



A Comparative Analysis of Lipid Profile among Rural and Urban School Going Male Adolescents in Katsina State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author AIY designed the study, wrote the first draft of the manuscript and the statistical analysis. Authors LS and MM managed the measurements of the clinical parameters of study participants and analyses of the study as well as literature review. All authors have read and approved the final manuscript.

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ABSTRACT

Aim: The study is aimed at analyzing blood samples from 484 male school going adolescents; of which 263 were randomly selected from a public school in Katsina metropolis (urban setting) and 221 from a public school in Batsari (rural setting) for the levels of serum total cholesterol (TC), high density lipoprotein cholesterol (HDL-CH), low density lipoprotein cholesterol (LDL-CH) and triacylglycerol (TG) in order to ascertain a risk of cardiovascular disease (CVD).

Study Design: A cross sectional study was conducted among male adolescents from urban and rural settings aged between 12-18 years attending public secondary schools in Katsina State-Nigeria to assess their nutritional status.

Place and Duration of Study: Department of Biochemistry, Bayero University, Kano-Nigeria. December 2008-April 2009.

Methodology: We determined the body mass index (BMI) and lipid profile of male school going adolescents. An end point colorimetric method was used to estimate serum total cholesterol. Test kits obtainable from Randox Laboratories Limited were used to estimate serum HDL-cholesterol, serum LDL-cholesterol and triacyl glycerol. Results obtained are presented as mean±standard deviation. Statistical analyses were carried out using Instat statistical package.

Results: The results indicate that the urban male adolescents have a significantly higher ($p < 0.05$) mean BMI, mean serum TC, mean serum LDL-CH and mean serum TG values than the rural male adolescents. This difference cuts across all age groups. Mean BMI values recorded for both the rural and urban male adolescents correspond to mild thinness on the BMI reference scale.

Conclusion: The nutritional and health status of the adolescent subjects in this study reflects a high percentage of underweight and a low risk for cardiovascular disease (CVD).

Keywords: Adolescents; settlement; lipid profile; Katsina state-Nigeria.

1. INTRODUCTION

Adolescents comprise a significant proportion of the world population. The proportion of adolescents within a population group is also rising relative to the other groups and an overwhelming proportion of young adolescents live in developing countries [1]. Traditionally, the main health indicator used by health planners has been mortality rates [2]. Adolescents have been considered to have the lowest mortality among different age groups and have therefore received low priority in terms of nutritional assessment [3].

As developing countries are undergoing nutrition transition due to increased development and market globalization leading to rapid changes in lifestyle and dietary habits [4]. Poor dietary habits combined with decreased physical activity have led to an increase in overweight and obesity among adults and children [4]. More so overweight and obesity during adolescent period are associated with risk factors for obesity related diseases in adults [5].

Ernst and Obarzanek examined two child and adolescents studies, the Bogalusa heart study and the Muscatine study and found both demonstrated a positive correlation between BMI or skin folds and total cholesterol and LDL-cholesterol levels and a negative correlation for HDL-cholesterol. Both established that the greater the BMI the greater the level of blood cholesterol and other lipids [6].

Risk factors for many health conditions need to be investigated. Studies indicate that cardiovascular risk factors in children have a significant temporal relationship with adult risk

factors and atherosclerotic cardiovascular disease incidence [7].

The aim of the study is toward finding out population of male school going adolescents from rural and urban setting in Katsina State who are obese and at risk for cardiovascular diseases.

While the objectives of the study are:

- i) To provide a baseline information on lipid profile of male school going adolescents in Katsina State.
- ii) To provide nutritional information that will enable policy makers, researchers and health and developmental agencies to formulate policies and suitable interventions.
- iii) To give recommendations based on research findings.

The dearth of information on the nutritional status and lipid profile of adolescents in Katsina State necessitates the current investigation. Specifically, the study was therefore undertaken to assess the nutritional status and lipid profile of school going male adolescents in two selected secondary schools in Katsina State. One in Batsari a rural setting and one in Katsina an urban metropolis. Thus, the study involved assessment of body mass index (BMI) and serum lipid profile (total cholesterol, HDL-cholesterol, LDL-cholesterol and triacyl glycerol).

