

Original Research Article

A comparative analysis on the effect of settlement on lipid profile: A study of rural and urban school going male adolescents in Katsina State, Nigeria

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 triacyl glycerol (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 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

Nutritional status assessment assess the nutritional status of the individual or a representative sample of individuals within a population by measuring anthropometric,

20 biochemical or physiological (functional characteristics) to determine whether the individual
21 is well nourished or undernourished [1].

22

23 As developing countries are undergoing nutrition transition due to increased development
24 and market globalization leading to rapid changes in lifestyle and dietary habits [2]. Poor
25 dietary habits combined with decreased physical activity have led to an increase in
26 overweight and obesity among adults and children [2]. More so overweight and obesity
27 during adolescent period are associated with risk factors for obesity related diseases in
28 adults [3].

29

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

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37 **2. MATERIAL AND METHODS**

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39 **2.1 Study population**

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41 A descriptive cross-sectional study was conducted among male adolescent students aged
42 12-18years attending secondary schools within Katsina metropolis and Batsari village both
43 located in Katsina State- Nigeria. The global location of the state is between latitude 12° 15'
44 north of the equator and longitude 07° 30' east of the Greenwich Meridian with a total area
45 of 24, 192km² and a population of 3, 878, 344 as of 1991 census [4]. The objectives of the
46 study were presented to the State Ministry of Education and the school principals in order to

47 obtain their authorizations. A total of 484 adolescent male students of which 263 from
48 Katsina (urban setting) and 221 from Batsari (rural setting) were randomly selected from the
49 schools for participation in the study. All participants were Hausa-Fulani and appeared
50 apparently healthy and aged between 12-18 years.

51

52 **2.2 Sampling Technique**

53

54 A comprehensive list of all the male secondary schools in Katsina State was collected from
55 the State Ministry of Education. The schools were divided based on location (urban or rural).
56 Two schools were then selected one from each setting with the use of the simple random
57 technique applied through the table of random numbers. With the use of the stratified
58 sampling technique, proportionate allocation was given to each school to make up the
59 required sample size depending on the population of the students in each age group [5].

60

61 All students of the two chosen schools within the study age groups were considered.
62 However, in each age group, systematic sampling method was employed in which the
63 students were given numbers serially according to their classroom register from class 1 to
64 class 6, thereby giving each student an equal chance. The random number table was used
65 to select the first number and thereafter students picked at regular interval (sample interval)
66 so as to meet the sample size requirement in each group. The sample interval was
67 determined by dividing the total number of students in the age groups by the sample size:
68 $4958/500=9.92=10$ [5].

69

70

71 A total of 500 students were selected for the study out of which 484 have complete data.
72 Only those with complete data were included in the study analysis. Excluded from the study
73 were non Hausa/Fulani and students that were ill [6].

74

75 **2.3 Anthropometric Measurements**

76

77 All measurements were made by persons trained on the proper techniques of measuring
78 height and weight. Weighing scale was standardized by the technicians, and weight was
79 taken based on internationally accepted standards for weight measurements. The weighing
80 scales were calibrated each morning before weighing was done. The weight of each student
81 was measured, with the student bare footed and with light clothing, using WEYLUX weighing
82 scale, model 424J; Sliding Beam Column Scale, (Short Pillar with height of 560mm). The
83 measurements were recorded to the nearest one (1) kilogram (Kg). Their height was
84 measured using ACCUSTAT Ross stadiometer, 44817, manufactured by Genentech
85 Incorporated. The students were asked to stand erect with the heels, buttocks, upper back
86 and occiput against the stadiometer. The measurements were recorded to the nearest 1 cm.
87 The BMI was then computed using the standard formula $[BMI = \text{weight (kg)} / \text{height (m}^2\text{)}]$ [5].

88

89 **2.4 Biochemical Measurements**

90

91 Blood samples were obtained from each subject by veni puncture and the samples were
92 allowed to clot at room temperature before being centrifuged to separate the serum and
93 frozen prior to analysis. Serum TC concentration was measured by the end point colorimetric
94 method [7] with the use of T60 spectrophotometer and test kits obtainable from Randox
95 Laboratories Limited. In this method, the cholesterol was determined after enzymatic
96 hydrolysis and oxidation. The indicator quinoneimine was formed from the reaction between
97 hydrogen peroxide and 4-aminoantipyrine in the presence of phenol and peroxidase.

98 Serum HDL-Cholesterol was measured with a T60 spectrophotometer with test kits
99 obtainable from Randox Laboratories Limited. In this method, low density lipoprotein and
100 chylomicron fractions are precipitated quantitatively by addition of phosphotungstic acid in

101 the presence of Mg^{2+} ions. After centrifugation, the cholesterol concentration in the HDL
102 fraction which remained in the supernatant was then determined [8].

103

104 Serum LDL-Cholesterol concentration was measured with a T60 spectrophotometer with test
105 kits obtainable from Randox Laboratories Limited. In this method, low density lipoproteins
106 are precipitated by heparin at their iso-electric point (pH=5.04). After centrifugation, the HDL-
107 Cholesterol and VLDL remained in the supernatant. The cholesterol concentration in the LDL
108 fraction was determined by enzymatic method [9].

109

110 Serum Triacyl glycerol concentration was measured with a T60 spectrophotometer with test
111 kits obtainable from Randox Laboratories Limited. In this method, the triglycerides are
112 determined after enzymatic hydrolysis with lipases. The indicator is a quinoneimine formed
113 from hydrogen peroxide, 4-amino phenazone and 4-chlorophenol under the catalytic
114 influence of peroxidase [10].

