Original Article

# The Study of Lipid Profile, Diet and Other Cardiovascular Risk Factors in Children Born to Parents Having Premature Ischemic Heart Disease

**MR Savitha, B Sandeep**

Department of Pediatrics, Mysore Medical College and Research Institute, Mysore, Karnataka, India

## ABSTRACT

**Background:** Dyslipidemia is a marker for ischemic heart disease (IHD), which can be detected in early childhood and tracks to adulthood. Dyslipidemia, along with factors like diet, obesity and sedentary activity, increases the risk of a child developing IHD in adulthood. Early detection and modification of these risk factors can prevent IHD. **Objectives:** To study the lipid profile in children born to parents with history of premature IHD and also to study the effect of diet, lifestyle factors, and obesity in the study group. **Materials and Methods:** Fifty children of parents with premature IHD and 50 control children without any family history of IHD were analyzed for cardiovascular risk factors such as lipid profile, body mass index (BMI) and hypertension. The effects of modifiable risk factors like diet and physical activity on lipid profile were analyzed. The correlation between parent and child lipid profile was studied. **Results:** Mean total cholesterol, low density lipoprotein cholesterol and triglycerides were significantly higher ($P<0.05$) in children with family history of IHD as compared to children without family history. There was a positive correlation between lipid levels of parents and their children. Children with elevated BMI, a sedentary lifestyle, and excess oily/junk diet intake showed increased incidence of dyslipidemia ($P<0.05$). **Conclusions:** Children of IHD patients have significant incidence of dyslipidemia. The risk factors like BMI, diet and physical activity increase the incidence of dyslipidemia. Therefore, all children of premature IHD patients should be screened for dyslipidemia.

**Keywords:** Cardiovascular risk factors, dyslipidemia, ischemic heart disease

## Introduction

World Health Organization (WHO) has drawn to the fact that ischemic heart disease (IHD) is our modern epidemic.[1] Until now, cardiovascular risk factors were more prevalent in the developed countries.[2] However, the World Health Report, 2002 indicates a rise in their prevalence even in the developing countries.[3] According to National Commission on Macroeconomics and Health (NCMH), a government of India undertaking, there would be around 62 million patients with IHD by 2015 in India, and of these, 23 million would be patients younger than 40 years of age.[4] Amongst all risk factors, hyperlipidemia is considered as the major risk factor for IHD. The changes in arteries that precede formation of intimal plaques are present as early as 3–9 years of age and the established risk factors are applicable to children as well as adults.[5-7] Thus, intervention must begin early in life to prevent or delay the onset of atherosclerotic disease. Hence, considering all these factors, the present study was undertaken to study the presence of risk factors for IHD in children born to parents with IHD.

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## Objectives

1. To study the lipid profile and other cardiovascular risk factors in children aged between 5 years and 18 years, born to parents having premature IHD.
2. To study diet and lifestyle factors in the study group having family history of IHD.

**Address for correspondence:**
Dr. MR Savitha, No. 79/A, 4th Main, Maruthi Temple Road, Saraswathipuram, Mysore - 570 009, India. E-mail: drsavithamr@yahoo.com

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## Materials and Methods

The present study was a case control study conducted from May 2008 to August 2008 at Mysore Medical College and Research Institute, Mysore, after obtaining institutional ethical committee clearance. Fifty cases of premature IHD (age <55 years for males, <65 years for females)[8] were selected from Intensive Coronary Care Unit. Their IHD status was obtained from the medical case sheets. Then, their children were included for the study. Sample size calculation was done based on the formula $n=Z \times PQ/d^2$, where Z=1.96, P is incidence of premature IHD which was taken as 6%, q=(1 - P), and $d^2$=95% confidence interval.

### Inclusion criteria

a. Age 5 years – 18 years
b. Parents suffering from premature IHD

### Exclusion criteria

a. Other secondary causes of hyperlipidemia like Cushing's disease, renal disorders, drugs like steroids, beta blockers, diuretics, etc.
b. Patients less than 5 years of age were excluded because 5 years of age is a reasonable age to screen since dietary interventions for those children with hypercholesterolemia can be safely applied at this stage of neurodevelopment.[9]

Controls were selected from the outpatient department and they were normal siblings of sick children, incidentally accompanying mother to outpatient department of pediatrics, and controls were not suffering from cardiovascular disease and were not having any family history of IHD.

