Prevalence of modifiable risk factors of coronary heart disease (CHD) in the children with parental history of premature CHD

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INTRODUCTION

Cardiovascular disease (CVD) has become a ubiquitous cause of morbidity and a leading contributor of mortality in most countries[1,2]. Projections based on the Global Burden of Disease Study estimate that by the year 2020, the burden of atherothrombotic cardiovascular disease in India would surpass that in any other region in the world. WHO predicts that India will have 100 million or 60 per cent of world's heart patients[3]. Asian Indians have the highest rate of CHD of any ethnic group[4,5]. Moreover, the nature of the disease among them is often premature, severe and extensive and follows a malignant course[6,7,8]. Atherosclerosis, which is the major pathological component involved, follows a long latent period. Epidemiological, experimental and pathological evidence have demonstrated its origin in childhood[9,10]. Autopsy data have left little doubt regarding the early onset of this pathological process[11,12]. Autopsies conducted in the Bogalusa Heart Study on accident victims aged 3-38 years who had a prior CV risk factor examination demonstrated a strong association of specific ante-mortem risk factor variable with

aortic or coronary atherosclerotic lesion. The extent of atherosclerotic lesions especially in coronary vessels correlated positively and significantly with all the major risk factors of CHD like body mass index (BMI), systolic blood pressure, serum triglyceride levels, total cholesterol (TC) level, low density lipoprotein cholesterol (LDL-C) level and total / high density lipoprotein cholesterol (HDL-C) ratio[13,14]. CHD has long been viewed as related to family history. In Bogalusa Heart Study, observations on the longitudinal changes in CVD risk factors from childhood to young adulthood revealed that offspring of parents with early onset coronary artery disease (CAD) became significantly more overweight starting from puberty. The significant increase in levels of TC, very low-density lipoprotein cholesterol (VLDL-C) and LDL-C was not observed till 18 years. Also these offspring had the highest increase in levels of insulin in the age of 25 to 31 years[15]. Though various international studies are reported on the prevalence of CV risk factors in children with familial history of CHD, there is a paucity of data as far as Indian studies are concerned.

Based on the foregoing evidence it was thought prudent to design a study to assess the prevalence of potentially modifiable risk factors of CHD in the children with established parental history of premature coronary artery disease. This would enable the study of the clustering of risk factors of CHD in a high-risk population who already have the presence of a potential risk factor of the disease i.e. family history. Further, the study would provide us with a fair risk statistics among these high-risk children, adolescents and young adults who will be a part of the adult population during the period when a very high incidence of CHD is predicted in India.

SUBJECTS AND METHODS

This was a hospital based study where for three years patients who had a major intervention for premature CHD were encouraged for family counselling. Those offspring who agreed to comply to this study were included. 102 subjects in the age range of 10 –20 years were studied. Out of them 53 were boys and 49 were girls.

Purposive sampling technique was used where in all the children of parents who have premature CAD and fulfill one of the following criteria were included:

- whose one of the parent or both at 55 years of age or less underwent diagnostic coronary angiography and were found to have coronary atherosclerosis

- whose one of the parent or both have undergone balloon angioplasty or coronary artery bypass graft
- whose one of the parent or both are suffering from documented angina pectoris, myocardial infarction or peripheral vascular disease
- whose one of the parent or both have hyperlipidemia / hypercholesterolemia (cholesterol > 200mg / dl)

The sample however did not include:

- subjects below the age of 10 years or above the age of 20 years
- the married offsprings who have different family life style
- subjects who due to obesity, congenital defects, hormonal problems and/or elevated blood cholesterol were at higher risk of developing premature coronary artery disease but their parents were normal.

Written informed consents were taken from parents or children depending on their age. In order to elicit information regarding the presence of risk factors of CHD and other general information in the subjects and their parents a set of four pretested questionnaires cum interview schedules was developed, pretested and administered. The questionnaire cum interview schedule elicited information in terms of general information like age, educational qualification, gestational age, birth weight, immunization, feeding pattern in infancy, parents disease profile and specific risk factors like obesity, blood pressure, lipid profile, glucose tolerance, dietary profile and lifestyle profile.