115

116 **2.5 Data Analysis**

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118 Data obtained were analyzed using Microsoft Excel and results were expressed as mean
119 $\pm$ standard deviation. The student- t test was used to test for significant differences.
120 Pearson's correlation coefficients between Age, BMI and serum lipids of the subjects were
121 computed to establish whether there is a linear relationship between the measured
122 variables. Also scatter diagrams were plotted to confirm a linear relationship. Statistical
123 variations were considered significant at $p < 0.05$.

124

125 **3. RESULTS**

126

127 Table 1 shows the mean BMI and serum lipid levels of the male adolescent subjects
 128 according to age grouping and location (rural and urban). The urban male adolescent
 129 subjects had a significantly ($p<0.05$) higher BMI than the rural male adolescent subjects and
 130 this difference cut across all the age groups. Male adolescents from urban setting had a
 131 significantly ($p<0.05$) higher TC values than those from rural setting and this difference cut
 132 across all the age groups. There is no significant difference in the HDL-CH levels between
 133 the rural and urban male adolescents.

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

140

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

143

144

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

Age	BMI		TC		HDL-CH		LDL-CH		TG	
(years)	(Kg/m ²)		(mmol/L)		(mmol/L)		(mmol/L)		(mmol/L)	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
12(n=65)	*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)	*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)	*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)	*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)	*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)	*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)	*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

146 *Values are mean±standard deviation with asterisk super scripts in the same column are significantly (p<0.05) higher*
147 *BMI=Body mass index; TC=Total cholesterol; HDL-CH=High density lipoprotein cholesterol; LDL-CH=Low density lipoprotein cholesterol;*
148 *TG=Triacyl glycerol*
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161 Significant correlations were found between Age, BMI and the concentrations of serum lipid
162 in our rural male adolescents (Table 2 and 3).

163 **Table 2. Correlation between BMI and serum lipids of rural male school going**
164 **adolescents**

Anthropometric parameter	Serum lipid	Correlation
BMI	TC	0.923148
BMI	HDL-CH	0.584587
BMI	LDL-CH	0.807317
BMI	TG	0.926168

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166

167 **Table 3. Correlation between age and serum lipids of rural male school going**
168 **adolescents**

Parameter	Serum lipid	Correlation
Age	TC	0.850214
Age	HDL-CH	0.719623
Age	LDL-CH	0.818189
Age	TG	0.925671

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170

171 Except for LDL-CH and TG concentrations, no significant correlations were found between
172 BMI, Age and the concentrations of the serum lipids in our urban male adolescent subjects
173 (Table 4 and 5).

174 **Table 4. Correlation between BMI and serum lipids of urban male school going**
175 **adolescents**

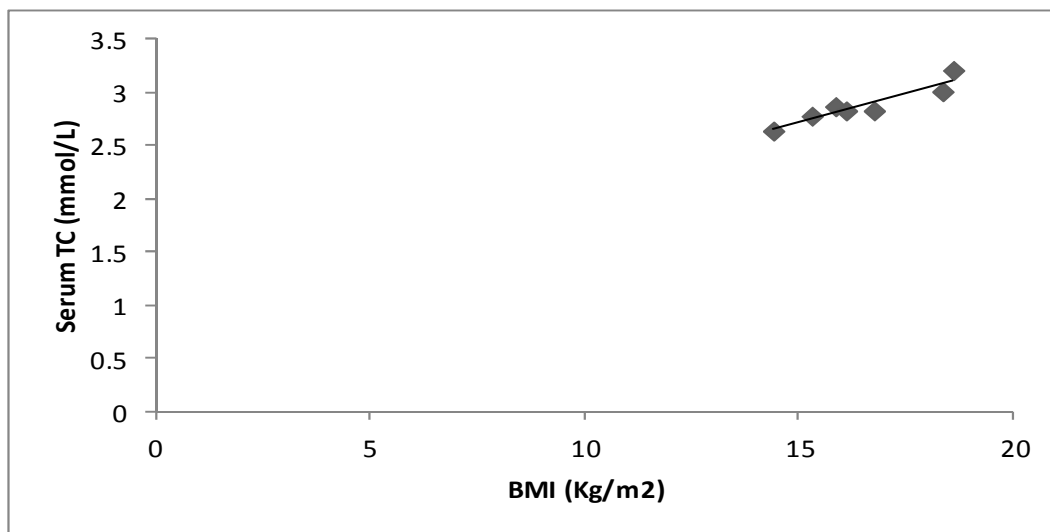
Anthropometric	Serum lipid	Correlation
BMI	TC	0.379113
BMI	HDL-CH	-0.17540
BMI	LDL-CH	0.933869
BMI	TG	0.912557

176 **Table 5. Correlation between age and serum lipids of urban male school going**
177 **adolescents**

Parameter	Serum lipid	Correlation
Age	TC	-0.19688
Age	HDL-CH	-0.09203
Age	LDL-CH	0.759948
Age	TG	0.804373

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179

180 When we plotted the serum lipid concentrations versus BMI, a strong positive correlation
181 was observed with TC, HDL-CH, LDL-CH and TG (Figures 1-4).



