of malnutrition due to wrong food choices and inadequate food intake as they often deviate from the family food

consumption pattern. De Onis et al. (2) reported increased incidence of overweight and obesity among adolescents in developing countries. This may be due to nutrition transition which is characterised by dietary and lifestyle changes. It is established that over-nutrition and undernutrition are most often simultaneous problems in adolescents (3).

Studies carried out on overweight, obesity and

abdominal obesity have reported prevalence ranging from 0.5% to 13.2% (4 - 6) while the prevalence of thinness was up to 31.0% (7 - 10). A high prevalence of anaemia was also reported by some researchers (9, 11, 12). Obesity is linked to a variety of unfavourable fatal diseases including hyperlipidaemia, atherosclerosis, diabetes, cardiovascular diseases, anaemia and changes in iron homeostasis (13). Iron deficiency continues to be one of the most prevalent nutritional deficiencies in the world, particularly in developing countries (14). When dietary iron intake falls short of the body's needs, iron deficiency occurs. Anaemia, reduced work capacity and mental performance, poor growth and development, impaired regulation of body temperature and decreased resistance to infections are only a few of the negative effects of iron deficiency (15). Adolescence, like other vulnerable age groups such as infancy and early childhood, is associated with a high risk of developing iron deficiency due to the combination of rapid physical growth, expansion of blood volume, menstrual iron losses in girls, and increase in muscle mass that occurs concurrently, especially in boys (16). Obesity, which describes increase in body mass, may worsen borderline/low iron status because of the need to supply blood to the extra tissues. According to a two-sample Mendelian randomization study (17), obesity can cause iron deficiency anaemia. This assertion was based on the strong association ($P < 0.001$) of iron deficiency anaemia with body mass index and waist circumference. Based on this, this study aimed to assess the anthropometric and iron status of adolescents in Afikpo North Local Government Area of Ebonyi State and evaluate the relationship between them. This will provide data to support prevention and control interventions as well as add to already existing literature.

MATERIALS AND METHODS

Area of study

The study was carried out in the Afikpo North Local Government Area of Ebonyi State, Nigeria. Afikpo North Local Government Area comprised eight communities.

Study design

A cross-sectional (descriptive and analytical) study design was adopted for this study.

Sample Size Determination

The sample size for this study was 490, obtained using the Cochran's formula $N = \frac{4P(1-P)}{w^2}$.

Where N denotes the total number of adolescents needed for this study; P denotes the proportion of adolescents assumed to be obese, which is 4.6% approximately 5% (6); and W denotes the precision

or probability level required for this study (0.05 or 5%). The design effect was 2, with a 5% non-response. Thirty percent of this formed the subsample on which the biochemical test was conducted.

SAMPLING TECHNIQUE

Multistage sampling

technique was used to select the study sample. In stage one, three communities (Itim, Ohaisu, and Nkpoghpro) were selected from the eight communities that make up Afikpo North LGA using simple random sampling technique. In stage two, three villages were sampled from each of the selected communities using a simple random sampling technique. This gave a total of nine villages. In stage three, village or clan heads helped with household listing, which enabled the researcher to select households using random sampling techniques by balloting without replacement. Since 152 is the sample size for each community, 51 households were selected per village ($152/3$). In stage four, a simple random sampling technique was used to select the respondents from the selected households. Only one adolescent was selected per household. If a household had more than one adolescent, a simple random sampling technique was used to select only one adolescent.

Ethical clearance and informed consent Ethical approval (EBS/MOH/COM/3/1/43) for the study was obtained from the Health Research Ethics Committee of the State Ministry of Health, Ebonyi State. Informed consent was obtained from the respondents and their parents or guardians after the study protocol had been explained and any question or issue raised had been answered or clarified to their understanding. The confidentiality of the data was guaranteed and maintained.

Data collection methods:

A validated questionnaire was used to obtain data on the socio-economic background of the children and their food consumption patterns. Weight, height, and waist circumference were the anthropometric measurements taken.