DATA ANALYSIS

Standard cut offs from National Cholesterol Education Program (NCEP), American Heart Association (AHA), Indian Council of Medical Research (ICMR), Task Force on Blood Pressure in Children, National Institute of Health (NIH), International Obesity Task Force, FAO/WHO/UNU, Report of the Expert Committee on Diagnosis and Classification of Diabetes Mellitus, Lipid Research Clinic Population Studies Data Book, NIH were used to ascertain risk. The study was conducted at Indraprastha Apollo Hospital, New Delhi.

RESULTS AND DISCUSSION

In the present study, the presence of CHD or dyslipidemia in the parents in all the cases was observed in the fathers. The general information regarding the study population is summarized in Table 1.

Table 1: General information about the subjects (n=102)

Characteristics	Categories	Girls (n=49)	Boys (n=53)
Presence of CHD in parents	● Father ● Mother	49 (100) 0 (0)	53 (100) 0 (0)
Age (years)	● 10-15 ● 15-20	26 (53.1) 23 (46.9)	45 (84.9) 8 (15.1)
Educational qualification	● School ● College ● Working	32 (65.3) 15 (30.6) 2 (4.1)	48 (90.6) 3 (5.7) 2 (3.8)
Monthly family income	● < 10,000 ● 10,000-20,000 ● > 20,000	0 (0) 4 (8.2) 45 (91.8)	0 (0) 2 (3.8) 51 (96.3)
Family structure	● Nuclear ● Extended ● Joint	33 (67.3) 4 (8.2) 12 (24.5)	36 (67.9) 14 (26.4) 3 (5.7)
Religion	● Hindu ● Islam	47 (95.9) 2 (4.1)	50 (94.3) 3 (5.7)
Gestational age	● Premature and weighing <2500gm at birth ● Full term and weighing >2500 gm at birth	7 (14.3) 46 (93.9)	4 (7.5) 48 (90.6)
Immunization	● Complete ● Incomplete	49 (100)	53 (100)
Feeding in infancy	● Exclusive breast feeding ● Both breast feeding and bottle feeding	3 (6.1) 46 (93.9)	5 (9.4) 48 (90.6)

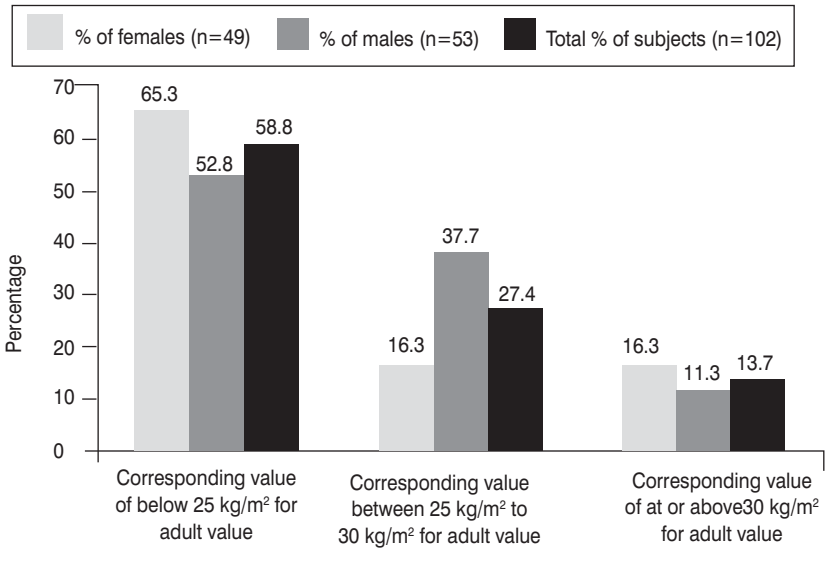
Figures in the parenthesis denotes percentages

CHILDHOOD OBESITY

This was assessed on the basis of cutoff points for BMI for 2-18 years based on international data and linked to the widely accepted adult cut off points of BMI of 25 and 30 kg/m^2 [16]. Any value for BMI for a particular age and sex corresponding to above 25 kg /m^2 and 30 kg/m^2 adult cut off point were considered as overweight and obese respectively.

