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Serum Lipid Profile of Nigerian Children in Urban Lagos

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Summary

Introduction

Hyperlipidaemia is one of the most significant biochemical risk factors associated with Coronary Heart Disease and atherosclerosis which have a long latent periods. Epidemiological, experimental and pathological findings have demonstrated their origins in childhood. Several observations reveal that childhood cholesterol levels "track" into adulthood. Cholesterol tends to maintain rank order so that young children with high cholesterol levels become older children and adults with high cholesterol levels.

Methodology

In a cross-sectional school based study, serum cholesterol and high density lipoprotein (HDL) cholesterol were measured in 357 children aged 6 to 18 years selected from six schools out of 106 schools by multistage random samplings between July 1994 and December 1995. The subjects belonged to five different social classes from Ikeja Local Government Area (LGA) in Lagos State of Nigeria.

Results

There were 150 males and 215 females, a M:F ratio of 1:1.43. The mean age of the subjects was 12.5(±2.88) years. The mean serum cholesterol was 143.55(±2.37) mg/dl and the mean HDL was 57.28(±19.34)mg/dl. The mean cholesterol level adjusted for differences in age and sex was highest in social class 1 with a value of 148.10mg/dl and lowest in social class 5 with a value of 137.10mg/dl. This difference was statistically significant at $P<0.05$.

The HDL values for subjects in social classes 1 and 5 were 53.81 (SD 23.88) mg/dl and 52.87 (SD 12.68) mg/dl respectively ($P=0.83$).

The atherogenic index was highest for social class 1 with a value of 3.62.

Conclusion

Although the present study has shown no significant hyperlipidaemia among the study population, it however points to the need to keep a keen watch on the lipid profile of our children particularly those in upper social classes in order to adopt primordial preventive measures that would check any trend towards accumulation of atherogenic materials in their blood vessels and thereby prevent Coronary Heart Disease among others during adulthood

Key words: Childhood serum cholesterol; High Density Lipoprotein; Atherogenic index.

Introduction

Hyperlipidaemia is one of the most significant biochemical risk factors associated with Coronary Heart Disease (CHD)[1,2]. Atherosclerosis has a long latent period and ante-mortem lipid levels show good correlation with post-mortem atherosclerotic changes[3,4]. Epidemiological, experimental and pathological findings have demonstrated its origin in childhood[5,6]. Several observations reveal that childhood cholesterol levels "track" into adulthood[7-8]. Cholesterol tends to maintain rank order so that young children with high cholesterol levels become older children and adults with high cholesterol levels[9,10].

Coronary Heart Disease was thought to be rare in the black race[11,12]. In more recent communications

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however CHD has been shown to be steadily on the increase and is an important cause of death in some developing countries, particularly among urban middle and upper-income groups who have adopted a life style evidently causally related[13-16]. In Nigeria, the final report of a national survey on non-communicable disease concluded among others, that there is a significant increase in the prevalence of CHD in Nigeria[17].

Some studies[21,22] especially in adults have recorded lower serum lipid levels in Nigerians compared to Caucasians. However, a few publications, have revealed cholesterol levels in a significant percentage of children in high socio-economic groups in Nigeria[19] and other developing countries[20] comparable to those of children in the Western World.

Against this background, the World Health Organisation, (WHO) has advised the need for "primordial prevention" with special attention given to children and adolescents in developing countries [23]. It aims to inculcate healthy habits and modes of living from an early age, in order to check the progression to that seen in developed countries [23]. With changing life styles and adoption of Western dietary habits by some Africans, coupled with the observed appreciable increase in the prevalence of CHD [17], it is important that studies of cardiovascular risk factors should be embarked upon in the young in order to provide objective grounds for "primordial" preventive measures when necessary. The present study is therefore undertaken to provide a database that would assist with the attainment of this objective when it becomes necessary. Thus the study set out to define the total serum cholesterol and HDL cholesterol profiles in the study population. Furthermore it set out to estimate the proportion of children with elevated total serum cholesterol levels (170mg/dl and above) and low HDL levels (30mg/dl and below) [24] in five different social classes in the Ikeja Local Government area of Lagos.

Methodology

A cross-sectional school based study in which serum cholesterol and high density lipoprotein (HDL) cholesterol were measured in three hundred and sixty-seven children aged 6 to 18 years between July 1994 and December 1995. The subjects belonged to five different social classes from six schools within Ikeja Local Government Area (LGA) in Lagos State of Nigeria.

