# Clinical and Angiographic Profile of Heart Attacks in Teenage Indians

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**ABSTRACT**

**BACKGROUND**

We wanted to study clinical, social, biochemical and angiographic profile of Indian youth in their teens (13 to 19 yrs. age) with Premature Coronary Artery Disease (PCAD).

**METHODS**

This is a prospective ongoing descriptive observational study of Indians aged below 40 years with Coronary Artery Disease which was started on 1st April, 2017. Of 3450 patients registered in PCAD registry till date, 17 satisfied entry criteria. Entire clinical and angiographic profile of these patients was documented. Conventional lipids were estimated using commercially available kits. The distribution of different lipid profile parameters was visualised by nonparametric density plot. The data was analysed by statistical software R version 3.5.0.

**RESULTS**

17 out of total of 3450 patients (0.6%) registered under PCAD registry belonged to study age group for this particular study. The mean age of all patients under PCAD registry was 18.34 years. 1 patient each was 15 and 16 years old, two and four seventeen-year olds and majority (9) of them were 19 years. Average age of this study group was 18.345 yrs. A majority of 16 (94%) of the patients were males. 8 (47.10%) were smokers. 1 patient (5.8%) was diabetic and 1 patient (5.8%) was hypertensive. 2 (11.7%) had strong family history of premature coronary artery disease. Most common index presentation of coronary artery disease in teenage Indians was with ST elevation myocardial infarction (10 patients – 58.9%), and unstable angina / Non-ST elevation MI (2 patients – 11.7%). 3 patients (17.6%) presented with evolved myocardial infarction, 2 patients (11.6%) presented with spontaneous myocardial infarction. Mean total cholesterol of entire study population was 171.95 ± 47.11, LDL was 116.39 ± 84.81 mg/dL, HDL was 34.50 ± 9.64, TG was 165.18 ± 87.11, non-HDL was 138.09 ± 46.18.

**CONCLUSIONS**

Previous Studies have shown that atherosclerotic plaques or their precursors can be seen in children younger than 10 years (2 – 5). During later life, effect of sedentary lifestyle, coupled with unhealthy nutrition, smoking, alcohol consumption, obesity and family history of cardiovascular disease accelerates atherosclerotic disease. The problem in India is the incomplete detection, treatment, and control of CAD risk factors. Larger sample population studies are needed to draw population specific cut-off values for risk factors and to discover novel risk factors.

**KEYWORDS**

Premature Coronary Artery Disease, Prospective Observational Study, Teen-Age

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## BACKGROUND

Atherosclerosis is a chronic inflammatory condition which starts from young age itself [1] and depends on many factors; the most important one is dyslipoproteinaemia i.e. lipid metabolism disturbance. Studies have shown that atherosclerotic plaques or their precursors could be seen in children younger than 10 years.[2] During later life, effect of sedentary lifestyle, coupled with unhealthy nutrition, smoking, alcohol consumption, obesity and family history of cardiovascular disease accelerates atherosclerotic disease. Atherosclerosis is a prerequisite for different diseases like acute myocardial infarction, stroke, peripheral vascular disease and many others.

Premature coronary artery disease (PCAD) by definition occurs at a younger age (before the age of 55 years in men and 65 years in women).[3] In its severe form, PCAD occurs below the age of 40 years.[4] Cardiovascular disease (CVD) is the leading cause (28%) of death in India.[5] The annual CVD mortality in India was predicted to rise to 4.77 million[6] making India the CVD capital of the world by 2020. The risk of coronary artery disease (CAD) in Asian Indians is 4 times Caucasians, 6 times Chinese, and 20 times Japanese.[7] Indians are prone to CAD at a much younger age.[8] Approximately 50% of first heart attacks occur before 55 years and 25% occur before 40 years of age.[9]

Obesity is also an independent risk factor for the development of dyslipidaemia, hypertension, and thus cardiovascular disease in later life.

