Cardiovascular Risk Factors in School Children from Low Middle Income Families in Karachi, Pakistan

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Abstract

Serum levels of total cholesterol (TC), low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C) and trigly cerides (TG) were determined on 239 school children aged 5-19 years belonging to lower middle class families. The mean TC, LDL-C, HDL-C and TG ranged from 3.70-4.37 mmol/L, 2.17- 2.70 mmol/L, 0.94-1.14 mmol/L, 1.07-1.26 mmol/L respectively. In general, girls had higher TC, LDL-C and HDL-C levels. There was no significant difference in the TG levels between boys and girls. Thirty-three percent of the girls and 22% of the boys had TC level _4.4 mmol/L, the level at which dietary intervention is recommended for children. Fifty-three percent of the girls and 37% of the boys bad TG levels _ than the 90th percentile of the levels for children of similar age and sex in North America. The HDL-C levels were low with 37% of the girls and 44% of boys having values _ the lath percentile of levels for North American children. The mean daily intake of cholesterol ranged from 241 mg to 364 mg/day. Except for the 5-9 year olds, boys had a higher cholesterol intake than girls (P<0.005). Twenty-two percent of the boys and 32% of the girls were overweight but weight status was significantly associated with elevated TC levels only in the boys (P <0.05). Activity level was not significantly related to TC levels but girls who were active had significantly higher HDL-C levels than girls who were sedentary (P <0.02). Family history of cardiovascular disease was significantly associated with elevated cholesterol levels in girls (P <0.05). The results show that the prevalence of cardiovascular risk factors in these school children is relatively high even though they belong to lower middle class families in a developing country (JPMA 44:106, 1994).

Introduction

Based on the concept that atherosclerosis originates as early as the first decade of life, much attention has been focussed on serum lipids in children and adolescents[1]. Earlier reports of serum lipid levels in adults as well as children indicated that hyperlipidemia was not common in developing countries[4,5]. However, the incidence of cardiovascular disease in Pakistan is reported to be increasing sharply and a substantial number of Pakistanis suffer their first heart attack between the relatively young ages of 40-45 years[6]. South East Asians in other parts of the world have also been reported to have a high prevalence of coronary heart diseasae[7,8]. Recent studies conducted at the Aga Khan University have shown that the serum cholesterol levels of the Pakistani population are relatively high. A study conducted in Karachi reports that of the 237 adults studied 32% of the males and 23% of the females aged 20-59 years had serum cholesterol levels _6.2 mmol/L[9]. Badruddin and co-workers[10] studied 388 school children aged 5-19 years and reported a mean serum cholesterol of 4.49 mmol/L for boys and 4.72 mmol/L for girls, the children in this study, all came from relatively affluent homes. The present study was, therefore, undertaken to determine whether the same degree of hypercholesterolaemia prevailed in children from lower middle class families and to determine the role of diet, weight status and physical activity on serum lipid levels. Key findings from the previous study on children from the

upper socio-economic class (mean family income Rs. 15000), are also presented for comparison[10].

Subjects and Methods

Subjects

The subjects included 239 children, 119 males and 120 females aged 5-19 years randomly selected from two elementary and two secondary government schools in Karachi. All children belonged to lower middle class families, with an average income of Rs.2500/month (US$115). The mean family size was eight. Sixty-two percent of the parents had some schooling but only 25% of the parents had finished school whereas 38% of the parents could not read or write.

Biochemistry

Venous blood samples were obtained in neutral tubes after an overnight fast, centrifuged and stored at 4°C. Total cholesterol (TC) and triglycerides (TG) were determined on the serum samples as described earlier[10]. Serum low density lipoprotein cholesterol (LDL-C) and high density lipoprotein cholesterol (HDL-C) were estimated using the Boehringer kit according to the methods of Burstein et al. [11] and Lopes-Virella et al. [12].

Dietary Data

Data regarding dietary habits, physical activity patterns, weight status and family history of hypercholesterolemia and heart disease were obtained on 212 Dietary data were obtained from each subject 10 years of age and above and from the subject and a parent for those aged 5-9 years. The usual serving size and the frequency with which each food was eaten were determined using a pretested questionnaire. Food models were used to help the respondent estimate the usual serving size. Dietary data could not be obtained from 21 children in the 5-9 year group due to the non-availability of the parents for interview. The other 6 children could not be interviewed due to the indefinite closure of the schools after the last day that the interviews were conducted. The average daily intake of cholesterol was calculated using food composition tables[13,14].