182

183 Fig. 1. The relation between BMI and serum TC of rural male adolescent subjects

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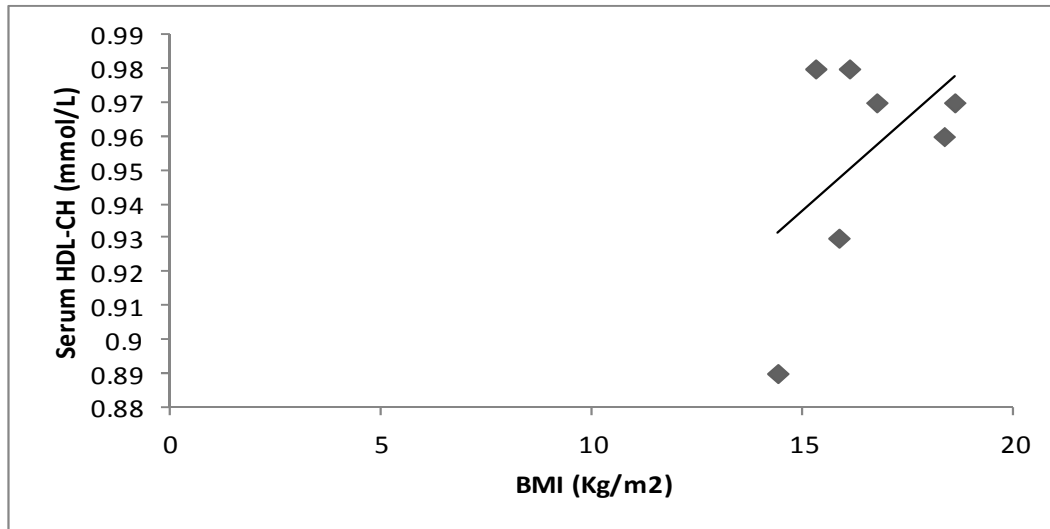
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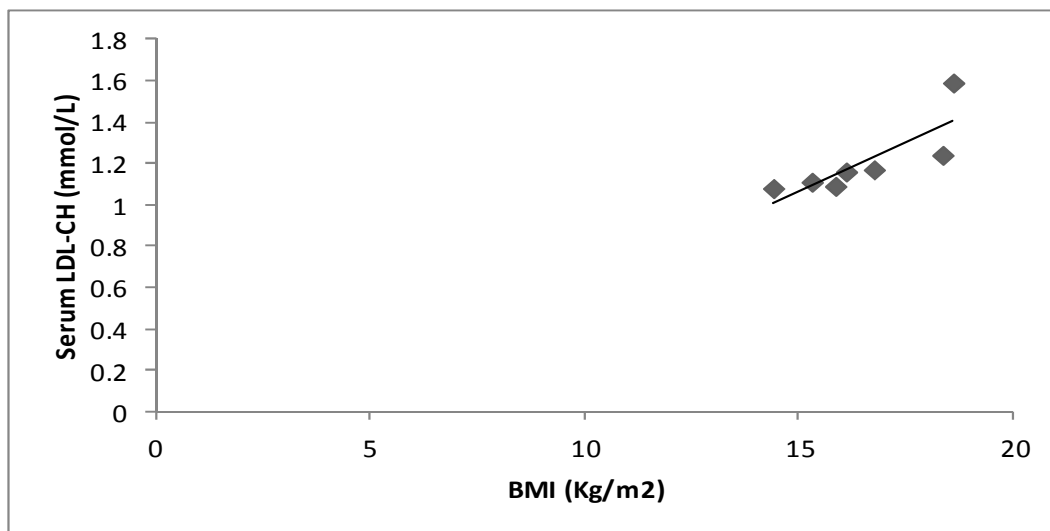
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192 Fig. 2. The relation between BMI and serum HDL-CH of rural male adolescent subjects

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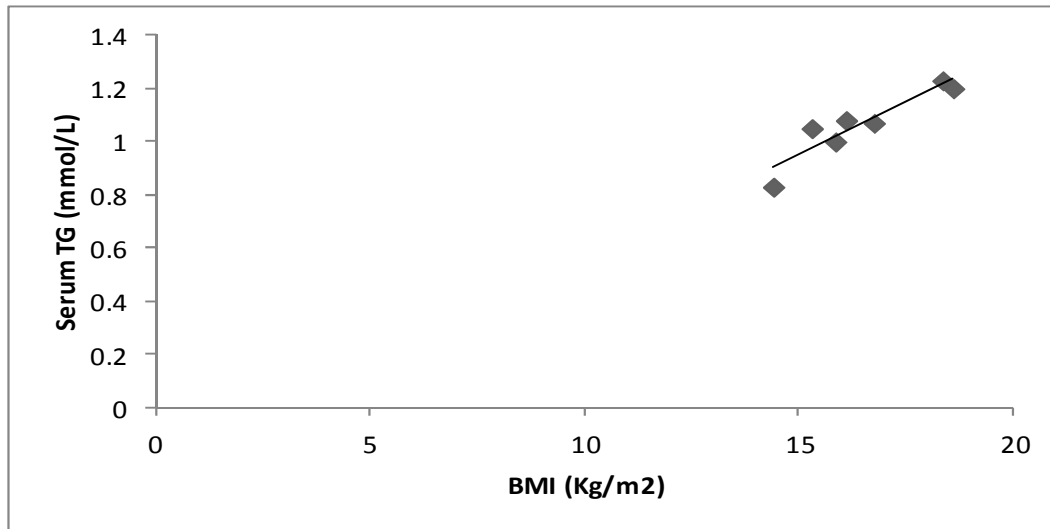
195 Fig. 3. The relation between BMI and serum LDL-CH of rural male adolescent subjects