2. MATERIALS AND METHODS

2.1 Study Population

A descriptive cross-sectional study was conducted among male adolescent students aged 12-18years attending secondary schools

within Katsina metropolis and Batsari village both located in Katsina State- Nigeria. The global location of the state is between latitude $12^{\circ} 15'$ north of the equator and longitude $07^{\circ} 30'$ east of the Greenwich Meridian with a total area of 24, 192 km² and a population of 3, 878, 344 as of 1991 census [8]. The objectives of the study were presented to the State Ministry of Education and the school principals in order to obtain their authorizations. A total of 484 adolescent male students of which 263 from Katsina (urban setting) and 221 from Batsari (rural setting) were randomly selected from the schools for participation in the study. All participants were Hausa-Fulani and appeared apparently healthy and aged between 12-18 years.

2.2 Sampling Technique

A comprehensive list of all the male secondary schools in Katsina State was collected from the State Ministry of Education. The schools were divided based on location (rural or urban). Two schools were then selected one from each setting with the use of the simple random technique applied through the table of random numbers. With the use of the stratified sampling technique, proportionate allocation was given to each school to make up the required sample size depending on the population of the students in each age group [9].

All students of the two chosen schools within the study age groups were considered. However, in each age group, systematic sampling method was employed in which the students were given numbers serially according to their classroom register from class 1 to class 6, thereby giving each student an equal chance. The random number table was used to select the first number and thereafter students picked at regular interval (sample interval) so as to meet the sample size requirement in each group. The sample interval was determined by dividing the total number of students in the age groups by the sample size: $4958/500=9.92=10$ [5].

A total of 500 students were selected for the study out of which 484 have complete data. Only those with complete data were included in the study analysis. Excluded from the study were non Hausa/Fulani and students that were ill [10].

2.3 Anthropometric Measurements

All measurements were made by persons trained on the proper techniques of measuring height and weight. Weighing scale was standardized by

the technicians and weight was taken based on internationally accepted standards for weight measurements. The weighing scales were calibrated each morning before weighing was done. The weight of each student was measured, with the student bare footed and with light clothing, using WEYLUX weighing scale, model 424J; Sliding Beam Column Scale, (Short Pillar with height of 560 mm). The measurements were recorded to the nearest one (1) Kilogram (Kg). Their height was measured using ACCUSTAT Ross stadiometer, 44817, manufactured by Genentech Incorporated. The students were asked to stand erect with the heels, buttocks, upper back and occiput against the stadiometer. The measurements were recorded to the nearest 1 cm. The BMI was then computed using the standard formula $[BMI = \text{weight (kg)} / \text{height (m}^2)]$ [9].

2.4 Biochemical Measurements

Blood samples were obtained from each subject by veni puncture and the samples were allowed to clot at room temperature before being centrifuged to separate the serum and frozen prior to analysis. Serum TC concentration was measured by the end point colorimetric method [11] with the use of T60 spectrophotometer and test kits obtainable from Randox Laboratories Limited. In this method, the cholesterol was determined after enzymatic hydrolysis and oxidation. The indicator quinoneimine was formed from the reaction between hydrogen peroxide and 4-aminoantipyrine in the presence of phenol and peroxidase.

Serum HDL-Cholesterol was measured with a T60 spectrophotometer with test kits obtainable from Randox Laboratories Limited. In this method, low density lipoprotein and chylomicron fractions are precipitated quantitatively by addition of phosphotungstic acid in the presence of Mg^{2+} ions. After centrifugation, the cholesterol concentration in the HDL fraction which remained in the supernatant was then determined [12].

Serum LDL-Cholesterol concentration was measured with a T60 spectrophotometer with test kits obtainable from Randox Laboratories Limited. In this method, low density lipoproteins are precipitated by heparin at their iso-electric point (pH=5.04). After centrifugation, the HDL-Cholesterol and VLDL remained in the supernatant. The cholesterol concentration in the LDL fraction was determined by enzymatic method [13].

Serum Triacyl glycerol concentration was measured with a T60 spectrophotometer with test kits obtainable from Randox Laboratories Limited. In this method, the triglycerides are determined after enzymatic hydrolysis with lipases. The indicator is a quinoneimine formed from hydrogen peroxide, 4-amino phenazone and 4-chlorophenol under the catalytic influence of peroxidase [14].