Physical Activity Patterns

The children and/or the parents were questioned in detail about the child's involvement in physical activity such as walking, cycling, callisthenics and organized sports as well as house work such as sweeping and mopping floors, washing clothes by hand or working at labour intensive jobs such as construction work after school. Information was obtained about the average duration of such activity periods and the number of times per week they occurred. The child was classified as sedentary, if he or she had less than three 30-mm periods per week of physical activity, moderately active with three to five 30-mm periods per week and active with more than five
30-mm periods per week.

Weight Status

The height and weight of the children were recorded, without shoes but in their school uniforms, at the time they were interviewed. The expected height for age and weight for height was determined for each child based on the NCHS data[15]. The children were classified as being overweight if they were more than 5% above expected body weight for height and stunted if they were less than the 10th percentile of height for age.

Family History

The children and parents were questioned about the presence of heart disease, hypertension or hypercholesterolaemia in blood relatives on both the maternal and paternal side of the family. On the basis of this information the children were classified as follows: (1) no relatives reported to be suffering from any of the above mentioned conditions: no family history; (2) one grand-parent, uncle or aunt afflicted family history and (3) more than one grand-parent, parent or sibling with any of the above

diseases strong family history.

Data Analysis

The students "t" test was used to test differences in serum lipid levels and differences in cholesterol intake between groups. The chi-square test was used to assess the association between serum cholesterol levels and weight status, activity level, family history and type of fats used.

Results

Table I. Mean (±SD) and range of age, height and weight of the school children.

	Boys			Girls		
Years	5-9	10-14	15-19	5-9	10-14	15-19
Number	36	41	42	32	54	34
Age (yrs)	7.2±1.1	12.7±1.2	16.1±1.1	7.8±1.2	12.5±1.3	15.5±2.0
Height (cm)	118.6±7.5	145.8±11.7	164.3±9.2	121.8±10.1	149.6±10.7	156.1±5.8
	105-138	126-174	124-174	104-148	121-170	144-165
Weight (kg)	18.8±3.0	35.8±9.8	52.1±11.3	21.5±5.4	37.1±7.9	54.6±6.8
	13-26	25-68	24-74	15-43	19-60	34-60

Table I shows the mean and ranges for the age, height and weight of the school children. Forty-two percent of the boys were underweight (more than 5% below expected weight for height) as compared to 33% of the girls. Stunting was also more prevalent in the boys, with 41% being below the 10 percentile of expected height for age versus 33% of the girls. In addition 32% of the girls were overweight as compared to 22% of the boys. The percentage of boys who were over weight increased from 3% for the 5-9 year old boys to 37% for the 15-19 year old. Similarly for girls the percentage overweight increased from 22% to 53%. The mean serum cholesterol, LDL cholesterol, HDL cholesterol and triglyceride levels are shown in Table II.

Table II. Serum lipids and lipoprotein cholesterol levels (mmol/L) of the school children.

Age groups	5-9		10-14		15-19	
years	Boys	Girls	Boys	Girls	Boys	Girls
Cholesterol[a]						
Mean±SD	3.89±0.51*	4.37±0.70	3.99±0.71	3.94±1.23	3.70±0.61*	4.18±0.69
Range	2.79-4.94	3.10-6.00	2.69-5.87	2.97-5.40	2.50-4.94	3.02-5.95
LDL-C[a]						
Mean±SD	2.43±0.49**	2.70±0.69	2.46±0.68	2.42±0.54	2.17±0.64*	2.65±0.63
Range	1.52-3.72	1.63-4.45	1.09-4.37	1.34-3.74	1.14-3.39	1.73-4.06
HDL-C[a2]						
Mean±SD	1.11±0.23	1.14±0.24	1.02±0.23*	1.14±0.22	0.94±0.18*	1.09±0.24
Range	0.72-1.68	0.70-1.68	0.62-1.58	0.78-1.89	0.65-1.63	0.72-1.52
Triglycerides[b]						
Mean±SD	1.07±0.41	1.20±0.50	1.21±0.53	1.11±0.38	1.26±0.58	1.20±0.59
Range	0.53-2.19	0.56-2.39	0.44-2.78	0.54-2.31	0.58-3.54	0.47-2.99

*P<0.05 **P<0.005 [a]0.02586 mmol/L = 1 mg/dl [b]0.01129 mmol/L = 1 mg/dl.