The weights of the adolescents were taken with an electronic weighing scale. This was done with the adolescents wearing only light/minimal clothing and without shoes. Each adolescent was made to stand erect (head upright and hands hanging by the sides) on the centre of the horizontal platform without touching anything. Reading was taken to the nearest 0.1 kg (7).

The heights of the adolescents were measured with a calibrated vertical measuring rod placed on a flat surface. The respondent was instructed to stand erect with feet together (and without shoes) and the heels, buttocks and back of the head touching the vertical

measuring rod. The reading was taken to the nearest 0.1 cm and recorded (7).

Body mass index (BMI) was calculated as weight in kg over height in metre squared. The value obtained was related with the adolescent's age according to the child growth standard of the World Health Organisation of 2006

(18) to assess his/her body mass index-for-age (BMI-for-age). BMI-for-age for adolescents was used to determine the level of overweight and thinness in the adolescents. This was done using the WHO (18) child growth reference table. Adolescents with -2SD and -3 SD were classified as having moderate and severe thinness whereas those with 2SD and 3SD were classified as overweight and obese, respectively.

The waist circumference was measured from the narrowest point between the lower borders of the rib cage and the iliac crest. A flexible, non-stretchable tape was used to take the measurement. The waist circumference was read and recorded to the nearest 0.1 cm. A waist circumference percentile chart from the Children's Hospital Research Institute of Manitoba, Canada, was used as a standard. Waist circumference was categorized as abdominal or central obesity equal to $\geq 90^{\text{th}}$ percentile and $< 90^{\text{th}}$ percentile was taken as normal (19).

Haemoglobin test:

Healthy-Q MULTI machine was used to measure haemoglobin. The tip of the index finger was first cleaned with an alcohol-soaked cotton ball before the finger-prick blood was obtained using ansoft-clix lancet. A drop of the whole blood was placed on the haemoglobin strip and inserted in the Healthy-Q Multi machine following the manufacturer's guidelines. The result was displayed on the screen. Anaemia was defined as haemoglobin levels below 12.0 g/dl and was further classified as severe (< 7.0 g/dl), moderate (7.0 - 9.9 g/dl), and mild (10-11.9 g/dl) (20). The sum of the adolescents who had these anaemia categories was taken as the prevalence of anaemia.

Data analysis

Data obtained from the study were entered into Microsoft excel, sorted and cleaned. Statistical analysis was conducted using the computer programme, Statistical Product and Service Solutions, version 22.0. The result was expressed as frequencies, percentages, means, and standard deviations. T-tests and Chi-square analysis were conducted to determine relationships among variables. The significance level of $p < 0.05$ was accepted.

RESULTS

Socio-demographic and dietary characteristics of the adolescents

Table 1 shows the socio-demographic and dietary characteristics of the respondents. Majority (54.3%) of the respondents were females while 45.7% were males. Forty-nine percent of the respondents were within the age range of 10-14 years whereas 51.0% were within the age range of 15-19 years. All the 490 respondents were single and while 99.2% of the respondents were in school, 0.6% were no longer in school and 0.2% never attended any school. Most (93.6%) of the respondents were in secondary school, 4.3% were in primary school and 2.1% were in tertiary institution. A total of 8.6% of the respondents' fathers had no formal education, while 37.1% had tertiary education. Few (8.2%) of the respondents' mothers had no formal education, only 37.3% had tertiary education. It was observed that 53.5% had 5-8 persons in their households; 12.0% had 9 or more persons. Furthermore, 61.2% of the respondents' households earned less than 50,000 and 2.5% had no idea of their average monthly household basic income. Whereas 11.4% consumed more than 3 meals daily, 42.0% consumed fast foods daily and 27.4% consumed them at least once a week.