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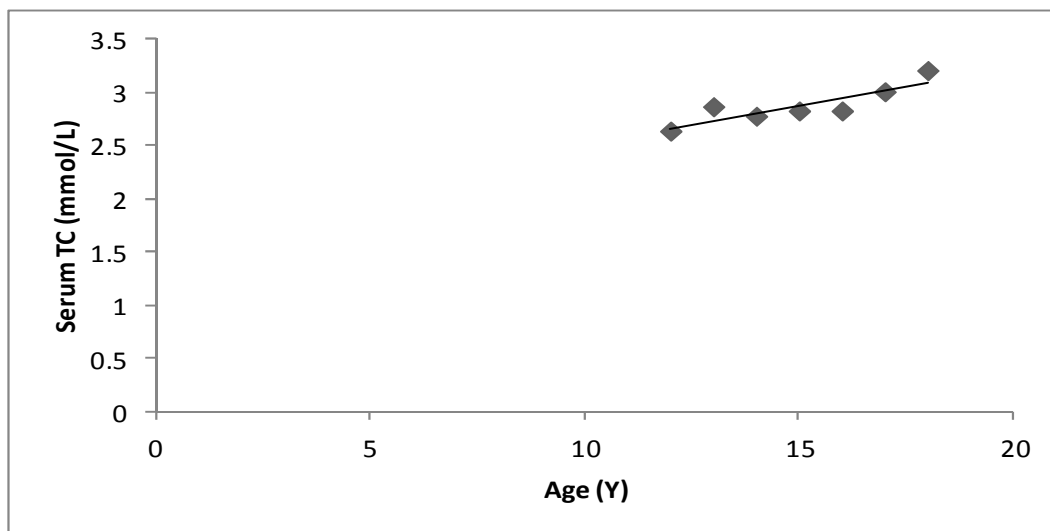
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201 Fig. 4. The relation between BMI and serum TG of rural male adolescent subjects

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204 The plots of all the serum lipid concentrations gave a strong positive correlation with age in
 205 the rural male adolescent subjects (Figures 5-8).



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207 Fig. 5. The relation between Age and serum TC of rural male adolescent subjects

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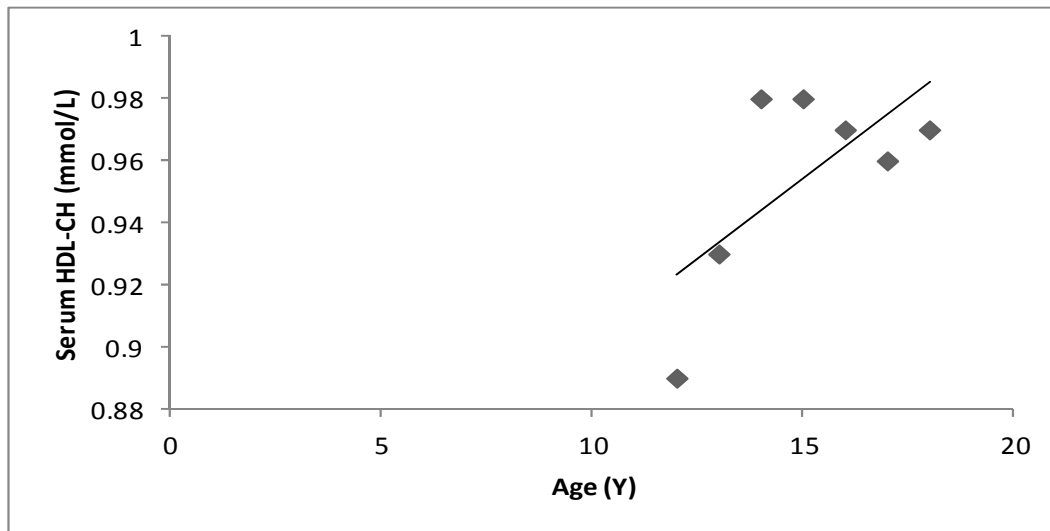
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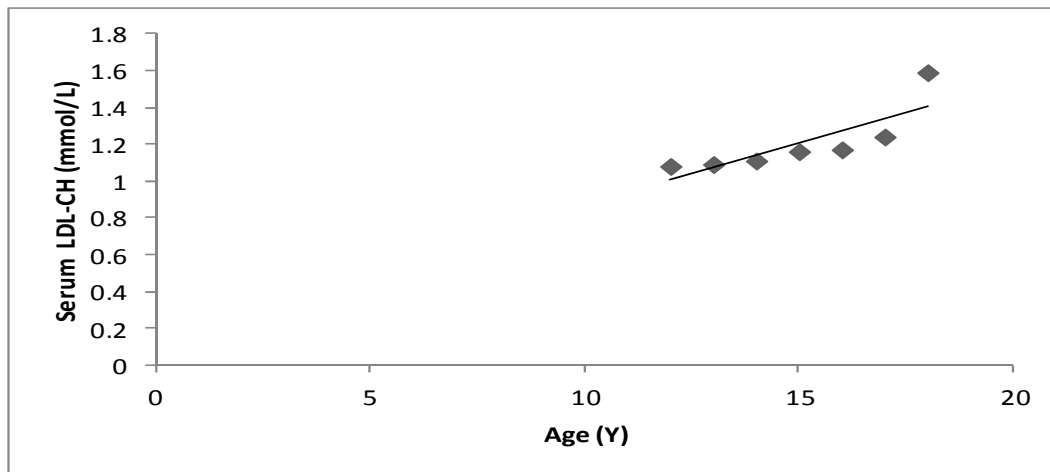
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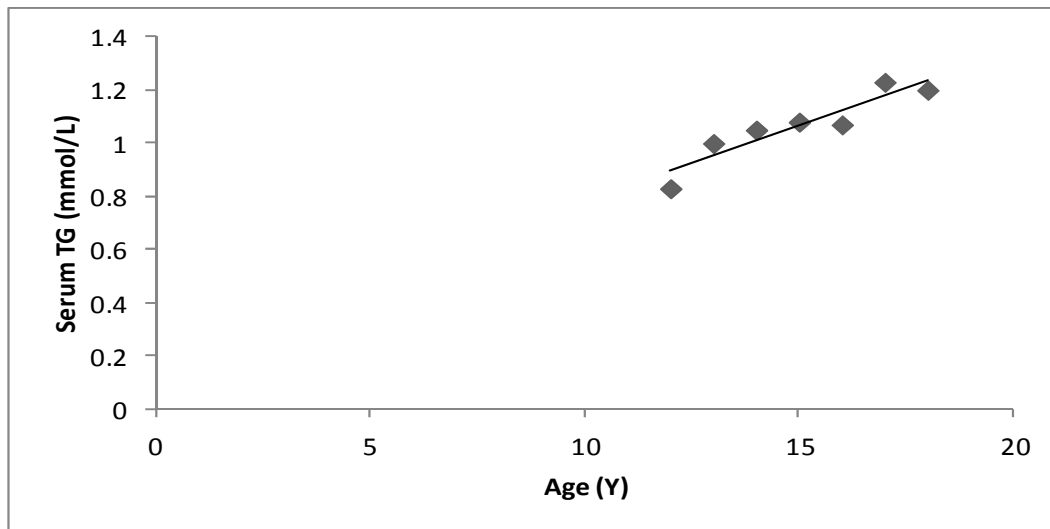
215 Fig. 6. The relation between Age and serum HDL-CH of rural male adolescent subjects
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221 Fig. 7. The relation between Age and serum LDL-CH of rural male adolescent subjects
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236 Fig. 8. The relation between Age and serum TG of rural male adolescent subjects