The highest mean serum cholesterol value was 4.37 mmol/L for the 5-9 year old girls. As compared to the boys, girls in general had significantly higher serum cholesterol and LDL-C values except for the

10-14 year old girls. There was good association between raised TC and raised LDL-C levels. Out of a total of 239 subjects only 11 children who had total cholesterol levels _4.4 mmol/L had LDL-cholesterol mmol/L and in all but one of these cases the HDL was higher than 1.4 mmol/L whereas the mean HDL-cholesterol level did not exceed 1.14 mmol/L for any age group. The HDL-C values were also significantly higher in the 10-14 year old and 15-19 year old girls as compared to boys of similar age. The lowest serum HDL-C values were observed in the 15-19 year old boys. There were no significant differences in the TG levels between boys and girls in any age group.

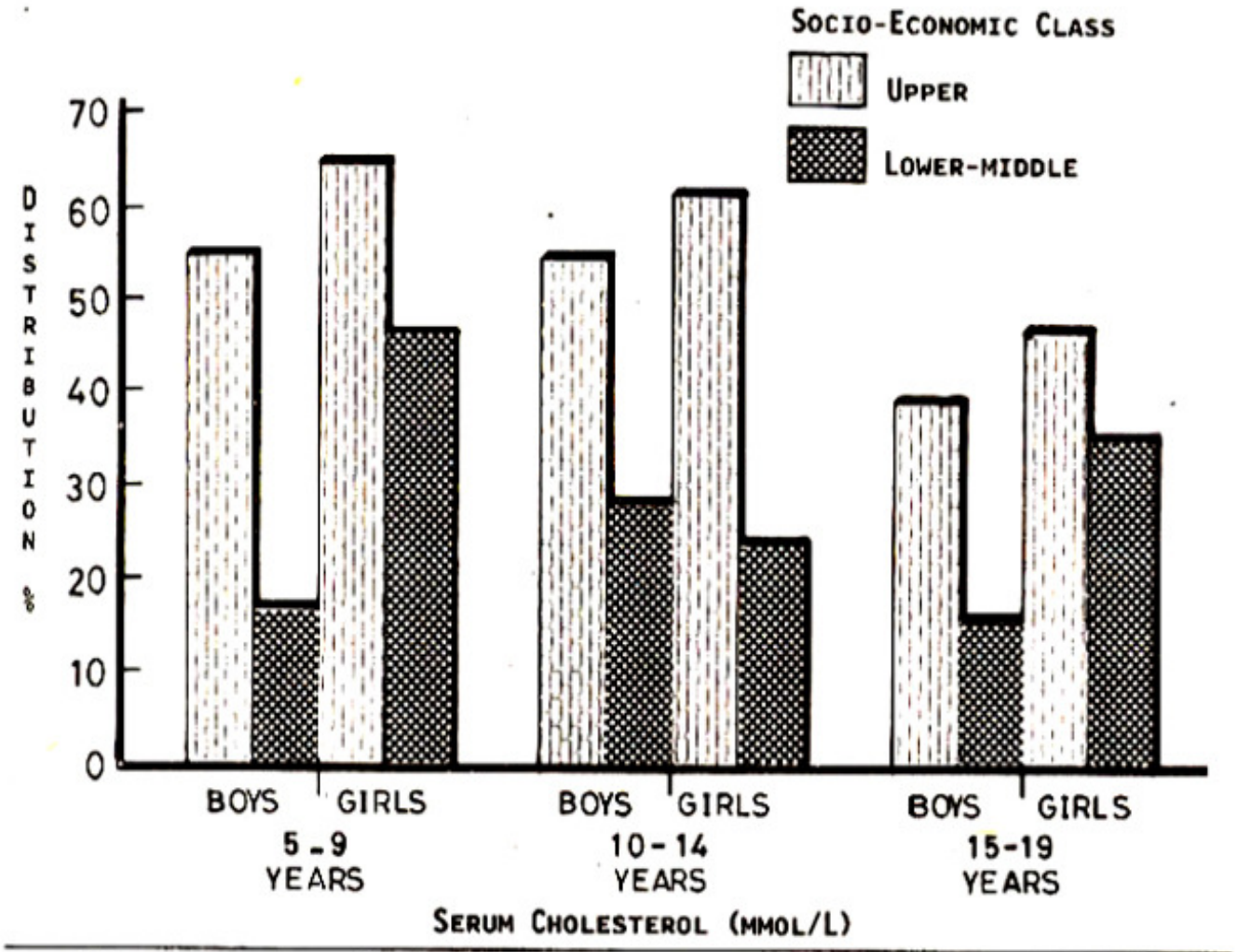

Figure. Percentage distribution of children with serum cholesterol ≥4.4 mmol/L.