2.5 Data Analysis

Data obtained were analyzed using Microsoft Excel and results were expressed as mean \pm standard deviation. The student- t test was used to test for significant differences. Pearson's correlation coefficients between Age, BMI and serum lipids of the subjects were computed to establish whether there is a linear relationship between the measured variables. Statistical variations were considered significant at $p < 0.05$.

3. RESULTS

Table 1 shows the mean weight, height, BMI and serum lipid levels of the male adolescent subjects according to age grouping and location. Except for age group 15 the urban male adolescent subjects are significantly ($p < 0.05$) heavier than the rural male adolescent subjects. The urban male adolescent subjects had a significantly ($p < 0.05$) higher BMI than the rural male adolescent subjects and this difference cut across all the age groups. Male adolescents from urban setting had a significantly ($p < 0.05$) higher TC values than those from rural setting and this difference cut across all the age groups. There is no significant difference in the HDL-CH levels between the rural and urban male adolescents.

Except for age group 18, there is significant difference in the LDL-CH levels between the rural and urban male adolescents. The urban male adolescents had a significantly ($p < 0.05$) higher LDL-CH values in the age groups 12, 13, 14, 16 and 17 than the rural male adolescents; whereas the rural male adolescents had a significantly ($p < 0.05$) higher LDL-CH values in the age group 15 than the urban male adolescents.

The male adolescents from the urban setting had a significantly ($p < 0.05$) higher TG values than their rural counterparts. The observed difference cut across all the age groups.

Significant correlations were found between age, BMI and the concentrations of serum lipid in our rural male adolescents (Tables 2 and 3).

The mean concentrations of the serum lipids for both rural and urban male adolescent subjects are presented in Fig. 1. With the exception of serum HDL-CH concentration, the urban male adolescent subjects have a significantly ($P < 0.05$) higher mean serum lipid concentration values than the rural male adolescent subjects.

4. DISCUSSION

The male adolescents in this study were from rural and urban parts of Katsina State northern Nigeria. Mean BMI values recorded for both the rural and urban male adolescents correspond to mild thinness on the BMI reference data [15]. The mean BMI for both the rural and urban male adolescents in this study is in accordance with studies carried out in other parts of Nigeria [9,10,15,16,17].

Adolescents anthropometry has been observed to vary significantly worldwide [18], but the trend of low anthropometric parameters observed in both rural and urban male adolescents compared to global standard is similar to what was reported in other parts of Africa [19-21]. The apparent difference seen in subjects of such studies has been attributed to malnutrition and recurrent parasitic infections seen in African children [22,23,24]. BMI as a measure of weight relative to height is a clinical diagnostic tool used to classify underweight, overweight and obesity in adults. BMI has also been demonstrated to be directly related to total cholesterol, VLDL and LDL-CH [25].

Findings from this study have shown that in the urban male adolescents the mean serum TC levels for age groups 13, 14 and 15 falls below the range of values considered acceptable for African Americans [26], but the values for those in age groups 12, 16, 17 and 18 falls within the limit. The mean serum LDL-CH values for all age groups for both rural and urban male adolescents obtained in this study fall below the LDL-CH values reported for subjects from Kano, Nigeria [27] and US general population [28] but similar to values reported from Jos plateau, Nigeria [26] and Katsina, Katsina State, Nigeria [10,29].

Table 1. Mean weight, height, body mass index and serum lipid levels in rural and urban male school going adolescent subjects according to age