Frequency of food consumption among the adolescents

Table 2 shows the respondents' weekly food consumption frequency. More than a quarter (30.8%) of the respondents consumed starchy roots, fruits and tubers 1-3 times weekly whereas 8.0% had never consumed starchy roots, fruits and tubers. Up to 30.4% of the respondents consumed cereals 1-3 times weekly, and 11.0% consumed cereals 4-6 times weekly. Legumes were occasionally consumed by 35.5% of the respondents, and were consumed by 6.8% of the respondents 4-6 times weekly. Meat, fish, and poultry food group was consumed daily by 25.6% of the respondents, whereas 7.8% of the respondents consumed meat, fish, and poultry 4-6 times weekly. Whereas egg was consumed 1-3 times weekly by 30.2%, 45.3% consumed milk daily. About one third (36.0%) of the respondents consumed vegetables 1-3 times weekly while 9.0% never consumed vegetables. About 30.6% of the respondents consumed fruits 1-3 times weekly, whereas 9.4% never consumed fruits. Less than half (43.6%) of the respondents consumed fats and oil daily; while 6.3% never consumed fats/oils. About a quarter (26.9%) consumed oil seeds and nuts 1-3 times weekly whereas 8.0% consumed oil seeds and nuts 4-6 times weekly.

Table 1: The socio-demographic and dietary characteristics of the respondents

Variables	Frequency (490)	Percentage
Sex		
Male	244	45.7
Female	266	54.3
Age (years)		
10-14	240	49.0
15-19	250	51.0
Marital status		
Single	490	100.0
School status		
Never attended any school	1	0.2
In school	486	99.2
No longer in school	3	0.6
School type if in school (n=486)		
Primary	21	4.3
Secondary	455	93.6
Tertiary	10	2.1
Highest educational level of father		
No formal education	40	8.2
Primary school	48	9.8
Secondary school	219	44.7
Tertiary	183	37.3
Highest educational level of mother		
No formal education	42	8.6
Primary school	33	6.7
Secondary school	233	47.6
Tertiary	182	37.1
Household size (persons)		
1-4	169	34.5
5-8	262	53.5
9 or more	59	12.0
Households' average basic income per month		
< ₦50,000	300	61.2
₦50 – 100,000	108	22.0
> ₦100,000	70	14.3
No idea	12	2.5
Number of meals consumed in a day		
One	5	1.0
Two	77	15.7
Three	352	71.9
More than three	56	11.4
Consumption of fast food		
No	110	22.4
Yes	380	77.6
Frequency of fast food consumption		
Once daily	161	42.4
Once a week	104	27.4
Occasionally	115	30.2

Table 2: Respondents' food consumption frequency

Food Groups*	Daily N (%)	4-6 times N (%)	1-3 times N (%)	Occasionally N (%)	Never N (%)	Total N (%)
Starchy roots, fruits and tubers**	123(25.1)	43(8.8)	151(30.8)	134(27.3)	39(8.0)	
Cereals	115(23.5)	52(10.6)	149(30.4)	114(23.3)	60(12.2)	490 (100.0)
Legumes***	65(13.3)	33(6.7)	111(22.7)	174(35.5)	107(21.8)	490 (100.0)
Meat, fish, poultry***	126(25.7)	38(7.8)	109(22.2)	127(25.9)	90(18.4)	490 (100.0)
Egg***	147(30.0)	47(9.6)	148(30.2)	110(22.4)	38(7.8)	490 (100.0)
Milk	222(45.3)	43(8.8)	131(26.7)	76(15.5)	18(3.7)	490 (100.0)
Vegetables***	135(27.6)	66(13.5)	174(35.5)	72(14.6)	43(8.8)	490 (100.0)
Fruits	140(28.6)	66(13.5)	150(30.6)	88(17.9)	46(9.4)	490 (100.0)
Fats/oils	214(43.7)	50(10.2)	104(21.2)	91 (18.6)	31(6.3)	490 (100.0)
Oil seeds/nuts***	89(18.2)	39(8.0)	132(26.9)	125(25.5)	105(21.4)	490 (100.0)

*Food groups according to FAO (2016) **Starchy fruits refer to plantains ***Sources of iron