### Methodology

All children were assessed based on a predesigned proforma. Nutritional intake was assessed by 24-hour dietary recall method for 2 days.[10] Dietary information (nonvegetarian, kind of fats, oil used as cooking medium, use of extra salt on curds/salad/fruits/vegetable) was noted and data collected were translated into nutritional intake as per the standard information: Nutritional value of Indian food, nutritional values of foods and fat and fatty acid contents of cereals and pulses.[11] More than thrice a week intake of oily/junk food was taken as excess oily or junk food intake.[12] The physical activity of the children was assessed and documented by taking history. Children should accumulate 60 minutes of physical activity each day and teens should do at least 20 minutes of vigorous activity 3 days a week and 30 minutes of moderate activity 5 days a week, otherwise were considered as having sedentary life as per National association for sport and physical education (NASPE).[13] In these children, body mass index (BMI) and blood pressure (BP) were documented. The percentile charts based on gender, age and height provided by Indian Academy of Pediatrics (IAP) were used for classification.[14]

All children underwent evaluation of complete lipid profile using enzymatic colorimetric method, after 12 hours fasting, and after ruling out the causes of secondary hypercholesterolemia.

The cut-off values for abnormal lipid levels were considered according to the National cholesterol education programme (NCEP) guidelines for children.[15] Atherosclerotic index (AI) [total cholesterol (TC)/high density lipoprotein (HDL)] >5 was taken as elevated.

Parent's lipid profile was also evaluated and the cut-off points were noted as per NCEP guidelines Adult treatment panel III (ATP).[16]

### Statistical analysis

Percentages, the arithmetic mean, the standard deviation, Pearson's index and chi-square test were employed using SPSS for Windows software (version 17.0).

A $P$ value < 0.05 was considered statistically significant.

## Results

### Cases and controls

In total, 33 (66%) cases had dyslipidemia when compared to 8 (16%) in controls. Mean levels of TC, low density lipoprotein cholesterol (LDL-C), triglycerides (TG), and AI were higher in children of the affected individuals as compared to controls ($P$ value < 0.001). The levels of HDL cholesterol were lower in cases than controls ($P$<0.001) [Table 1].

### Parent to child correlation

A comparison of lipid profile of children and their corresponding parent showed positive correlation with TC ($r$=0.440, $P$=0.05) and TG levels ($r$=0.444, $P$=0.000), but not with HDL ($r$=0.463, $P$=0.201) levels.

### Socio-demographic profile

#### *Age*

Of the 100 subjects (50 cases and 50 controls), in the 5–10 years age group, there were 6 cases and 2 controls;

**Table 1: The mean values of lipid profile between cases and controls and comparison**

| | Cases | Controls | *P* value |
|---|---|---|---|
| Total cholesterol | 161.88 ± 39.26 | 140.24 ± 17.06 | 0.001 |
| Triglycerides | 121.78 ± 31.47 | 98.64 ± 24.049 | 0.000 |
| HDL | 36.518 ± 4.467 | 40.64 ± 2.039 | 0.000 |
| LDL | 101.02 ± 38.71 | 80.094 ± 19.01 | 0.001 |
| Atherosclerotic index | 4.4743 ± 1.292 | 3.5554 ± 0.815 | 0.000 |

HDL: High density lipoprotein, LDL: Low density lipoprotein

in the 10–15 years age group, there were 9 cases and 14 controls; and in above 15 years age group, there were 35 cases and 34 controls.

The lipid profile amongst cases showed that TC, LDL, and AI were high and HDL was low in the age group of less than 15 years as compared to above 15 years age group.

### *Sex*

There were 15 females and 35 males amongst cases and 16 females and 34 males amongst controls.

In the cases, the boys had higher mean values of TC, Triglyceride, LDL than the girls, and the mean values of HDL of boys was lower than the girls. But however, it was not statistically significant. The AI mean in boys and girls were almost similar.