The prevalence of overweight among the male subjects was more than 2 times higher than females. However, the number of subjects in the obese category was higher in the female group (Figure 1). A total of 41.1 per cent of the sample of boys and girls (n=42) belonged to a category that had their BMI above the acceptable limits. The prevalence of obesity observed in this high risk group was almost double the prevalence rate of 7.4 per cent and same as the prevalence rate of overweight (24.7 per cent) reported in a recent population study of 870 subjects conducted on affluent adolescent children residing in Delhi[17]. A study conducted on 4700 school going adolescents (13-18 years) residing in urban India reported

Figure 1: BMI profile of subjects

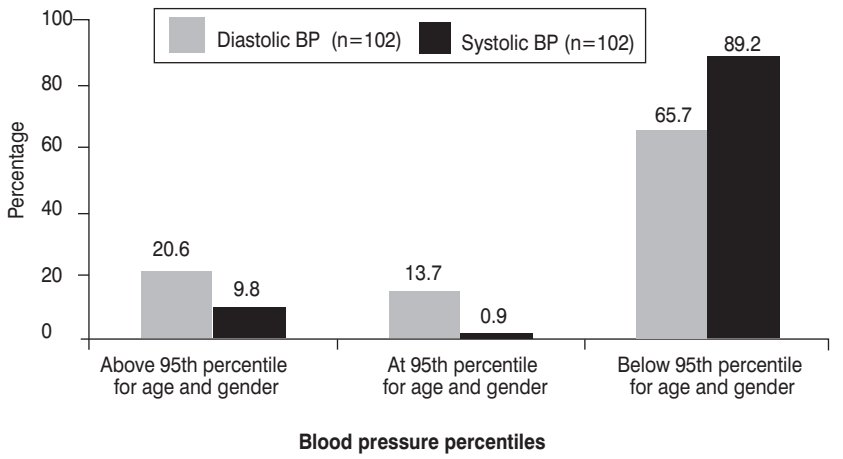


age-adjusted prevalence of overweight to be 17.8 per cent for boys and 15.8 per cent for girls. The prevalence of obesity was 3.6 per cent in boys and 2.7 per cent in girls[18]. This finding of the present study is much in consonance with the findings of the Bogalusa Heart Study which concluded that those children with parental CAD were consistently overweight beginning in their childhood. Further, frank obesity was approximately twice as prevalent in the offspring with parental CAD history as compared to offspring without parental history[15].

CHILDHOOD BLOOD PRESSURE PROFILE

The blood pressure profile was assessed on the basis of cut off points at 95th percentile for age and gender given by task force on blood pressure in children, 1987. The data showed that 7.8 per cent of the subjects (n=8) had both their diastolic and systolic blood pressure above 95th percentile. The diastolic BP of more than a third of the sample population (34.3 per cent) was at or higher than the 95th percentile for age and gender (Figure 2). Such subjects definitely required further evaluation regarding their higher diastolic BP values. The diastolic blood pressure in white males, in Bogalusa Heart Study also seemed to be highly associated with parental CAD[15].

Figure 2: Blood pressure profile of subjects



In the present study, all the children showing higher values of blood pressure also belonged to the category of overweight or obese, which strongly supported the fact that patients with mild elevation of blood pressure are usually overweight. A study by Gupta et al, 1990, reported that mean blood pressure levels, both diastolic and systolic were found to be significantly higher in obese children compared to the controls. Further, similar findings associating childhood obesity with elevated blood pressure has been reported in other studies as well[19,20].

CHILDHOOD LIPID PROFILE AND GLUCOSE TOLERANCE TEST (GTT)

Out of 102 subjects only 27 (26.4 per cent) agreed to have a blood test for their lipid profile and GTT. The data is given in Table 2.