Table 3: Anthropometric status of the respondents by sex and age

Variables	Sex		Age in years		Total
	Male	Female	10-14	15-19	
Body mass index-for-age					
Mean body mass index	18.1±2.66	19.8±3.41	17.9±2.867	20.5±3.086	
T value (P value)	3.294(0.001)		5.233(0.000)		
Categories	N(%)	N(%)	N(%)	N(%)	N(%)
Severe thinness (-3SD)	18(8.0)	13(4.9)	19(7.9)	12(4.8)	31(6.3)
Moderate thinness (-2SD)	24(10.7)	27(10.1)	30(12.5)	21(8.4)	51(10.4)
Mild thinness (-1SD)	42(18.8)	66(24.8)	48(20.0)	60(23.9)	108(22.0)
Normal	84(37.5)	100(37.6)	92(38.3)	92(36.9)	184(37.6)
Overweight (+2SD)	46(20.5)	39(14.7)	36(15.0)	49(19.6)	85(17.4)
Obesity (+3SD)	10(4.5)	21(7.9)	15(6.3)	16(6.4)	31(6.3)
Total	224(100.0)	266(100.0)	240(100.0)	250(100.0)	490(100.0)
χ ² (p-value)	χ ² = 8.651, P = 0.124		χ ² = 9.706, P = 0.467		
Waist circumference					
Mean waist circumference	65.6±6.136	69.2±6.635	65.6±6.55	70.6±5.62	
value (P value)	3.406(0.001)		4.923(0.000)		
Categories	N(%)	N(%)	N(%)	N(%)	N(%)
Central obesity (≥90 th percentile)	3(1.3)	14(5.3)	8(3.3)	9(3.6)	17(3.5)
Normal (<90 th percentile)	221(98.7)	252(94.7)	232(96.7)	241(96.4)	473(96.5)
Total	224(100.0)	266(100.0)	240(100.0)	250(100.0)	490(100.0)
χ ² (p-value)	χ ² = 5.590, P = 0.018		χ ² = 0.065, P = 0.968		

Anthropometric status of the adolescents

Table 3 presents the anthropometric status of the respondents by sex and age. The mean body mass index (BMI) were 18.1±2.66 for males and 19.8±3.41 for females (P<0.01). The mean BMI was significantly (P<0.001) higher (20.5±3.086) in the older adolescents (15-19 years) than the younger ones aged 10-14 years (17.9±2.867). For males, it was observed that 37.5% had normal BMI-for-age, 8.0% had severe thinness and 4.5% were obese while among females, 37.6% had normal BMI-for-age, 4.9% were severely thin and 7.9% had obesity. There was no significant difference in body mass index-for-age and sex (p>0.05). For adolescents aged 10 to 14 years, 38.3% had normal BMI-for-age, 7.9% were severely thin and 6.2% were obese. In addition, 36.9% of adolescents aged 15 to 19 years had normal BMI-for-age, 4.8% were severely thin and 6.4% had obesity. These

differences were not significant (p>0.05).

Females (69.2±6.635) had significantly (P<0.01) higher waist circumference than their male counterparts (65.6±6.136). A significantly (P<0.001) higher value (70.6±5.62) was observed among those aged 15-19 years than 65.6±6.55 among the 10-14 years-olds. Also, 1.3% of the male adolescents and 5.3% of the female adolescents had central obesity. There was a statistically significant difference between waist circumference and gender (p<0.05) with more females than males being affected. For waist circumference, 3.3% of the adolescents aged 10 to 14 years and 3.6% of adolescents aged 15 to 19 years had central obesity, while adolescents aged 10 to 14 years (96.7%) and 15 to 19 years (96.4%) had normal waist circumference. It was observed that general and central obesity was more prevalent in adolescents within the ages of 15 to 19 years. These differences

were not significant ($p>0.05$).

Prevalence of anaemia among the adolescents:

Figure 1 shows the prevalence of anaemia among the adolescents. Female adolescents (45.3%) had higher prevalence of anaemia than males (34.7%). Higher prevalence of 50.0% was observed among the early adolescents (10-14 years); 41.3% of the late adolescents were anaemic.

Haemoglobin status of the adolescents

Table 4 illustrates the haemoglobin status of the respondents by sex and age. Half (50.0%) of the male adolescents had moderate anaemia whereas, 6.2% had severe anaemia. For the female adolescents, 47.7% had moderate anaemia, and 9.3% had severe anaemia. Haemoglobin was not significantly associated

For age 10 to 14 years, 55.7% and 9.0% of the adolescents had moderate and severe anaemia,

respectively, while adolescents aged 15 to 19 years had moderate (38.7%) and severe (6.5%) anaemia. There was no significant difference between haemoglobin status and age ($p>0.05$).