The Ikeja (LGA) is a moderately densely populated part of the state which serves as the state capital. It is one of the largest LGA with a population of 639,762 [25]. The 106 schools (primary and secondary) within the LGA have a population of about 85,000 children which is representative of the ethnic and socio-economic subgroups. A stratified multi-staged sampling method was utilised in selecting the schools and pupils used in this study. A limited number of six schools were used to curtail the high financial cost, a greater number would incur. All participating schools were co-educational and the total population of children in all six selected schools was approximately 10,000.

The required sample size was calculated to be 348 children. However, in order to make allowance for errors in the course of sample collection, storage and analysis, 400 subjects were recruited from whom 400 blood samples were collected.

A questionnaire (previously tested in the pilot study and modified accordingly) was administered to every child in which, among others, social, family and past medical history were documented. Social class was determined from father's occupation and level of mother's education as enumerated by Olusanya et al [26]

Every child had a physical examination after which their heights were measured by standard techniques. The subjects were weighed using a calibrated bathroom weighing scale (to the nearest

0.5kg) which was regularly checked with a standard weight whenever it was moved.

Two millilitres of venous blood was collected into a heparinised bottle from each subject at least 2 hours after a meal. Usually samples were collected before the first school break. The blood was centrifuged within 4 hours of collection at 5000 rpm and the serum stored at -20°C for subsequent processing.

Analytical technique:

Analysis of total and high density lipoprotein (HDL) cholesterol was done within three months, of collection of sample in all cases. The enzymatic method using standard kits, Chronolab for total cholesterol and Boehringer Mannheim for HDL cholesterol[27].

Quality Control:

To ensure precision, the sera with known values were included in every batch of 100 test samples analysed using any one kit. If the same values for the control sera were obtained, then precision was ensured. Otherwise the result was unacceptable and test had to be repeated.

The analysis was carried out in the Research Laboratory of Paediatrics Department of Lagos University Teaching Hospital.

Statistical Analysis:

The EPI Info statistical software was used for data analysis. For categorical variables, frequency distributions were generated. The various measures of central tendency and of dispersion were computed for all quantitative variables. The analysis of variance (ANOVA) technique was used for the comparison of means and the F- statistics was used to evaluate the significance of the differences. Correlation and regression analyses were employed to examine the linear relationship between quantitative variables. Furthermore, the 95% confidence intervals were determined for both the correlation and regression coefficients. The Chi-square test was used for the comparison of proportions, for example, comparison of the proportion of children in each social class with elevated serum total cholesterol.

Results

In all the six schools, where the study was carried out, 415 parental consent letters out of about 2,000 were returned with approval for participation. This was approximately 20% of total number distributed. Exact age and accurate parents' educational background and occupation could not be ascertained in 25 subjects. These were eliminated from the study along with 9 others who failed selection criteria on physical examination. Of these 9 subjects, 5 had acute febrile illness, 3 were known sickle cell disease patients and 1 child had chronic jaundice. A total of 12 children either refused to show up or were absent from school on days of venepuncture in all six schools. Blood samples from twelve subjects were either haemolysed or spilled in storage and were unsuitable for cholesterol and high density lipoprotein analysis.

Data analysis was thus carried out on results from 367 children, with 357 acceptable results of cholesterol or HDL estimation. Twenty-one subjects had one missing variable, either social-class, age, sex, weight or height. Comparison of mean cholesterol value in all study children with those for which information was available on all variables viz - age, sex, weight, height, social class and cholesterol with HDL values yielded F value of 0.90; using analysis of variance. This was not statistically significant. The missing variables thus did not affect the overall results obtained in this study.

Study Population

The ages of the children in the study population ranged between 6 and 18 years with a mean of 12.48 (±2.88) years. There were 152 males and 215 females with a M:F ratio of 1:1.43. On the average,

girls were generally older by a mean value of 0.79yrs ($p < 0.05$). The difference in mean age between boys and girls was statistically significant. Participation amongst the various social classes ranged from 18% to 36%. Social class 3 constituted the largest percentage and social class 5 the least. The actual numbers of subjects from the various classes range from 30 to 114 as follows:- 95 social class 1, 57 social class 2, 114 social class 3, 61 social class 4 and 30 social class 5.