Table 2: Childhood lipid profile of the subjects (n=27)

Characteristics	Categories (NCEP)	Subjects (n=27)
Total Cholesterol (mg/dl)	● <170	20 (74.1)
	● 170-199	4 (14.8)
	● >200	3 (11)
LDL cholesterol (mg/dl)	● <110	25 (92.6)
	● 110-129	0 (0)
	● >130	2 (7.4)
Triglyceride (mg/dl)	● <120	21 (77.8)
	● >120	6 (22.2)

Figures in parenthesis denotes percentages

The prevalence rate of hypercholesterolemia, high LDL-C and hyper triglyceridemia, that were observed in the present study are consistent with the three different studies conducted in the high risk groups in different states of North India[21,22,23]. Since the sample size for estimating lipid profile of the subjects in the present study was also small, it is difficult to draw any major conclusion. However, looking

at the prevalence rate of hypertriglyceridemia (22.2 per cent) in this small sample it gives us a fair idea of the presence of potential risk factor like dyslipidemia in the sample population under study.Though all the subjects who had undergone blood test in the present study (n=27) showed normal results with GTT, however studies on Bogalusa children have shown a distinct effect of parental diabetes on various risk factors of CAD especially GTT, obesity and serum triglycerides[24]. Out of the 27 subjects who agreed to get their blood test done, 12 had parental diabetes (type 2), however none of them had higher values on GTT.

DIETARY PROFILE

The dietary practices of the subjects revealed that majority (58.8 per cent) of the subjects were vegetarians (Table 3) . The meal pattern of the subjects showed that all the subjects consumed 3-6 meals per day with majority of the subjects (40.2 per cent) consuming 4 meals per day. Almost 80 per cent of the subjects reported to eat outside home regularly. Eating in-between meals was reported by

Table 3: Dietary Profile of the subjects (n=102)

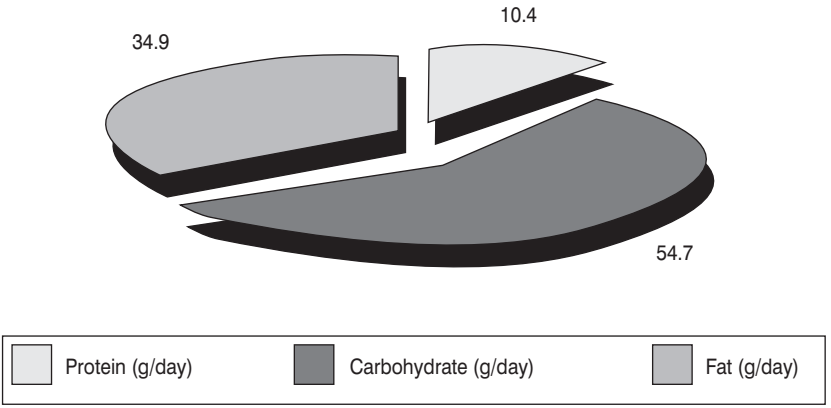
Characteristics	Categories	Subjects
Kind of diet	● Vegetarian	60 (58.8)
	● Ovo-vegetarian	12 (11.8)
	● Non- vegetarian	30 (29.4)
No. of meals per day	● 3	27 (26.5)
	● 4	41 (40.2)
	● 5	26 (25.5)
	● 6	8 (7.9)
Eating in-between meals	● Yes	90 (88.2)
	● No	12 (11.2)
Eating out	● Daily	15 (14.7)
	● More than 3 times a week	67 (65.7)

Table 4: Dietary intake pattern of the subjects		
Food group	**Subjects consuming (n=102)**	**Mean intake/ day**
Milk and milk products (ml)	102 (100)	468± 224
Flesh foods (g)	14 (13.7)	125± 42.7
Eggs (no.)	30 (29.4)	1
Pulse (g)	96 (94.1)	37.4± 14.1
Green leafy vegetables (g)	71 (69.6)	97.9± 51.7
Other vegetables (g)	102 (100)	238± 123
Roots & tubers (g)	84 (82.3)	95± 43.6
Fruits (g)	82 (80.4)	286± 128
Cereals & cereal products (g)	102 (100)	230± 72.5
Sugar and jaggery (g)	102 (100)	40.6± 16.2
Fats and oils (total) (g)	102 (100)	81.1± 21.3
Visible fat	102 (100)	49.3± 17.1
Invisible fat	102(100)	33.1± 12.1