Age (years)	Weight (Kg)		Height (m)		BMI (Kg/m ²)		TC (mmol/L)		HDL-CH (mmol/L)		LDL-CH (mmol/L)		TG (mmol/L)	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
12(n=65)	*28.26±17.13	*38.90±6.43	1.40±0.30	1.40±0.30	*14.40±5.59	*19.90±0.09	*2.69±0.67	*4.51±1.01	0.89±0.01	0.98±0.10	*1.08±0.76	*1.36±0.48	*0.83±0.79	*1.24±0.38
13(n=52)	*35.65±14.74	*40.90±9.49	1.50±0.20	1.50±0.20	*15.85±4.14	*18.20±1.79	*2.87±0.63	*3.11±0.39	0.93±0.05	0.94±0.06	*1.09±0.25	*1.22±0.39	*1.00±0.62	*1.25±0.37
14(n=78)	*34.40±22.71	*42.90±14.21	1.50±0.20	1.50±0.20	*15.30±4.69	*19.10±0.89	*2.78±0.72	*3.16±0.34	0.98±0.01	1.05±0.17	*1.11±0.73	*1.30±0.54	*1.05±0.57	*1.22±0.40
15(n=72)	41.20±20.14	41.20±20.14	1.60±0.10	1.50±0.20	*16.10±3.89	*18.30±1.69	*2.83±0.67	*3.10±0.40	0.95±0.07	1.04±0.16	*1.60±0.68	*1.28±0.56	*1.08±0.54	*1.21±0.41
16(n=62)	*42.90±24.20	*50.80±16.80	1.60±0.10	1.60±0.10	*16.75±3.24	*19.90±0.09	*2.83±0.67	*3.67±0.17	0.97±0.09	0.96±0.08	*1.17±0.67	*1.47±0.37	*1.67±0.55	*1.37±0.25
17(n=82)	*47.00±21.20	*50.60±17.60	1.60±0.10	1.60±0.10	*18.35±1.64	*19.80±0.19	*3.01±0.49	*3.57±0.07	0.96±0.08	0.96±0.08	*1.24±0.60	*1.41±0.43	*1.23±0.39	*1.34±0.28
18(n=73)	*53.60±21.30	*59.80±15.10	1.70±0.00	1.60±0.10	*18.60±1.39	*23.40±3.41	*3.21±0.29	*3.61±0.11	0.97±0.09	0.98±0.10	1.59±0.25	1.60±0.20	1.20±0.42	*1.53±0.09

Values are mean±standard deviation with asterisk super scripts in the same column are significantly ($p<0.05$) higher, BMI=Body mass index; TC=Total cholesterol; HDL-CH=High density lipoprotein cholesterol; LDL-CH=Low density lipoprotein cholesterol; TG=Triacyl glycerol

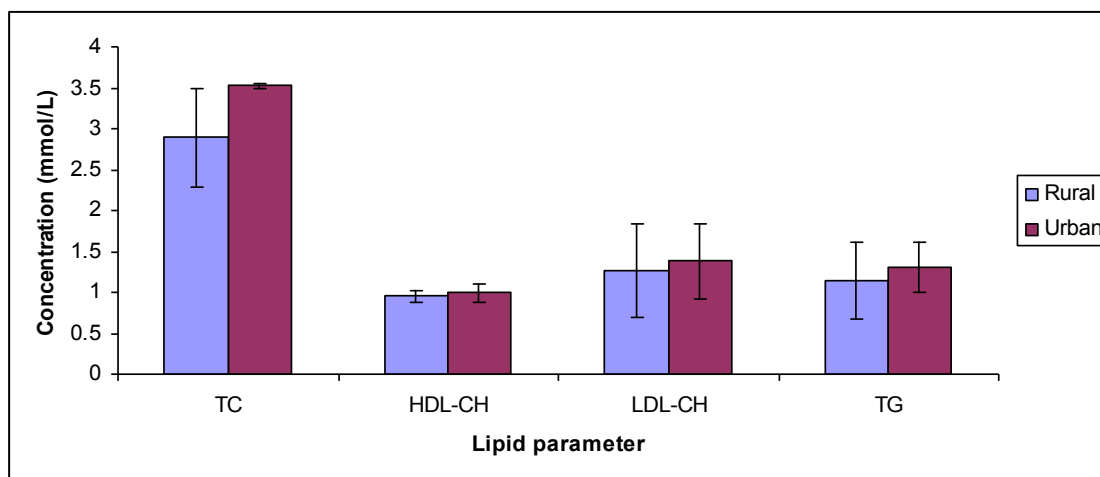


Fig. 1. Mean serum lipid concentrations in the rural and urban male adolescent subjects

Table 2. Correlation between BMI and serum lipids of rural and urban male school going adolescents