The mean age of the children in social class 3 was the highest at 13.61 (±2.09) years followed by social class 4 at 13.42 (±2.83) years. Social class 1 had the lowest mean age of 11.2 (±2.82) years (Table 1). The differences in mean ages between the various social classes was statistically significant. ($P<0.05$). No association was found between sex and social class in the five different social classes. The sex distribution was proportional within the various social classes.

Table 1

Mean Age of children in the Different Social Class

Social Class	Population (n)	Mean ages in years (Standard Deviation)
1.	95	11.28 (2.8)
2.	57	11.72 (3.09)
3.	114	13.61 (2.3)
4.	61	13.43 (2.8)
5.	30	11.50 (2.6)

P = 0.000001

Overall Age = 12.48 (± 2.8) n = 357

Mean age (males) = 12.00 (± 3.04) n = 144
Mean Age (females) = 12.80 (± 2.72) n = 213

Anthropometric Measurements

The heights ranged from 1.03m to 1.96m for the study population of 367 with a mean of 1.49m (± 0.41). The females were taller 1.50 (±0.13) than males 1.48m (±0.15) (*p< 0.5)*. As shown in Table 2 social class 3 had the highest mean height of 1.53m (± 0.12)m and lowest mean height was from social class 5 at 1.14 (±0.12)m. the difference was statistically significant($p< 0.5$).

Table 2

Anthropometric measurements in school children of different social class in Ikeja LGA

Social Class (n)		Height Mean (I SD)(Metres)	Weight Mean (ISD)	BMI Mean(I SD)
1	95	1.500 (0.133)	42.7 (13.2)	18.5 (3.4)
2	57	1.489 (0.170)	42.0 (15.8)	18.3 (4.2)
3	114	1.532 (0.128)	43.9 (12.1)	18.4 (3.2)
4	61	1.459 (0.154)	39.2 (12.0)	18.2 (5.7)
5	30	1.411 (0 .120)	31.3 (8.1)	15.4 (1.7)

The body mass index (BMI) weight / height x height had a range of 11.02 to 36.31kg/m^2 with a mean of 18.11 (±3.93) kg/m^2 for the entire study population of 367. The mode was at 18.59 kg/m^2 and median was 17.58 kg/m^2. There was an average difference of 1.62 kg/m^2 between boys and girls for BMI. The girls had a higher value of 18.77 (± 4.43) kg/m^2 while the boys had 17.15 (±2.87) kg/m^2. This difference was statistically significant. ($p<0.05$). *It should however be noted that girls were significantly more in number than boys($p<0.05$) and were older ($p>0.05$)*

Distribution of BMI within the social classes revealed a significant difference ($p< 0.05$). Social class 1 had the highest mean BMI with a value of 18.51 (± 3.36) kg/m^2 while social class 5 had the lowest with a mean value of 15.42 (±1.65) kg/m^2.

Distribution of Total Serum Cholesterol And High Density Lipoproteins in the study population.

On the 357 blood samples analyzed, the total cholesterol values ranged from 66mg/dl to 236mg/dl with a mean of 143.55mg/dl (± 2.37mg/dl). The mode and median were both at 140mg/dl. Total serum cholesterol was thus found to have a normal distribution in the study population. Statistical calculation test of normality was positive. The distribution was not skewed.

The range of HDL values were between 12 and 112mg/dl with a mean of 57.28mg/dl (± 19.34). The mode and median were both at the value of 56mg/dl. HDL was thus found to be normally distributed in the study population. The distribution was not skewed.

Relationship between BMI and total serum cholesterol

Evaluation of BMI and total cholesterol revealed no significant linear relationship between the two variables (r = -0.02) 95% confidence limits with a range of -0.13 to 0.08.

Comparison between mean total cholesterol and HDL cholesterol by age, sex and social class

In comparing cholesterol levels between the sexes, the mean values were adjusted for differences in age because of the statistically significant difference in age between male and female in the study population. The adjusted mean cholesterol level between boys and girls was not significantly different from the crude mean cholesterol level. Comparison of mean serum cholesterol concentration of boys and girls in the study population, using either adjusted or crude mean levels, did not reveal any statistically significant gender difference ($p > 0.05$). The crude values were 144.60 (± 26.89) mg/dl and 142.92 (± 26.12)mg/dl for boys and girls respectively while the corresponding adjusted mean values were 144.29mg/dl and 143.16mg/dl.