Figures in the parenthesis denote percentages

majority (88.2 per cent) of the subjects. These food items eaten in-between meals were found to be high in sugar and fat content and hence were calorie dense. This lead to consumption of surplus calories. The mean total intake of fat (81.1± 21.3 g per day) in the sample population was quite high (Table 4). About 75 per cent of the subjects exceeded ideal intake of fat according to age and gender[25]. The mean fat en per cent of the population was 34.9± 6.44 (Table 5). The mean fatty acid composition of the diet of the subjects was in the ratio of 2.8: 1.0: 2.0 of SFA: MUFA: PUFA. This was quite inconsistent to the ideal ratio of 1:1:1. Only

Figure 3: En% distribution



9.8 per cent of the subjects were consuming an ideal combination of fats. An over consumption of PUFA rich oils was observed in the families of the subjects. The energy balance study showed that majority of the subjects (68.6 per cent) were in positive energy balance. Though a positive energy balance is desirable for this age group, however, the presence of obesity (13.7 per cent) and overweight (27.4 per cent) in the sample population indicates that the energy balance was more than what was desirable. The mean en per cent for carbohydrate was 54.7$\pm$ 6.54 and that of protein was 10.4$\pm$ 2.03 (Figure 3). The sample population showed a low crude fibre consumption with a mean intake of 7.97$\pm$ 3.85 g per day. The vitamin A and vitamin C intake of the sample population was quite satisfactory. The mean salt (NaCl) intake of the sample population was 9.06$\pm$ 2.42 g per day, which was higher than desirable (Table 5). The dietary intake pattern of the sample population showed lacunae in terms of inadequate intake of pulses and leafy vegetables. The diets were high in hidden sources of fat or invisible fat in the form of full cream milk and eggs as well as visible fat and sugar.

LIFESTYLE PROFILE

The lifestyle pattern of the subjects were assessed in terms of physical activity pattern and also the other aspects of day-to-day lifestyle such as exercise schedule,

Table 5: Nutrient intake of subjects		
Nutrient	**Mean intake**	**En%**
Energy (Kcal / day)	2111 ± 305	–
Protein (g / day)	54.2 ± 12.4	10.4 ± 2.03
Carbohydrate (g / day)	291 ± 71.8	54.7 ± 6.54
Fat (g / day)	81.7 ± 19.9	34.9 ± 6.44
Cholesterol (mg/day)	189 ± 109	–
SFA (g/day)	39.9 ± 13.3	17.0 ± 5.08
MUFA(g/day)	13.4 ± 5.11	5.7 ± 2.80
PUFA(g/day)	28.3 ± 8.69	12.1 ± 3.20
Crude fibre (g / day)	7.97 ± 3.85	–
Vitamin A (µg / day)	1464 ± 932	–
Vitamin C (mg / day)	114 ± 67.7	–
Salt (NaCl) (g / day)	9.06 ± 2.42	–

stress management, drinking and smoking behaviour.

The data on physical activity pattern (Table 6) revealed that a majority (88 per cent) of the subjects showed a preference towards sedentary ways to commute to their educational institutions or work places. Almost 50 per cent of the subjects at home and at educational institution and work place were found to be quite sedentary who took no active part in outdoor games or physical exercise at either places. The rest who took part in such physical activities were involved in active sports like playing football, volleyball, badminton etc. or going for regular exercises like walking, jogging, cycling, dancing, swimming etc. A clear-cut gender difference was observed as girls were found to be more sedentary than boys. This gender difference was also evident in terms of the kind of physical activities performed as well as the level at which these activities were performed. About half of the sample population (52 per cent) reported of engaging themselves in some or the other

Table 6: Time spend on various activities by the subjects (n=102)		
Kind of activity	**Subjects involved (n=102)**	**Average time spend (hours)**
Commuting to school/college/work place	102(100)	0.8±0.5
In school/ college/ work place	102 (100)	6.7±0.5
Active play at home	49 (48)	1.3±0.8
Regular exercise schedule	32 (31.4)	0.8±0.4
Studying	102 (100)	2.8+0.9
TV watching	99 (97.1)	2.5±1.1
Household chores	53 (52)	0.7±0.5
Other sitting activities	87 (85.3)	2.1±1
Sleeping	102 (100)	7.9±1.1

kind of household chores. In this case, females got involved in more of this kind of activites.