In another study [10] of Prevalence of coronary heart disease risk factors in boys 95 boys, 8 to 12 years of age, were subjected to a comprehensive medical and physiologic evaluation in an effort to identify the extent to which coronary heart disease risk factors are manifest in a population of young boys. The prevalence of hypertension was extremely low. However, 13% of the population were considered obese, 20% and 8%, respectively, demonstrated elevated serum cholesterol (> 200 mg per 100 mL) and triglyceride (> 100 mg per 100 mL) values, and 34% identified at least one blood relative with a myocardial infarction at or before the age of 60 years. Of the total group, 36% exhibited no risk factors, 46% had one, and 14% had two or more.

All these facts highlight the fact that the foundation or the nidus for future CAD starts from as early as 8 to 12 years. This point reiterates the fact that 'You are never too young to start a Heart Healthy lifestyle'. Also, the problem in India is the incomplete detection, treatment, and control of CAD risk factors.

The non-availability of population-specific normal ranges and guidelines for various risk factors such as low-density lipoprotein-cholesterol (LDL-C) hampers treatment. The result is that treatment of the risk factor is denied. Once the guidelines for cut-off values for Asians for the two sexes are available, a true picture of the prevalence of these risk factors in this population will be available. Appropriate guidelines for identifying and treating an individual at risk of developing CAD could then be established. Thus, we conducted a study to determine clinical, social, biochemical and angiographic profile of teen age (13 to 19 years age) Indian youth with premature coronary artery disease.

## METHODS

This is a prospective multicentre descriptive observational study examining a cohort of young Indian adults aged ≤40 years with CAD from the point of index admission between April 2017 and April 2020. This is registered under the Clinical Trials Registry of India (CTRI/2018/03/012544). The present sub-study of the registry included patients aged 13 to 19 years with ischemic heart disease, as proven by (1) Documented episode of acute coronary syndrome and (2) Chronic stable angina with documented evidence of CAD were included in the study. The patients were excluded (1) with myocarditis, cardiomyopathies, and pulmonary embolism; (2) who previously diagnosed case of CAD or on medications such as antiplatelets and statins; and (3) with chronic kidney disease, liver failure, consumption of oral contraceptives, and steroids.

Once admitted into the hospital, patients who satisfied the entry criteria for age group were selected. Demographic factors like age, gender, socioeconomic factors like occupation, income, marital history, religion. Risk factor profile like presence of smoking, diabetes, hypertension, family history were all recorded.

Presentation to hospital, window period from onset of symptoms to arrival in hospital, primary method of management, course in hospital, and echo on admission were all documented. Biochemical and haematological profile was documented. About 5 mL of patients' venous blood sample was collected in plain vacutainers even before the first dose of cardiac drugs were administered and sent for assessment. The blood was subjected to centrifugation at 3500 rpm for 10 min, and the separated serum was used for the estimation of routine lipid profile. Total cholesterol and triglycerides (TGs) were estimated using commercially available kits (Accurex Biomedical Pvt. Ltd., Mumbai, Maharashtra, India). Measurement of direct LDL-C was done by enzymatic homogeneous colorimetric assay using Cobas Gen3. C502 analyser. Coronary angiographic profile and mode of intervention (if any) were all documented.

### Statistical Analysis

The categorical variables were summarized by count and percentage, while continuous variables were tabulated by descriptive statistics such as mean, median, standard deviation (SD), interquartile range, minimum, and maximum. Some extreme values of lipid profile were excluded (above the 99th percentile) to prevent the data from asymmetric shape. The data were analysed by R statistical analysis and computing language version 3.5.1 (R core team, 2018) which is released under the GNU General Public License (GPL), version 2, published by the Free Software Foundation.

## RESULTS

A total of 3450 patients were registered under the PCAD registry (2017-2020), of which a total of 17 patients (0.49%) belonged to the proposed study age group (13 – 19 years). 1 patient each was 15 and 16 years old, two and four seventeen-year olds and majority of 9 of them were 19 years (Figure 1). Mean age of this study group was 18.35 ± 1.28 years. Six patients (35%) were from rural side, 8 patients were from within city, 7 from surrounding districts, and 2 were from other states in north India. Most of the patients (64.7%) were students.