In comparing cholesterol levels within the various social classes, the mean values were adjusted for differences in age, sex and BMI. This was done to eliminate age as confounding factor in interpretation of the cholesterol values between the sexes; similar measures were taken to eliminate sex and BMI as confounding factors.

The mean cholesterol level adjusted for differences in age, sex and BMI was highest in social class 1 with a value of 148.10md/dl and lowest in social class 5 with a value of 137.10mg/dl. The adjusted mean values were not significantly different from the corresponding crude values of 148.8mg/dl and 137.9mg/dl for classes 1 and 5 respectively. Table 3 shows the crude mean cholesterol level and their SD as well as the adjusted means.

There was no statistically significant difference in the mean value within the various social classes. ($p=0.05$) when compared as a whole. However comparing mean values of class 1 and 5, revealed a significant difference ($p< 0.05$).

Table 3
Social class showing mean crude and mean adjusted cholesterol levels

Social Class	N	Crude Mean	SD	Adjusted Means
1	94	148.8	26.70	148.10
2	56	140.7	27.10	140.03
3	111	145.7	25.05	146.48
4	60	137.9	26.90	138.46
5	31	137.9	25.80	137.10

The mean HDL concentration for boys and girls in the study subjects were 56.17 (± 18.27)mg/dl and 57.70 (±20.25) mg/dl respectively. There was no statistically significant difference ($p>0.05$). The highest value within the social classes was 60.63 mg/dl for social class 3 while the lowest was 52.87 mg/dl for social class 5. This difference was not statistically significant.($p>0.05$). However, comparison of the mean values of HDL for social classes 1 & 5, 53.81 (±23.88)mg/dl and 52.87 (±12.68) respectively, the t-test yielded a value of $p = 0.829$ indicating that there was no statistical significant difference. Table 4 gives a summary of the mean total serum cholesterol and high density lipoprotein cholesterol values for all subjects according to their social class.

Comparison of elevated total cholesterol values between the sexes and social classes.

Elevated total cholesterol level (> 170mg/dl) was found in 52 subjects out of the total of 357 samples, representing 14.6 % of the total population. Of

Table 4 Mean Total Serum Cholesterol and HDL values for school children by social class

Social	(n)	Total Cholesterol (x)g/dl	HDL (x)g/dl
SC1	94	148.79 (SD 26.71)	53.81 (SD 23.88)
SC2	56	140.66 (SD 27.10)	56.46 (SD 18.57)
SC3	111	145.66 (SD 25.05)	60.63 (SD 18.03)
SC4	60	137.90 (SD 26.10)	57.43 (SD 14.78)
SC5	31	137.87 (SD 23.78	52.87 (SD 12.68)

these there were 30 (57.7%) females and 22 (42.3%) males. The male female ratio was (ratio 3:2.2). Relative risk for elevated serum cholesterol for female was 1.03. Table 5 shows the number of subjects in the different Social Classes with elevated cholesterol values and low HDL values (< 30mg/dl).

Table 5 : Prevalence of elevated total serum cholesterol and low HDL levels in the various social classes.

Social Class	1	2	3	4	5	Total
Elevated cholesterol (> 170 g/dl)	15(16%)	7(12.5%)	18(16.2%)	9(15.0 %)	3(9.7%)5	2(14.8%)
Low HDL (< 30 mg/dl)	17(65.4%)	3(11.5%)	4(15.4%)	2(7.7%)	0(0.0%)	26(7.4%)

Social Class 3 had the highest number of subjects 18, (16.2%) with elevated cholesterol. The least number came from Social Class 5 with 3 subject 9.7%.

A chi square analysis however, shows that there was no statistically significant differences in the number of subjects with ***elevated cholesterol*** in the various social classes. A value of 1.16 ($p > 0.05$; 0.884), degree of freedom = 4. In other words, no association was found between the social classes as a group and prevalence of ***elevated cholesterol***. However when the number of subjects with ***elevated cholesterol*** levels in class 1 was compared with those in class 5 in isolation of the other social classes, there was a significant difference ($p<0.05$)

Comparison of low high density lipoprotein values between the sexes & social classes

Of the 357 samples analysed for HDL concentration a total of 26 (7.4%) had *low* HDL levels (< 30mg/dl). Of these, 17 (65.4%) were females and 9 (34.6%) were males. On the basis of social class, the highest number (17) of subjects with *low* HDL was in class 1. This constituted 65.4% of the total number. The *lowest* number of 2 was in class 4 which made up 7.7% of the total number. No subject in class 5 had a *low* level of HDL. (Table 5) When the analysis was subjected to chi square test it yielded 22.64. This was a significant value ($p < 0.05$).