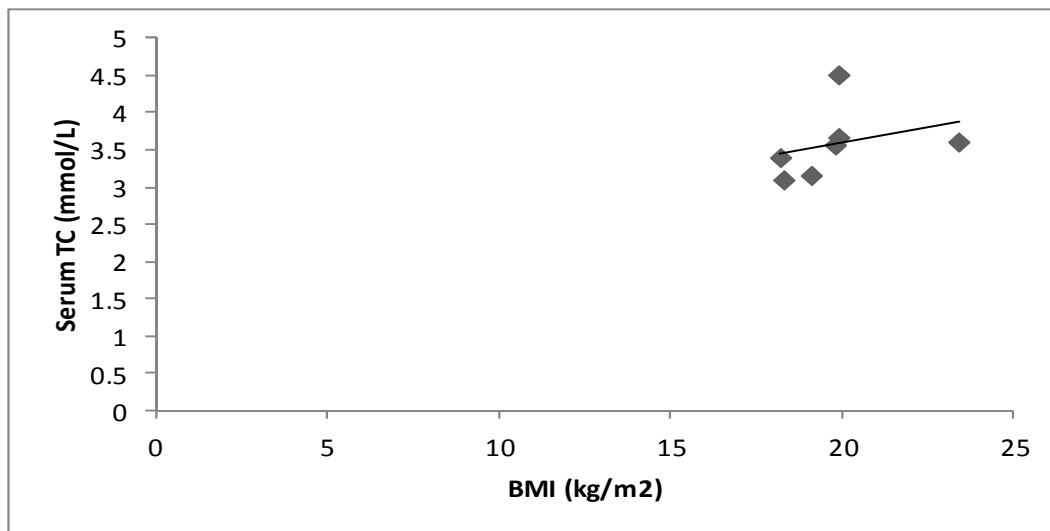
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239 When we plotted the serum TC concentrations of the urban male adolescents versus BMI a

240 weak positive correlation was observed (Figure 9), but with age a negative correlation was

241 observed (Figure 10).



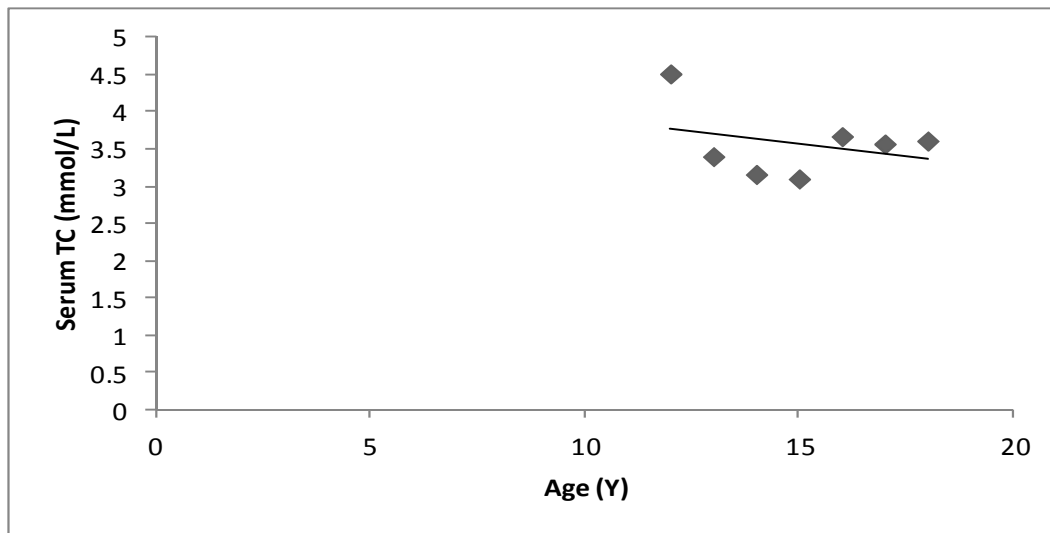
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243 Fig. 9. The relation between BMI and serum TC of urban male adolescent subjects