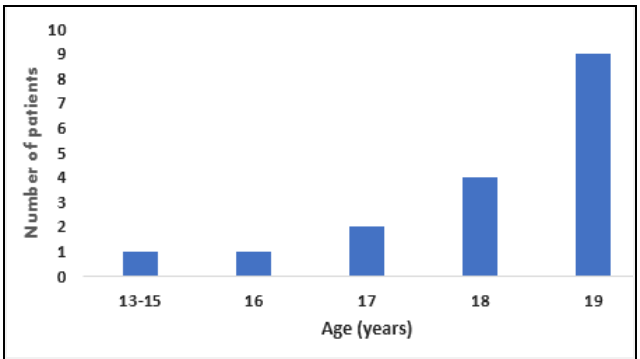


***Figure 1. Age Distribution of Patients***

Mean total cholesterol was 147.3 ± 28.2, mean HDL cholesterol was 34.2 ± 6.3, mean LDL cholesterol was 96.25 ± 28.3, and mean triglyceride was 164 ± 67.5. None of the patients had elevated total cholesterol levels, 3 had borderline and 1 patient (5.8%) had elevated LDL cholesterol, 7 patients (41.7%) had low HDL cholesterol levels. And 6 patients (35.2%) had elevated triglyceride levels (Figure 2). Most common index presentation of coronary artery disease in teenage Indians was with ST elevation myocardial infarction (10 patients – 58.9%), and Unstable angina/ Non-ST elevation MI (2 patients – 11.7%). Three patients (17.6%) presented with Evolved myocardial infarction, 2 patients (11.6%) presented with spontaneous myocardial infarction. Window period from onset of symptoms to presentation to hospital was within 3 hrs in 4 patients (23.5%), between 3 to 6 hours in 3 patients (17.6%), between 6 to 12 hours in 8 patients (47%) and more than 12 hours in 2 patients (11.7%).

| Parameters | Patients (n = 17) |
|---|---|
| Age, (Mean ± SD, years) | 18.35 ± 1.28 |
| Male, n (%) | 16 (94.11%) |
| Diabetes, n (%) | 1 (5.80%) |
| Hypertension, n (%) | 1 (5.80%) |
| Family History, n (%) | 2 (11.76%) |
| Smoking, n (%) | 8 (47.05%) |
| Alcohol, n (%) | 1 (5.80%) |
| Obesity, n (%) | 1 (5.80%) |

***Table 1. Risk Factor Profile of Patients***

| Management | Patients |
|---|---|
| Medical management | 15 (88.23%) |
| Anticoagulation | 1 (5.88%) |
| Death | 1 (5.88%) |
| PCI | 0 (0.00%) |
| CABG | 0 (0.00%) |

***Table 2. Ultimate Mode of Management of PCAD***

Physical parameters showed that 9 patients (53%) had normal BMI, while 3 patients (17.6%) had high BMI (2 overweight, 1 obese), 5 patients (30%) had BMI which according to the revised BMI classification for south Asian Indians comes under the category of overweight. Going by waist-hip ratio definition, 13 patients (76.4%) had abdominal obesity. Haemoglobin estimation showed 11.5% had anaemia, while 23.5% had polycythaemia, and remaining 65% had normal haemoglobin levels.

Eleven patients (64.7%) were coming under the below poverty line category, while 1 was covered under Scheduled Caste and Scheduled Tribes scheme and remaining 5 patients were under the general category. Majority of patients 11 (64.7%) belonged to Hindu community, while 5 (29.4%) belonged to Muslim and 1 (5.9%) belonged to Christian community.