It is note worthy that subjects in social class 1 had the highest mean cholesterol level with a high number of subjects having elevated cholesterol. While their mean HDL levels were among the lowest, social class 1 subjects had the highest number of subjects with low HDL levels. It is thus not surprising that the atherogenic index for class 1 was found to be the highest among the various social classes. Table 6 shows the mean atherogenic indeces for the various social classes.

Table 6 : Social class and Atherogenic Index

Social Classes	Atherogenic index*(cholesterol concentration:HDL concentration)
1	3.62
2	2.85
3	2.66
4	2.53
5	2.69

*Atherogenic index is the ratio of the total serum cholesterol concentration to that of the High density lipoprotein. The normal value is below 3.0.

Discussion

Few studies[19, 20] on serum lipids have focused on social groups and wide population settings within the West African sub-region. These have revealed differences in serum cholesterol concentrations among various social groups within rural and urban populations similar to what the present study has demonstrated.

The growing awareness among adult populations that positive lifestyle changes such as eating less saturated fat, weight shedding, regular exercise and avoidance of cigarette smoking, diminish the risk of CHD has resulted in more attention being focused on prevention. This prevention should begin in childhood especially as serum lipids have been observed to "track" (maintain rank order) [22] into adulthood[9, 19]. More importantly childhood affords the opportunity for teaching and imbibing positive lifestyle early in life. The role of the paediatrician in prevention of CHD will therefore grow to be pivotal especially in regards to primordial prevention, policy formation and implementation.

Relationship between anthropometric Parameters and serum cholesterol:

Although the children in social class 1 had the lowest mean age, they had the highest mean values in all anthropometric indeces. This observation is consistent with that made by Taylor[19]. In the current study, mean BMI and total serum cholesterol were highest in Class 1 and lowest in Class 5. There was however, no strong correlation between body mass index and total cholesterol in all the social classes. Some studies especially in adult have related obesity, body mass index or weight with increased blood lipids [28-30], while other studies have found no strong correlation [31, 32]. In the Bogalusa survey while there was a positive correlation between ponderal index and total serum cholesterol in white children, there was no such correlation in black children[33]. This is similar to the observation made by another study[31] carried out on a multi-racial sample of school children in the United States. In assessing the relationship between BMI and total cholesterol, a statistically significant association between BMI and plasma cholesterol was found among whites and Hispanic children, but not in black children.[31]. The basis for this racial difference is unclear as previously noted [30].

Total Serum Cholesterol Levels

A wide range of 66 mg/dl to 236 mg/dl for total serum cholesterol levels was obtained in the present study. Similar wide ranges have been obtained in previous studies [33,34]. For example, Okoro had a range of 2.85mmol/l (110.01mg/dl) to 5.80mmol/l (223.88g/dl).[34] The Bogalusa study attributed the wide range to differences in age, sex and race[33]. From the present study, it would appear that variation in age and social class also contributed to the wide range obtained. This is indicated by the significant difference in mean total serum cholesterol value between social class 1 and 5 ($p<0.005$). A similar observation has been made in previous studies on Nigerian children [19, 35]. A narrower range of values for total serum cholesterol (117 to 177mg/dl) was obtained in a Pakistani study conducted among a similar age range (5-17 years) as in the present study. Subjects in the Pakistani study were, however, restricted to only children from upper social class, which further strengthens the observation that social class may have contributed to the wide range of values obtained [22].