Figure, shows the percent of school children from the lower and upper socio-ecoriomic group having serum cholesterol levels _4.4 mmol/L. A comparison of the children across socio-economic groups shows that the percentage of children having elevated serum cholesterol levels was higher for the well to do children for all age groups and this difference was highly significant for the 5-9 and 10-14 year old boys and 10-14 year old girls. The mean cholesterol intake per day of the children for both socio-economic groups is shown in Table III.

Table III. Comparison of mean daily cholesterol intake of school children from different socio-economic classes.

Age years	Cholesterol intake mg/day (mean± SD) Upper socio-economic class	Lower middle class
Boys		
5-9	535.9±159.7*	296.9±134.6
10-14	469.6+173.4*	363.8±152.2**
15-19	541.7±178.2*	318.8±134.3**
Girls		
5-9	486.9±157.1*	343.9±175.6
10-14	463.7±186.1*	275.9±129.8
15-19	410.7±191.5*	240.9±108.8

*P<0.005 Comparisons between socio-economic groups.

**P<0.005 Comparison between sexes

For the children in the lower socio-economic group the intake by the girls decreased with age going from 344 mg/day in the 5-9 year old to 241 mg/day in the 15-19 year old. Only the 5-9 year old girls had cholesterol intakes above 300 mg/day. Whereas, the intake of cholesterol by the boys was close to or above the recommended 300 mg/day. Organ meat such as brain, liver, kidneys made a major contribution to the overall cholesterol intake of these children, although the intake of other animal food was relatively low. The mean cholesterol intake of the well to do children of all ages was above 300 mg/day and for all ages both boys and girls had significantly higher intakes than their less affluent counterparts. In addition, boys had higher cholesterol intakes than girls except for the 5-9 year old boys from the lower middle class. No significant correlation was observed between individual serum cholesterol levels and mean daily cholesterol intakes (r= 0.01). Although the cholesterol intake by the children from the lower socio-economic group was lower than the intake by the children in the upper income group, the saturated fat intake was high since 50% of the families used only saturated fat (ghee) for cooking and another 34% used both ghee and oil (Table IV).

Table IV. Association of elevated cholesterol levels to other cardiovascular risk factors.

	Serum cholesterol mmol/L			
	Boys		Girls	
	<4.4	≥4.4	<4.4	≥4.4
Total number	74	24	76	38
	%		%	
Weight status				
≤Ideal body weight	83	62	69	65
≥5% ideal body	17[a]	38[b]	31	35
Activity level				
Sedentary	26	21	29	13
Moderately active	23	25	45	47
Active	51	54	26	39
Family history of CVD				
Nil	59	43	52	31
Family history	18	17	19	19
Strong family history	18	40	29[c]	50[d]
Type of fat used				
Oil	12	15	22	14
Ghee	49	40	52	51
Both	39	45	26	35

a vs b $P < 0.05$ c vs d $P < 0.05$

Weight status was significantly associated with elevated cholesterol levels in boys, 38% of the boys who had cholesterol levels, _4.4 mmol/L were overweight as compared to 17% of those whose cholesterol levels were below 4.4 mmol/L. No significant relationship between weight status and serum cholesterol levels was observed for the girls. Activity level was not significantly related to total serum cholesterol levels in girls or boys. However, girls who were active had significantly higher HDL-C levels than girls who were sedentary 45.38±10.13 vs 40.07±6.68 mmol/L ($P < 0.02$). Overall, 24% of the boys and 36% of the girls reported a strong family history of cardiovascular disease. A strong family history of cardiovascular disease was significantly associated with elevated cholesterol levels in girls ($P < 0.05$).