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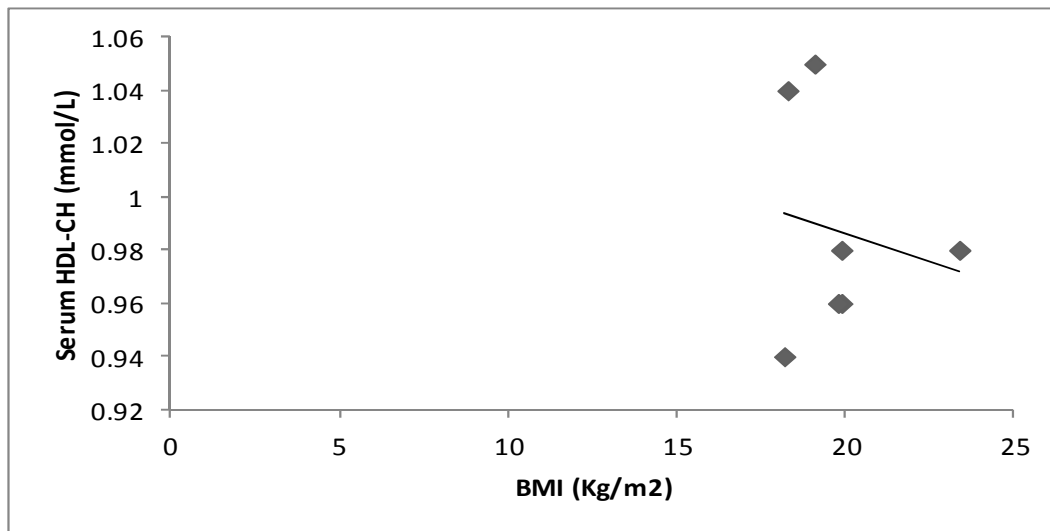
248 Fig. 10. The relation between Age and serum TC of urban male adolescent subjects

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251 The plots of serum HDL-CH versus BMI and age gave a very weak negative correlation

252 (Figures 11 and 12).



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254 Fig. 11. The relation between BMI and serum HDL-CH of urban male adolescent subjects

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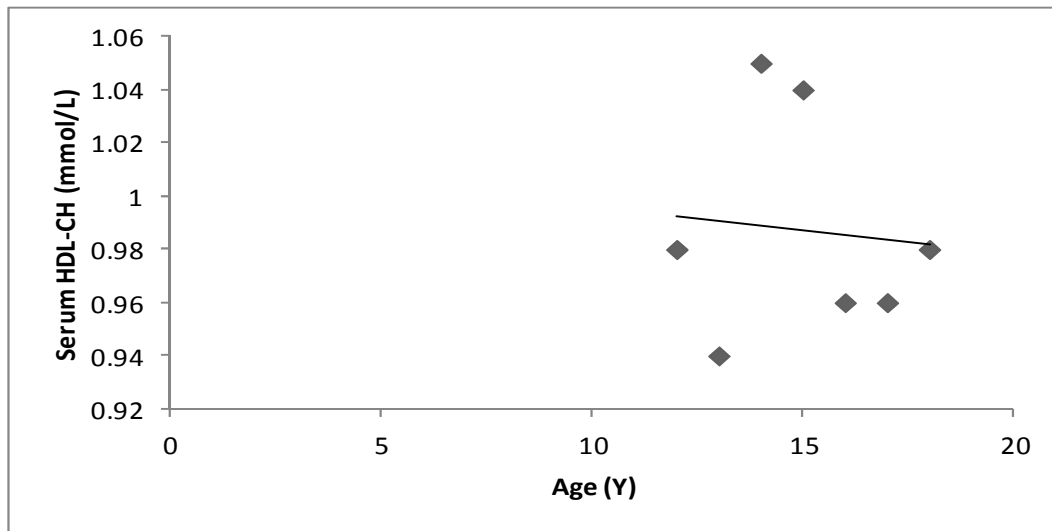
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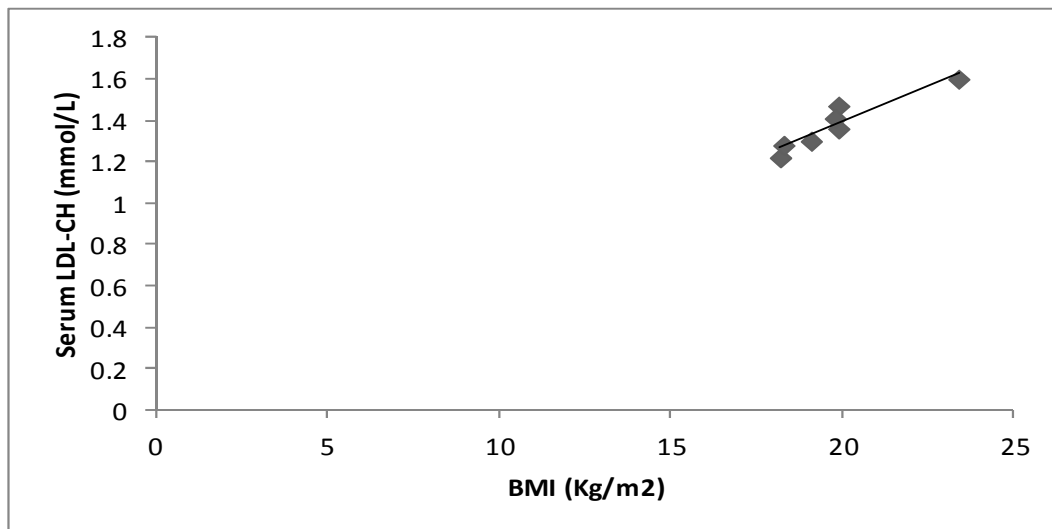
262 Fig. 12. The relation between Age and serum HDL-CH of urban male adolescent subjects