Mean values

The overall mean total cholesterol level of 143.55mg/dl (± 23.7mg/dl) obtained in this study is similar to the mean value of 148mg/dl (± 25mg/dl) obtained by Taylor in Ibadan. It is however; lower than the mean value of 168mg/dl (± 29mg/dl) obtained by Okoro [34] in Enugu and higher than the 127mg/dl (± 28mg/dl) obtained by Onajobi in Ile-Ife [21]. It would appear at first to be no cause for concern. But the fact that 14.6% of the study population had elevated serum cholesterol (i.e. >170mg/dl), and that about 70% of these belonged to social class 1,2 and 3 would appear to suggest that a significant segment of the children in the upper and upper middle classes are adopting life styles that may be unhealthy in terms of risk for CHD. The mean cholesterol values obtained from the entire study population, as well as that obtained from the selected boys and girls matched for age in the present study, were lower than those obtained in children from the reference studies carried out in the United States. This result is in keeping with the

findings of other workers that the mean cholesterol levels of children in the developing countries are lower than those obtained in children in the Western world [18, 20-22].

Mean cholesterol levels within the social classes

There was no statistically significant difference when mean cholesterol levels were compared within the social classes as a whole ($p = 0.05$). There was however, a statistically significant difference when mean cholesterol values of social class 1 was compared with that of social class 5 ($p<0.005$). The mean level in Social Class 1 children (148.8mg/dl), is well below the mean level (170mg/dl) in the U.S. children. This finding is inconsistent with earlier studies done by Taylor and Okoro et al. In their studies, mean total cholesterol levels in children of upper class were comparable to those of children in the developed countries. Okoro et al found an average cholesterol level of 168mg/dl in their study population while in children of upper social class the mean value was 208mg/dl. In addition to the limitations of comparing studies with non-standardized methods, the differences between the present study and previous studies may be due to the differences in geographic locations and the periods these studies were carried out viz. mid 1990's for the present study and early 1980's for the previous ones. The result of the present study may reflect the relative economic depression of the 90's under the military regimes compared with that of the previous decade. Prior to this era, Nigeria was considered a "rich" third world country following the "oil boom" of the 1970's and early 1980's. The present low mean serum cholesterol, should however, not downplay the necessity of primordial prevention now. Using other parameters, the fact that the children in social class 1 had a mean atherogenic index of 3.6 and statistically significant high number of subjects with low levels (<30mg/dl) of HDL among the various social classes should raise some concern.

Elevated cholesterol levels (>170mg/dl)[24]

The total number of subjects with *elevated* cholesterol was 14.6% of the study population. Again this should raise some concern. Social class 3 had the highest number of subjects with *elevated* cholesterol level. Apart from the fact that this social class also had the highest number of subjects in the study population, no obvious explanation can be given for this observation. There was no association between social class and *elevated cholesterol.*

A study in the United States used an even higher cholesterol value of 200mg for defining elevated levels and found 20.0% of the study population to have elevated cholesterol levels[36]. In this study, only about 3% of the study population had cholesterol values of 200mg/dl and above. *Elevated* levels of total serum cholesterol may not be a sensitive indicator of CHD risk factor especially with the relatively low population means cholesterol levels prevalent in the developing countries. The low-density lipoprotein (LDL) levels may be a more sensitive index of CHD risk factor as other studies have indicated [34, 41]. This has however not been studied in the present communication.

Serum High-density Lipoprotein Levels

The range of HDL values was between 12mg/dl to 112mg/dl; quite a wide range. The overall mean value of 57.28 (±19.34) mg/dl is higher than those of children in the Western world[37] and is in keeping with results from other local workers [19, 38]. Several studies have shown that generally Negroes have higher HDL levels than their Caucasian counterparts [34, 39, 40]. Occurrence of low CHD incidence in black populations has been attributed to the high HDL values [41]. This pattern needs to be maintained in Nigerian children if we have to maintain the relatively low incidence of CHD.

The pattern of mean HDL levels among the social classes contrast with that of total serum cholesterol. Social class 1 had the second lowest mean value. The lowest mean value was obtained in social class 5 while social class 3 had the highest mean HDL

value. There was no statistically significant difference in the values obtained within the social classes ($p>0.05$). This observation differs from that made by Taylor who found higher levels in the upper social class 1. This variation could be attributed to the different methods of social class assessment used in the two studies.

Conclusion

This study has shown a wide range of total serum cholesterol level and HDL levels in the population of school children studied. The mean total serum cholesterol level is comparatively low while the mean HDL level is higher than the average for children in the western world. The results also reveal that children in social class 1 had the highest number of subjects with low HDL and highest atherogenic index. These findings raise questions about the risk for CHD this subset might have in their adult lives if preventive measures are not embarked upon in their childhood.

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