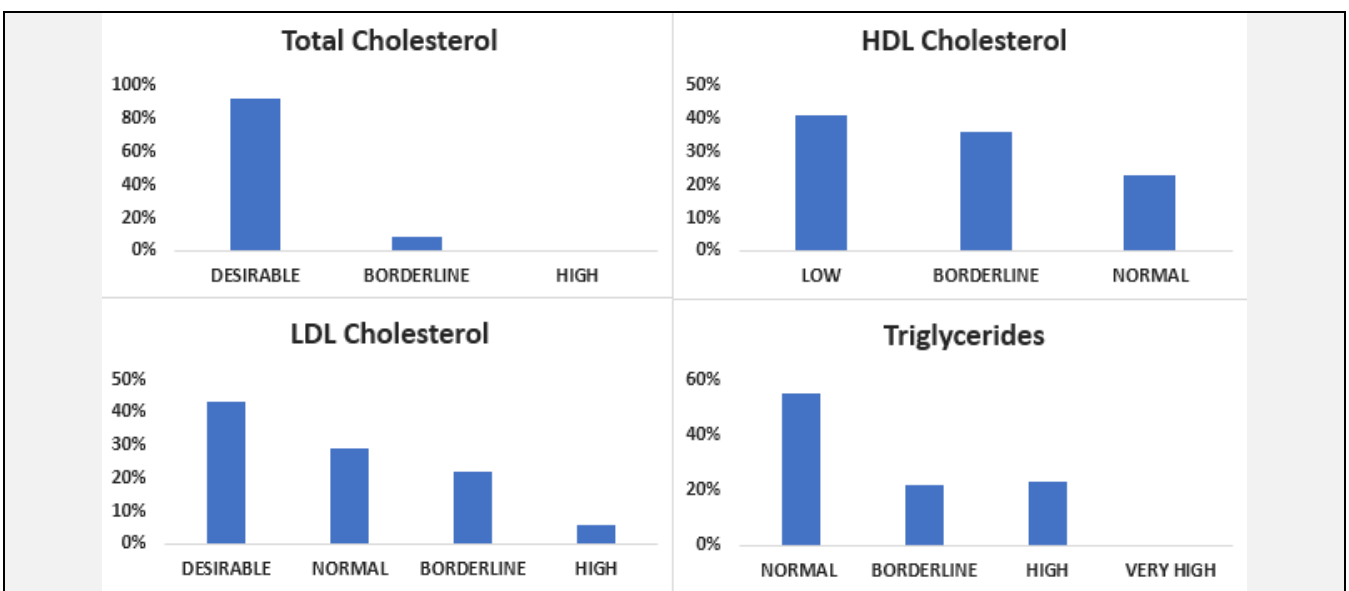


***Figure 2. Distribution of Conventional Lipid Parameters***

A majority of 16 (94.1%) of the patients were males. 8 (47.1%) were smokers. Duration of smoking was less than one year in 6 patients (75% of smokers) and 2 years duration in remaining 2 smokers. A patient (5.8%) was diabetic and 1 (5.8%) was hypertensive. 2 (11.7%) had strong family history of premature coronary artery disease (Table 1).

Among patients presenting with STEMI 66.6% were thrombolysed with streptokinase, while 33.3% were thrombolysed with Tenecteplase. Coronary angiogram was done for 13 patients (76%), among which 8 (61.5%) showed recanalised coronary arteries, 2 patients (15.5%) showed normal arteries, 3 patients (23%) showed single vessel disease of which 2 were not hemodynamically significant while 1 patient showed thrombus in one vessel totally occluding total flow.

Left ventricular Ejection fraction recorded for each of patients showed adequate systolic function (>50%) in 7 patients (41.5%), moderate LV systolic dysfunction (40-50%) in 8 patients (47%), while it was severe LV dysfunction (<40%) in 2 patients (11.5%). Ultimately 16 out of 17 patients (94%) were discharged and continued on optimal medical therapy and follow-up (Table 2), 1 among them was advised triple antithrombotic and follow up check angiogram and percutaneous coronary angioplasty only if recurrent symptoms. While one of the patients who was admitted with severe LV systolic dysfunction and cardiogenic shock succumbed and died on day 2.

## DISCUSSION

Asian Indians have the highest risk of PCAD and diabetes. When compared with Whites, Asian Indians have double the risk of CAD and triple the risk of diabetes mellitus. A cause of concern to developing countries such as India is the incomplete detection, treatment, and control of
CAD risk factors. The non-availability of guidelines for various risk factors with particular reference to Indians hampers treatment.

In the absence of population-specific upper and lower extreme values for a risk factor, a clinician is left with an "action level" for a risk factor that is perhaps more appropriate for Western populations. The result is that treatment at lower levels of the risk factor is denied. Once the guidelines for cut-off values for Asians for different risk factors at different ages and BMI for the two sexes are available, a true picture of the prevalence of these risk factors in this population will be available.