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265 The plots of LDL-CH and TG gave strong positive correlations with BMI and Age (Figures

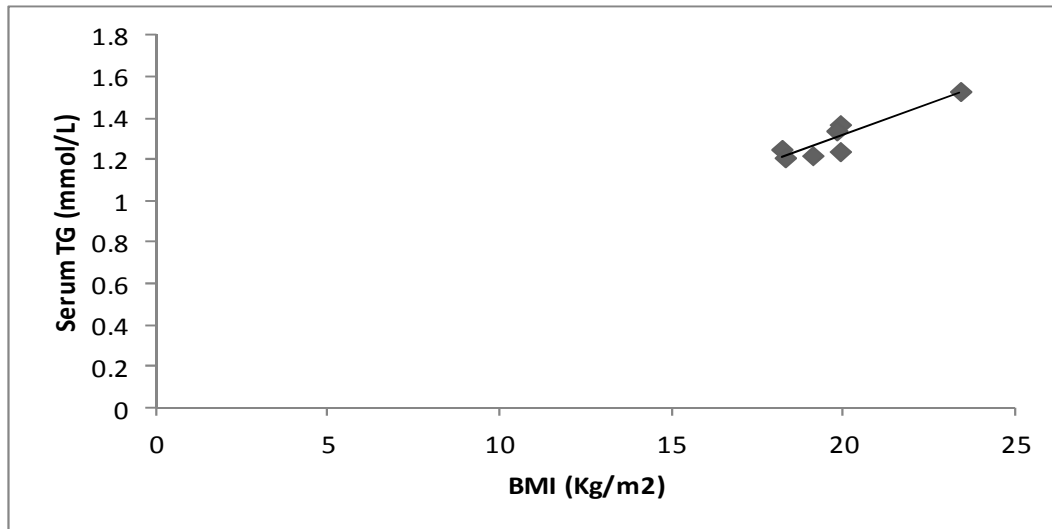
266 13, 14, 15 and 16).



267

268 Fig. 13. The relation between BMI and serum LDL-CH of urban male adolescent subjects

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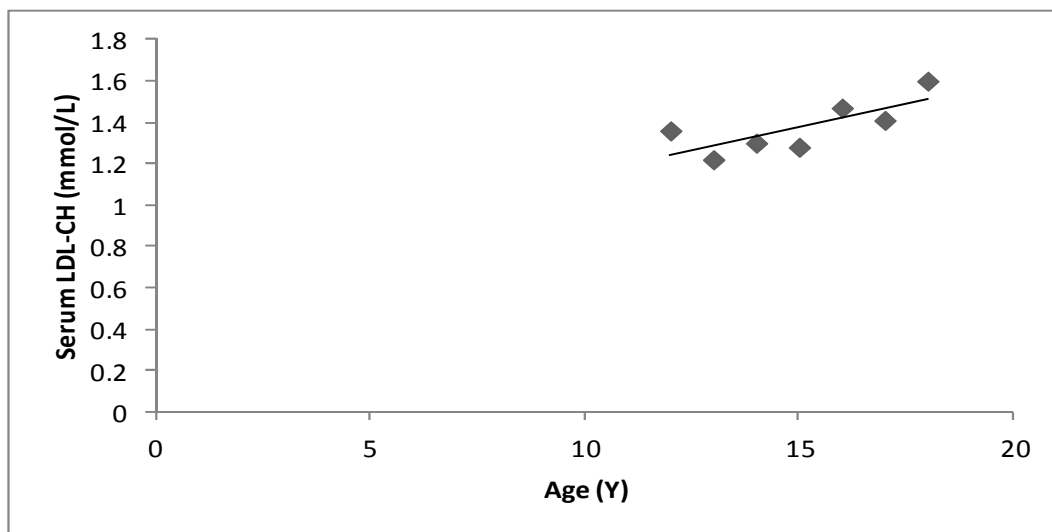
271 Fig. 14. The relation between BMI and serum TG of urban male adolescent subjects

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277 Fig. 15. The relation between Age and serum LDL-CH of urban male adolescent subjects