Anthropometric parameter	Serum lipid	Correlation	
		Rural	Urban
BMI	TC	0.923148	0.37943
BMI	HDL-CH	0.584587	-0.17540
BMI	LDL-CH	0.807317	0.933869
BMI	TG	0.926168	0.912557

Table 3. Correlation between age and serum lipids of rural and urban male school going adolescents

Parameter	Serum lipid	Correlation	
		Rural	Urban
Age	TC	0.850214	-0.19688
Age	HDL-CH	0.719623	-0.09203
Age	LDL-CH	0.818189	0.759948
Age	TG	0.925671	0.804373

Moreover, the results of our study have shown that a negative correlation exist between HDL-CH, BMI and age in the urban male school going adolescents. The low TC levels observed in this study for both the rural and urban male adolescents is in line with observations reported from other states in Nigeria [27,28,30].

However, the results of this study have shown that a positive correlation exist between BMI and the serum concentrations of TC and LDL-CH in both the rural and urban male adolescents. Although this observation differs from earlier studies carried out in Nigeria [28,31]. Our findings are in line with several studies which have shown consistent positive independent

association between excess body weight and TC levels [6,9,32,33,34,35]. Also in line with our study the Bogalusa heart study and the Muscatine studies have demonstrated a positive correlation between BMI, TC and LDL-CH levels [6,36].

Differences in mean BMI and serum lipid levels among the rural and urban male adolescents is a further proof of the effect of life style and dietary habits on serum lipid profile [29,30]. The long distance to and from school (either walking or riding bicycles) for male adolescent subjects from rural setting may account for the higher prevalence of underweight and lower serum lipid levels among the rural male adolescents irrespective of age groups.

Although the findings of this study revealed that the male adolescent subjects both from the rural and urban setting had BMI and a lipid profile indicative of low risk cardiovascular diseases, the very low serum cholesterol concentration may likely predispose our subjects to hemorrhagic stroke in the future especially among those who have high blood pressure [37].

The serum lipid concentrations of our rural male adolescent subjects gave a positive correlation with age and BMI. This is a cause for concern even though at present the BMI and lipid profile for our rural male adolescent subjects is indicative of low risk cardiovascular disease. Our study has revealed that as our rural subjects increase in age so is their BMI. Hence the need for our rural subjects to maintain a healthy BMI range in order to avoid attendant complications

associated with cardiovascular diseases in future. As our study has revealed a positive correlation between BMI, age and serum lipid concentrations in our rural male adolescent subjects.

Although our study does not include data on blood pressure to ascertain the prevalence of hypertension which is an independent risk factor for cardiovascular diseases [38]. But a study conducted on Fulani pastoralists in northern Nigeria to ascertain cardiovascular risk factors has shown that prevalence of hypertension among the Fulani men and women in the study was low compared with other Nigerian population [28]. As all our subjects are Hausa Fulani the finding of Glew et al. [28] may by extension apply to our subjects.

The cross-sectional nature of our study makes generalization of our findings to the entire population difficult. Notwithstanding, the result of this study can be extrapolated to populations with similar socioeconomic attributes. Though our findings are by no mean novel, they confirm previous reports of low prevalence of overweight and obesity among adolescents in Nigeria [7]. The study also confirms low risk cardiovascular diseases in the Hausa/Fulani [10,27,28,29,30].

5. CONCLUSION

Although significant correlations were found between age, BMI and the concentrations of serum lipid in our rural male adolescents; in our urban male adolescents, significant correlations were found between age, BMI and lipid concentrations only for LDL-CH and TG concentrations. However, the lipid profile in both rural and urban setting is indicative of low risk for cardiovascular diseases. The urban adolescents are also significantly heavier than their rural counterparts. There is a need to maintain a normal BMI level especially among our rural subjects as our study has revealed a positive correlation between age, BMI and serum lipid concentrations in our rural adolescent subjects. We recommend that a long term progressive study of BMI and lipid profile be conducted to monitor trends in BMI and lipid profile changes across age groups.

ETHICAL APPROVAL

Authors hereby declare that written permissions were obtained from appropriate authorities and all experiments have been performed in

accordance with the ethical standards laid down in the 1964 declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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