### *Socioeconomic status*

All the subjects belonged to lower, upper-lower and lower-middle class.[17]

## Family history

Among the cases, 40% had a family history of IHD other than that of parents. They showed higher mean levels of TC and LDL compared to children without family history other than parents ($P$<0.000). The means of AI also were high in children with family history ($P$<0.001) [Table 2].

## Physical activity

Out of 20 cases with a positive family history of IHD, 9 had an active lifestyle and 11 had a sedentary lifestyle. Those children who were physically active had lower mean levels of TC ($P$<0.005), LDL ($P$<0.005) and TG compared to the children with a sedentary lifestyle, whereas the level of HDL was higher in children who were physically active. The mean of AI also was high in sedentary children as compared to the children with an active lifestyle ($P$<0.005).

## Diet

The children with family history of IHD other than that of parents, who had consumed excess oily/junk food, had mean levels of TC ($P$<0.001), LDL ($P$<0.002), TG ($P$<0.05) and AI ($P$<0.002) higher than the children who consumed normal diet.

## BMI

Of the total 50 cases, 14 (28%) had BMI above 85$^{th}$ percentile. The cases had mean BMI higher than that of controls ($P$<0.002) [Table 3]. The cases with family history of IHD other than parents had mean BMI higher than the cases without family history other than parents ($P$<0.05). The cases with family history and with a sedentary lifestyle had mean BMI more than the cases with family history and an active lifestyle ($P$<0.05).

**Table 2: Lipid profile of cases with family history other than parents and without family history other than parents**

| | With multiple family history ($n$=20) | With only parents affected in family ($n$=30) | $P$ value |
|---|---|---|---|
| Total cholesterol | 185.2 ± 47.244 | 146.33 ± 22.739 | 0.000 |
| Triglycerides | 122.85 ± 33.103 | 121.06 ± 30.858 | 0.847 |
| HDL | 36.005 ± 3.679 | 36.86 ± 4.955 | 0.513 |
| LDL | 124.62 ± 44.871 | 85.28 ± 23.909 | 0.000 |
| Atherosclerotic index | 5.1945 ± 1.4777 | 3.9942 ± 0.892 | 0.001 |

HDL: High density lipoprotein, LDL: Low density lipoprotein

**Table 3: BMI of cases and controls, and BMI of cases with various risk factors like family history, lifestyle, diet**

| | BMI | $P$ value |
|---|---|---|
| Cases | 20.754 ± 3.36 | 0.002 |
| Controls | 18.908 ± 2.284 | |
| Cases with multiple family history (FH) | 22.388 ± 3.284 | 0.004 |
| Cases without multiple FH | 19.665 ± 2.982 | |
| Cases with FH with active lifestyle | 20.773 ± 2.931 | 0.043 |
| Cases with FH with sedentary lifestyle | 23.709 ± 3.058 | |
| Cases with FH with normal diet | 21.967 ± 3.294 | 0.601 |
| Cases with FH with oily/junk food diet | 21.055 ± 4.374 | |

There was a positive correlation between BMI and TC ($r$=0.384, $P$=0.006), BMI and LDL ($r$=0.397, $P$=0.000) and BMI and AI ($r$=0.358, $P$=0.001).

## BP

Totally, 9 cases (18%) had pre-hypertension and hypertension in our study. The cases had mean systolic BP higher than that of controls. There was a positive correlation between BMI and systolic BP ($r$=0.330, $P$=0.001), and also between BMI and diastolic BP ($r$=0.353, $P$=0.000).

# Discussion

## Cases and controls, family history

Our study revealed that children of IHD patients have significant incidence of dyslipidemia compared to age-matched controls**.** Among the 50 cases, we observed hypercholesterolemia in 66% children. Similar results were obtained by Gupta *et al*. (44%),[18] Dholpuria *et al*. (50%),[19] and Gulati *et al*. (74%).[20] The pattern of dyslipidemia in our study was similar to the results obtained by Gulati *et al*. Our study has revealed decreased HDL in 45.45% cases. Many studies have shown that high HDL levels are protective against IHD at all ages. Although HDL is a more useful predictor of IHD than TC alone, the ratio of HDL to TC may be even more predictive.[21] AI has been used as a marker of future coronary atherosclerosis.[22] In our study, there was increased AI in 24.24% cases among the dyslipidemic children. This ratio has received limited attention in children.