Relationship between the haemoglobin status and anthropometric status of the adolescents:

Table 5 shows the relationship between the haemoglobin status and anthropometric status of the respondents. Among those who were overweight/ obese, 22.5% had anaemia and 20.0% had normal haemoglobin. This relationship, however, did not reach significant ($P>0.05$) proportions. The relationship between haemoglobin and waist circumference was not significant ($P>0.05$). Among adolescents with central obesity, 4.2% had anaemia while those with normal haemoglobin were 3.3%.

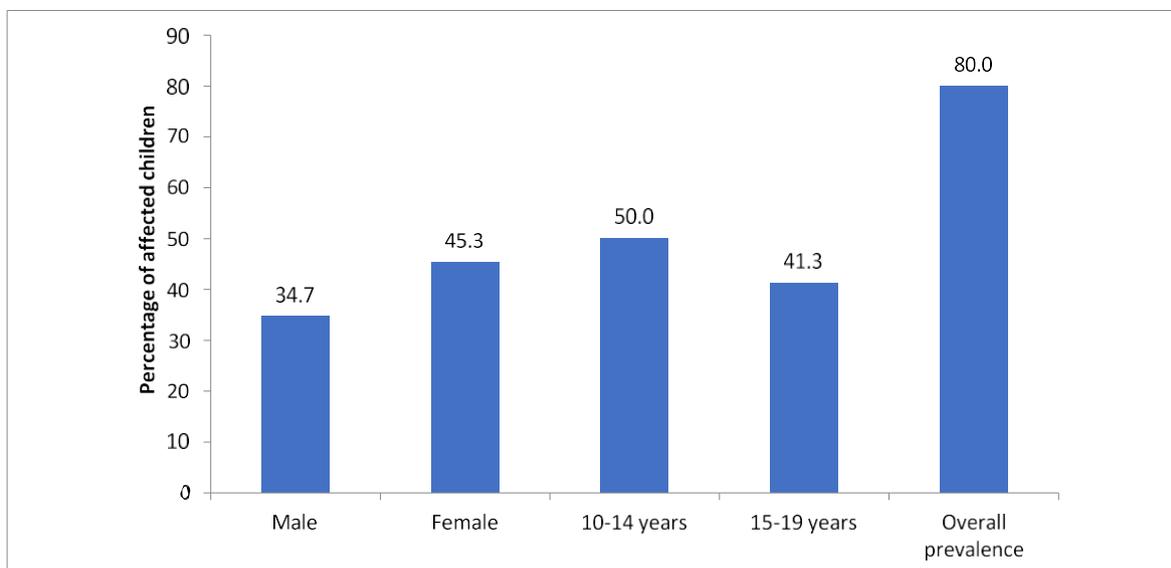


Figure 1: Prevalence of anaemia among the adolescents with sex ($p>0.05$).

Table 4: Haemoglobin status of the respondents by sex and age

Variables	Sex		Age in years		Total
	Male	Female	10-14	15-19	
Haemoglobin (g/dl)					
Mean haemoglobin	9.7 ± 1.96	9.8 ± 1.89	9.37 ± 1.99	10.3 ± 1.676	
T value (P value)	0.414(0.680)		2.936(0.004)		
Categories	N(%)	N(%)	N(%)	N(%)	N(%)
Normal (≥ 12.0)	12(18.8)	18(20.9)	13(14.8)	17 (27.4)	30(20.0)
Mild anaemia (10.0-11.9)	16(25.0)	19(22.1)	18(20.5)	17 (27.4)	35(23.3)
Moderate anaemia (7.0-9.9)	32(50.0)	41(47.7)	49(55.7)	24(38.7)	73(48.7)
Severe anaemia (<7.0)	4(6.2)	8(9.3)	8(9.0)	4(6.5)	12(8.0)
Total	64(100.0)	86(100.0)	88(100.0)	62(100.0)	150(100.0)
χ^2 (p-value)	0.688 (0.876)		6.135 (0.105)		