Discussion

The anthropometric data indicates that poor nutrient intake during the first five years of life must have been common since 37% of all children were below the 10th percentile of expected height for age. Admittedly genetics plays a role in determining height, however, the standards used for comparison are recommended by WHO for use in developing countries. Secondly, unpublished data from our previous

study[19] show that in the school children from well to do homes, the prevalence of stunting is 15°k when the same standard is used. The caloric intake with respect to requirement appears to increase with age since the percentage of children who are over-weight increases with age from 12.5% for the 5-9 year old to 43% for the 15-19 year old. The TC and LDL-C levels in the lower middle class children were comparable with that of North American children reported by the Lipid Research Clinics (LRC) population studies in the United States and Canada[16]. The acceptable blood cholesterol level in children has been defined as <4.4 mmol/L or LDL that children with total cholesterol over 4.4 in mol/L receive dietary counselling to lower serum cholesterol levels. Twenty-two percent of the boys and 33% of the girls had TC values greater than the 75% percentile (approximately 4.4 mmol/L) for North American children and 5% of the boys and 13% of the girls had TC values greater than the 90th percentile (4.74-5.66 mmol/L) of values reported for American children. The triglyceride levels were high with 37% of the boys and 53% of the girls having TG values _ the 90th percentile (0.96-1.35 mmol/L) for North American children. On the other hand the HDL-C levels were low with 44% of boys and 31% of the girls having MDL- C values 1Oth percentile (0.88-1.03 mmol/L) of American values. Although there are no firm recommendations on measurement of triglycerides for risk assessment or for treatment of hypertriglyceridemia in children, the fact that 45% of the children had triglyceride values above the 90th percentile of values reported for North American children is disturbing. The Framingham data indicates that serum triglycerides are independently predicative of coronary artery disease in people with low serum concentration of HDL cholesterol[19]; raised triglycerides have been reported to be a strong indicator of angiographically assessed coronary artery disease[20] and hypertriglyceridemia has been reported to be strongly associated with an excess of major Q-waves in South Asians[21]. In general it is believed that blood cholesterol levels are lowest in countries in which nutrition is not optimal and growth is retarded[17]. Our results show that inspite of a high prevalence of stunting indicating poor nutritional intake in early childhood, children from lower-middle class families currently have serum cholesterol levels that are similar to those of children in developed countries such as North America. The relatively high serum cholesterol levels seen in this population may be due to a variety of factors. Although these children may have experienced initial nutritional deprivation in the first five years of life, which results in stunting. In this “adapted” state as the child grows older and can fend for himself better, his calorie intake increases often as a result of consuming foods high in fat and calories which may be bought at school. This is evidenced by the fact that 32% of the girls and 22% of the boys were overweight and weight status was associated with elevated cholesterol levels in our study. Secondly, the intake of cholesterol and saturated fats in the form of banaspati ghee is also relatively high in the school age group as shown in our results. Lastly, a genetic component cannot be ruled out as 40% of the boys and 50% of the girls who had elevated serum cholesterol levels reported a strong family history of cardiovascular disease. There was no significant correlation between individual serum cholesterol levels and daily choles¬terol intake, however, data does indicate that groups with lower cholesterol and saturated fat intake have lower serum cholesterol levels. Since the mean serum cholesterol levels and mean cholesterol intake of these children was significantly lower than that reported for children from affluent homes[10]. However, it should be noted that the cholesterol intake by children in the lower socio-economic group was close to the upper limit of intake, i.e., 300 mg/day recommended by the American Heart Association[17]. Other workers have also reported that association between cholesterol intake and serum cholesterol is not readily apparent in school age children but categorical comparisons did indicate that in general, children with high serum cholesterol values showed higher fat intakes than those with the lowest serum cholesterol value[22,23]. It is believed that the weak statistical correlation between cholesterol intake and serum cholesterol level is probably related to individual metabolic variation in sensitivity to dietary intake as well as due to the difficulty of obtaining accurate nutrient intake data[24]. Several studies[25-27] have shown that childhood levels of

serum cholesterol are a good predictor of adult serum cholesterol values and that increases in obesity in youth are adcompanied by an increasingly atherogenic lipoprotein profile. Mortality and morbidity from coronary heart disease have been reported to be higher in people of South Asian (Indian, Pakistani and Bangladeshi) descent settled overseas than in other groups[28]. Although CHD mortality and morbidity data are not available for these South Asian groups in their home countries, the prevalence of major Q-waves was 3.8-4% in two cities in India[29,30]. This suggests that rates in urban India may be as high as in South Asian overseas. Given the prevalence of hypercholesterolemia, hypertriglyceridemia, obesity, sedentary life styles and family history of cardiovascular disease in these children, the incidence of coronary heart disease in Pakistan is bound to increase unless health care providers and policy makers initiate preventive measures to prevent the epidemic of heart disease.

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