## Parent to child correlation

There exists a positive correlation between lipid levels of parents and their children in our study. This observation

is consistent with the previous studies.[5-7] Rallidis *et al*.[23] and Parmar *et al*.[24] showed that there was a correlation between lipid levels of parents and their children and the strongest father–offspring correlation was with TC values.

### Age

There was more dyslipidemia in the age group of less than 15 years as compared to the children above 15 years, resembling serum lipid and lipoprotein changes induced by puberty. This result is similar to that reported by Niinikoski *et al*. (The STRIP Study).[25] Androgens may regulate HDL cholesterol concentrations in boys during puberty.

### Sex

Boys had higher prevalence of dyslipidemia than girls in our study (though statistically not significant). Similar increased prevalence of dyslipidemia was observed by Gupta *et al*.[18] Bogalusa heart study[5] and Framingham heart study[7] have also shown that males are more affected.

### Physical activity

In the present study, sedentary lifestyle was found to have an enhancing effect on the BMI and lipid profile. Furthermore, there is evidence that physical activity behavior pattern acquired during childhood and adolescence is likely to be maintained throughout the life span.[26]

### BMI

Our study showed that cases had mean BMI higher than the controls. This result is similar to the results obtained by Csabi *et al*.[27] and Chu *et al*.,[28] who reported the prevalence of two or more cardiovascular risk factors four to five times greater in obese than in non-obese children. BMI shows a strong tracking effect from childhood into young adulthood. Waist-to-hip ratio has been positively correlated with serum cholesterol and LDL as early as 4 years of age.[29] The cases with multiple family histories had mean BMI higher than the cases without multiple family histories in our study. This result is similar to the observations of Gulati *et al*.[20] and Parmar *et al*.[24] Those with a sedentary lifestyle had mean BMI more than those with an active lifestyle. This is in concordance with the result of a study by Singh *et al*. who reported that 54.4% of boys and 69.3% of girls replied as not being engaged in sports at school or at home, and among them 52.8% were obese.[12] A study by Elgar *et al*. has also shown that both sedentary behavior and physical activity in early adolescence influenced BMI in late adolescence.[30]

### Diet

The mean values of TC were higher in cases who consumed excess oily/junk food than those in with normal diet. These results correlate with many other studies. The study results of Dholpuria *et al*.[19] showed that high prevalence of hypercholesterolemia was related mainly to dietary habits of the study children. High saturated fat intake has been shown to be associated with high cholesterol and LDL levels.[31]

### BP

Our study revealed elevated mean systolic BP in cases than in controls. The prevalence of pre-hypertension and hypertension in our study was 18%.

This result is similar to that reported by Gulati *et al*.[20] Family history of hypertension was present in 66.6% of the hyertensives as against 30% of normotensive children, which is not statistically significant. However, family history of hypertension is a well-established risk factor.[32]

There was significant correlation between the BMI and the systolic and diastolic BP, a finding similar to that of other studies. According to Mohan *et al*., the BMI values of hypertensive adolescents in both rural and urban areas were significantly higher than those of the respective normotensive population.[33]

### Socioeconomic status

Our study entirely consisted of children belonging to lower class and lower-middle class, and the results have shown significant dyslipidemia in them.

## Conclusion

We conclude that children in our area belonging to lower class and lower-middle class and born to parents with premature IHD have significant incidence of dyslipidemia compared to age-matched controls. There is a positive correlation between lipid levels of parents with premature IHD and their children. There has been increased incidence of risk factors like obesity, diet, physical activity in these children with dyslipidemia and family history of premature IHD. Therefore, all children of premature IHD patients should be screened for dyslipidemia, so that dietary and lifestyle measures can be instituted at the earliest.

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