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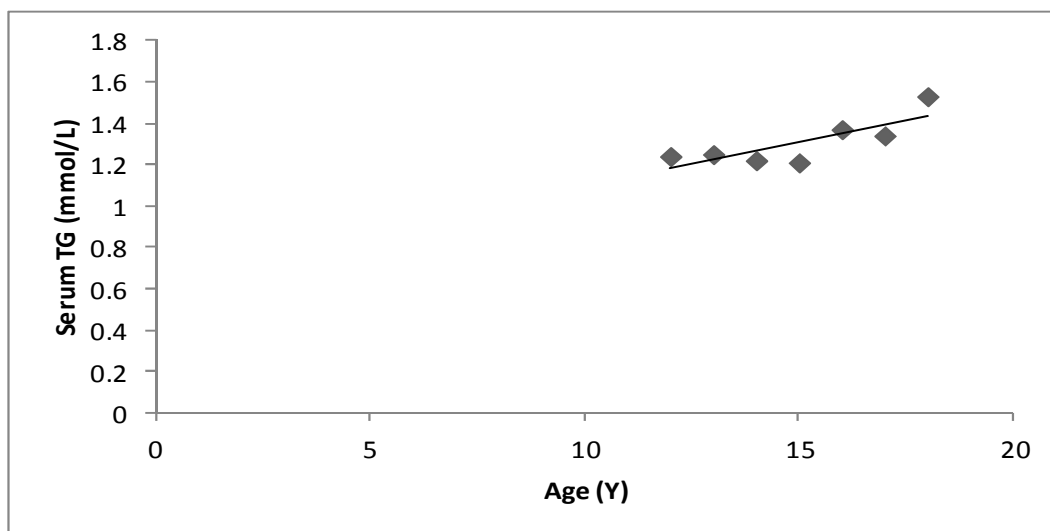
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288 Fig. 16. The relation between Age and serum TG of urban male adolescent subjects

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291 4. DISCUSSION

292

293 The male adolescents in this study were from urban and rural parts of Katsina state northern
 294 Nigeria. Mean BMI values recorded for both the urban and rural male adolescents
 295 correspond to mild thinness on the BMI reference data [11]. The mean BMI for both the
 296 urban and rural male adolescents in this study is in accordance with studies carried out in
 297 other parts of Nigeria [5, 6, 11, 12, 13].

298

299 Adolescents anthropometry has been observed to vary significantly worldwide [14], but the
 300 trend of low anthropometric parameters observed in both urban and rural male adolescents
 301 compared to global standard is similar to what was reported in other parts of Africa [15, 16,
 302 17]. The apparent difference seen in subjects of such studies has been attributed to
 303 malnutrition and recurrent parasitic infections seen in African children [18, 19, 20]. BMI as a
 304 measure of weight relative to height is a chemical 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 [21].

307

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 [22], 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 urban and rural male adolescents obtained in this study fall below the LDL-CH values reported for subjects from Kano, Nigeria [23] and US general population [22] but similar to values reported from Jos plateau, Nigeria [24] and Katsina, Katsina State, Nigeria [6, 25].

315

The low TC levels observed in this study for both the urban and rural male adolescents is in line with observation reported from other states in Nigeria [23, 24, 26].

318

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 urban and rural male adolescents. Although this observation differs from earlier studies carried out in Nigeria [24, 27]. Our findings are in line with several studies which have shown consistent positive independent association between excess body weight and TC levels [28, 29, 30, 31, 32, 33]. 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 [30, 34].

326

Differences in mean BMI and serum lipid levels among the urban and rural male adolescents is a further proof of the effect of life style and dietary habits on serum lipid profile [25, 26]. 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.

332 Although the findings of this study revealed that the male adolescent subjects both from the
333 urban and rural setting had BMI and a lipid profile indicative of low risk cardiovascular
334 diseases, the very low serum cholesterol concentration may likely predispose our subjects to
335 hemorrhagic stroke in the future especially among those who have high blood pressure [35].

336

337 The plots of serum lipid concentrations of our rural male adolescent subjects gave a positive
338 correlation with age and BMI. This is a cause for concern even though at present the BMI
339 and lipid profile for our rural male adolescent subjects is indicative of low risk cardiovascular
340 disease. Our study has revealed that as our rural subjects increase in age so is their BMI.
341 Hence the need for our rural subjects to maintain a healthy BMI range in order to avoid
342 attendant complications associated with cardiovascular diseases in future as our study has
343 revealed a positive correlation between BMI, age and serum lipid concentrations in our rural
344 male adolescent subjects.

345

346 The cross-sectional nature of our study makes generalization of our findings to the entire
347 population difficult. Notwithstanding, the result of this study can be extrapolated to
348 populations with similar socioeconomic attributes. Though our findings are by no mean
349 novel, they confirm previous reports of low prevalence of overweight and obesity among
350 adolescents in Nigeria [5]. The study also confirms low risk cardiovascular diseases in the
351 Hausa/Fulani [6, 23, 24, 25, 26].

352

353 **5. CONCLUSION**

354

355 Although the findings of the study revealed that the male adolescent subjects have a lipid
356 profile indicative of low risk cardiovascular diseases; there is a need to maintain a normal
357 BMI level especially among our rural subjects as our study has revealed a positive
358 correlation between BMI, age and serum lipid concentrations in our rural adolescent

359 subjects. We recommend that a long term progressive study of BMI and lipid profile be
360 conducted to monitor trends in BMI and lipid profile changes across age groups.

361

362 **ETHICAL APPROVAL**

363

364 Authors hereby declare that written permissions were obtained from appropriate authorities
365 and all experiments have been performed in accordance with the ethical standards laid
366 down in the 1964 declaration of Helsinki.

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