Premature coronary artery disease generally makes up to 30 to 40% of total ischemic heart disease population. Of this our study showed that almost 0.5% of the PCAD population belonged to teenage group. This population under study (teenagers with premature coronary artery disease) was predominantly male (94%) between the age of 16 to 19 years and hence average age of 18.34 years. 35% of them were from rural areas, while 47% were residents of Bangalore city itself. As expected from the age group it was a predominantly student population (64.7%) and majority of them (64.7%) were from lower socio-economic status.

Majority of patients (88.5%) were non vegetarians. Another fact which is worth noting was 29.4% belonged to Muslim population which was significantly higher compare to their proportion in general population. This could be secondary to multiple social and economic factors.

Coming to traditional cardiovascular risk factors, most common risk factor was smoking present in 52.9% of patients. Only 5.8% of them had diabetes or hypertension, while 11.6% of them had history of familial premature coronary artery disease. Even among smokers, almost 75% of them had started smoking within 1 year of present admission.

Going by the standard western classification of BMI, only 17.6% of patients were overweight/obese, but as per revised south Asian Indian classification 47% of them were overweight/obese. However, what serves to be more accurate and sensitive physical parameter for this population is waist-hip ratio by which 76.4% of these patients had abdominal obesity.

The profile of this population reflects the unique nature of Indian PCAD, wherein almost 50% had a normal BMI, and only 9% were obese (remaining 41% being overweight). However, the same group by WHR criteria, 75.3% had abdominal obesity (average BMI: 23.52 and average WHR: 1.1).

23.5% of patients (mostly smokers) showed polycythaemia which is seen more commonly in smoking PCAD population. Going by mean average values of individual lipid parameters, predominant dyslipidaemia pattern seen in this study group is a combination of low HDL along with high triglyceride levels. None of the patients had elevated total cholesterol levels, while only 1 patient had elevated LDL cholesterol levels.

Most common index presentation seemed to be with transmural myocardial infarction, with 58% presenting to hospital with STEMI, while 17.6% had delayed presentation with evolved MI. ST Elevation with spontaneous resolution seems to be comparatively more common in younger age groups with 11.6% incidence. While only 11.6% presented with unstable angina/NSTEMI and none of the patients presented with chronic stable angina.

Although ACS events in younger patients are known to be acute and severe onset, only 23% patients presented within 3 hours, while more than 50% presented after 6 hours of symptom onset.

The angiographic profile of acute coronary syndrome in young usually involves high thrombus load which usually responds well to thrombolytics, anticoagulants and antiplatelets. This was reflected in this study by the fact that 16 out of the 17 patients were discharged on optimal medical therapy and did not require any coronary intervention.

Conventional lipid parameters fail to explain the higher occurrence or severity of CAD in the young Indian population. With respect to entire study population as a whole, LDL as an independent entity did not seem to be a strong risk factor. Hence, among all the conventional lipid parameters, low HDL-C along with high TGs seems to be the

main contributing factor for premature coronary artery in Indians.

Furthermore, risk assessment that considers the entire lipid profile will identify more number of high-risk individuals than evaluating LDL-C alone. Some epidemiologic data suggest that instead of measuring the cholesterol in LDL or HDL, measuring their respective apolipoproteins, apoB-100 and apoA-I, ratios of lipids and/or apolipoproteins have been better predictors of CHD risk.[11]

Many studies, among them YUSAD study[12] and Bogalusa study[13] indicate a close relationship between lipid and nonlipid atherogenic risk factors in early childhood and atherosclerosis development in later life. Identification of the risk factors and their limitation lead to significant decrease of the possibility of cardiovascular disease development.[14.] Nevertheless, accumulating evidence from longitudinal studies indicate the early identification of risk in children, particularly for body fat percentage, blood lipids, hypertension, cigarette smoking and cardiorespiratory fitness, all of which appear to track with age. Furthermore, habitual physical activity has been shown to be significantly related to other risk factors in children.

## CONCLUSIONS

The problem in India is the incomplete detection, treatment, and control of CAD risk factors. The non-availability of population-specific normal ranges and guidelines for various risk factors hampers treatment.

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