Table 5: Relationship between haemoglobin status and anthropometric status

Anthropometric status	Haemoglobin status			χ^2 (P value)
	Anaemic N (%)	Normal N (%)	Total N (%)	
Body mass index-for-age				0.043(0.835)
Thin ($\leq 2SD$)	50 (41.7)	14 (46.7)	64 (42.7)	
Normal (-1 to +1 SD)	43 (35.8)	10 (33.3)	53 (35.3)	
Overweight/obesity ($\geq +2SD$)	27 (22.5)	6 (20.0)	33 (22.0)	
Total	120 (100.0)	30 (100.0)	150 (100.0)	
Waist circumference				0.251(0.882)
Central obesity ($\geq 90^{\text{th}}$ percentile)	5 (4.2)	1 (3.3)	6 (4.0)	
Normal ($< 90^{\text{th}}$ percentile)	115 (95.8)	29 (96.7)	144 (96.0)	
Total	120 (100.0)	30 (100.0)	150 (100.0)	

χ^2 =chi square

DISCUSSION

Majority of the adolescents in this study had normal body mass index-for-age and waist circumference. The prevalence of general obesity found in this study is higher than 2.7% reported by Oduyoye, Bello and Julius among in-school adolescents in Ogun State (4). A study among adolescents in Asaba, Delta State, had similar findings with a prevalence of 6.8% (21). This finding is in contrast with that reported in Lagos, where 9.4% had general obesity (22). The prevalence of central obesity in this study was lower than 11.2% from the study carried out in Uyo (5). The prevalence of general and central obesity reported in this study may be attributed to genetics, environmental and socio-cultural characteristics of the adolescents. These factors may affect food choices, intake, utilization as well as lifestyle of individuals. Obesity among the affected individuals may progress into adulthood and may lead to obesity associated comorbidities with reduction in life expectancy (23).

Females, on the other hand, were found to have a higher prevalence of general and central obesity. The higher prevalence of general and central obesity among females (5.2% and 1.8%) than males (3.8% and 0.8%) is similar to the findings of other studies in Port Harcourt (6) and Oyo State (24). A study by Mustapha and Sanusi (25) found a higher prevalence (1.24%) of obesity among males. Overweight or obese adolescents are likely to remain obese into adulthood and are more prone to non-communicable diseases such as diabetes and cardiovascular diseases at a younger age (26). The high prevalence among females may be attributed to hormones and higher energy consumption coupled with low physical activity level.

The high prevalence of iron deficiency anaemia recorded in this study is in line with other studies carried out in Nigeria (9,12), although it contrasts with 40.3% from a study conducted in Enugu State (11). Compared to males, more females had severe iron deficiency anaemia. This was

anticipated because the start of menstruation increases a female's need for iron, and with low consumption of iron rich foods, this may be difficult to meet. The implication of this finding is vast. Haemoglobin is described as an oxygen carrier that transports oxygen from the lungs to all parts of the body. The low values observed imply low oxygen for energy production, lowered immunity, reduced work capacity, and educational performances, and also pose a major threat to future safe motherhood in girls.

In this study, anthropometry has nothing to do with iron since the relationship between the anthropometric and iron status of the respondents was not significant. Some studies have found a link between anthropometrics and iron status (27, 28, 29). Although the reason for the disparity is not known, it may be attributed to the fact that the adolescents might have had severe nutritional deficiencies during childhood. However, the finding of higher prevalence of anaemia among overweight/obese adolescents should sound a warning of the possibility of anaemia in overweight and obese individuals.

CONCLUSION

This study highlights the significant public health concern posed by the high prevalence of iron deficiency anaemia, thinness and obesity among adolescents in Afikpo North local government area. Among adolescents with overweight/obesity and central obesity, a higher prevalence of anaemia was observed though this relationship was not significant.

RECOMMENDATION

The implementation of nutrition education programmes is necessary to guide adolescents toward healthy eating patterns that can be maintained as adults and help the future reduction of anaemia and obesity risks.

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