Majority (75 per cent) of the subjects were studying for more than 2 hours a day. Almost all the subjects reported regular TV watching with the mean time of 2.5± 1.1 hours spend per day. Majority of the subjects (85.3 per cent) also reported specific sitting activities like chatting with family members, chatting on phone, playing sedentary indoor games like cards and board games, computer games and were spending more than 2 hours in such sedentary activities. Upon analysing this lifestyle profile it was evident that majority of the subjects were spending a substantial part of the day indulging in sedentary activities. Almost 41.2 per cent of the subjects reported to undergo psychosocial stress in some form or other and

accepted the fact that they had a stressful life. Messages regarding methods of coping up with stress and stressful situations were thus incorporated in the module. Only few subjects (n=2) reported to smoke and none reported to consume alcohol. The data on parents profile revealed that some of them (3.4 per cent) were perhaps exposed to passive smoking at home.

PARENT'S DISEASE PROFILE

The data on the parents profile of the subjects revealed that the male population i.e. the fathers in the present study had a mean age of 44.4 $\pm$ 5.4 years. All of them suffered from CHD or dyslipidemia. The age of onset in majority of the cases (93.2 per cent) was below 45, which reflects the present scenario of higher incidence of prematurity of the disease in the Indian population[8]. A majority of them had to undergo some form or the other of interventional procedures in cardiac rehabilitation. More than 50 per cent of the fathers had undergone coronary artery bypass graft (CABG), which is quite a significant number. Other associated risk factors like hypertension, dyslipidemia, and diabetes were found to be significantly high in this population. Thus clustering of most of the potential risk factor of CHD was quite evident in the first-degree relative of the subjects. None of the mothers on the other hand had CHD. However, higher incidence of overweight and obesity (72.7 per cent) and hypertension (25 per cent) was reported in them also. The population of the grandparents had the highest incidence of diabetes (21.6 per cent) as an associated risk factor for CHD. While only 5.7 per cent of the grandparents had a history of CHD yet their sons frankly exhibited the disease. This indicates that other environmental factors interplay much more heavily than family history. Rising trend of CHD clearly indicates that modifiable risk factors are holding primary position in expressing the disease and in case of family event the prognosis of high-risk children is not good.

CLUSTERING OF RISK FACTORS

Upon analyzing the subjects in terms of the frequency of presence of various risk factors this study revealed that apart from the non-modifiable risk factor of family history, which was present in all the subjects, 3.9 per cent of the subjects

(n=4) had none of the other risk factors. Rest of the subjects had the risk factors present in various frequencies. About one fourth (22.5 per cent) of the subjects had presence of one risk factor. Majority of the subjects 48 per cent had presence of two risk factors. 18.6 per cent of the subjects already had presence of three risk factors. About 4.9 per cent of the subjects and 0.98 per cent of the subjects had presence of 4 and 5 risk factors respectively.

CONCLUSION

The study clearly shows the occurrence of modifiable risk factors of CHD in varying degrees in children with genetic predisposition of the disease. Since behavioral and lifestyle pattern learned in childhood tend to continue in adulthood, it seems reasonable to assume that environmental factors leading to the origin of the risk factors of CHD in childhood may continue to play a crucial role in adulthood in precipitating the disease. Though uncertainty exists in terms of prevalence of risk factors in childhood and occurrence of the disease in future, this should however not detract efforts from introducing healthful behaviour in childhood in terms of lifestyle and dietary management to prevent the disease in future.

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