International Journal of Research in Medical Sciences
*Swain L et al. Int J Res Med Sci. 2018 Jul;6(7):2264-2270*
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20182428

**Original Research Article**

# Demographic and clinic-angiographic profile of coronary artery disease in young adults: a retrospective observational study

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**Received:** 21 May 2018
**Accepted:** 28 May 2018

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## ABSTRACT

**Background:** Cardiovascular diseases (CVD) and its complications are on an increased trend in the younger age group. In this study we aimed to identify the different risk factor profile and coronary angiographic characteristics of young adults presenting with coronary artery disease.
**Methods:** We conducted this retrospective observational study at SCB MC and H and Ashwini Hospital, Cuttack, Odisha, India over a period of one year from June 2016 to June 2017 on 170 patients who undergone coronary angiogram. Inclusion criteria being patients admitted for STEMI, NSTEMI, or UA, age <40 years and those who underwent coronary angiography. All patients who underwent coronary angiography for surgical fitness e.g., patients of rheumatic heart disease and congenital heart disease were excluded from the study.
**Results:** Among the 150 cases included in the study, 85.3%were males and 14.7% were females. Maximum number of cases i.e. 71.3% were in the age group 36-40 yr, while 23.3% were between 31-35 and 5.4% were between 25-30 age group. Among 150 cases with critical CAD, SVD was most prevalent seen in 68.7% cases, followed by DVD in 22.6% and TVD in 8.7% cases.
**Conclusions:** Incidence of critical CAD in young adults is quite high. Young patients with CAD are mainly males, and SVD is more common. Comparative analysis of young patients with STEMI and NTEMI/ UA revealed that SVD was predominantly involved in STEMI group, whereas TVD was predominant in NSTEMI/UA group.

**Keywords:** Coronary artery disease, Coronary angiography, Young adults

## INTRODUCTION

Cardiovascular diseases (CVD) and its complications account for approximately 12 million deaths annually in the Indian subcontinent.[1] The Global Status Report on Noncommunicable Diseases has reported that in India, CVD caused more than 2.5 million deaths in 2008. As per 2014 statistics by the World Health Organization, 26% of total mortality in India is contributed by CVD.[2] Mortality due to coronary artery disease (CAD) is higher in South India.[1] Studies carried out in India and other places suggest that Asians in general and Indians in particular are at an increased risk of myocardial infarction at a younger age (<40 years), irrespective of whether they have migrated to other countries or are resident Asians.[3] Heart diseases are rising in Asian Indians and present 5-10 years earlier than in other populations around the world. The mean age for the first presentation of acute myocardial infarction in Indians is 53 years.[4] Onset of CAD before 40 years of age is considered as premature CAD (PCAD).[5,6] Incidence of CAD in young Indians is

about 12-16%, which is higher than any other ethnic group.[3,7]

If the current trend continues, the burden of CAD in India will surpass other regions of the world by the year 2020.[8] In addition to higher rate, it is also reported that Indian individuals may develop CAD at a very early age.[9] According to an estimate, more than half of death related to cardiovascular disease occurs in patients below the age of 50 years and one-fourth of acute myocardial infarction cases are being reported in patients under the age of 40 years.[9] It has also been noted that the clinical presentation, risk factor profile, and coronary anatomy of young patients who develop CAD differs to those who develops CAD at an older age.[9-11] Overall, these studies have indicated that patients with early onset of CAD exhibit preponderance of single vessel disease, and dominance of coronary risk factors such as hypercholesterolemia, family history of CAD, and cigarette smoking as compared to older patients. However, there have been very limited data on comparison of demographic and angiographic characteristics in young patients stratified according to the type of acute coronary syndrome. We selected an age cut-off of 40 years to define a premature CAD, based on previous studies.[9,12]

Therefore, we aimed to identify the differences between risk factor profile and coronary angiographic characteristics of young adults presenting with ST-elevated myocardial infarction (STEMI), non-ST-elevated myocardial infarction (NSTEMI), or unstable angina (UA). The purpose of this study is to collect data of young patients presenting with AMI and to assess the incidence of critical CAD in patients aged <40 years who were evaluated for chronic stable angina or acute coronary syndrome (ACS) angiographically so that it would be helpful in future for better management in this particular group of patients.

## METHODS

This was a retrospective observational study conducted at SCB MC and H and Ashwini Hospital, Cuttack, Odisha, India over a period of one year from June 2016 to June 2017 on 170 patients who undergone coronary angiogram. Inclusion criteria are patients admitted for STEMI, NSTEMI, or UA, age <40 years and those who underwent coronary angiography. All patients who underwent coronary angiography for surgical fitness e.g., patients of rheumatic heart disease and congenital heart disease were excluded from the study. Patients below 18 years and above 45 years were excluded from the study. Similarly, patients having prior cardiac conditions that could affect outcome like valvular heart disease, cardiomyopathy, and previous left bundle branch block were excluded. Patients with diagnosed acute or chronic liver disease, renal impairment or having secondary conditions that could precipitate angina (anemia, arrhythmias, fever) were also excluded from the study.

Critical (severe) CAD was defined as critical narrowing (70% or more) of a coronary artery that results in a significant reduction in maximum flow capacity in a distal vascular bed.[13] CAD manifested in <40 years of age was defined as PCAD.[5,6]

Diagnostic CAG was performed by a team of expert interventional cardiologists. A detailed analysis of angiographic images was done by the operators. Both eye-balling method and quantitative CAG were used to estimate the coronary lesions. The patients were grouped into single vessel disease (SVD), double vessel disease (DVD), and triple vessel disease (TVD) according to the number of major epicardial coronary arteries involved. Stenosis of the coronary vessels was considered mild when the luminal diameter was reduced by <50%, moderate (50%-70%), and severe/critical (>70%) of the original diameter.

Hospital records of the selected patients were examined for associated coronary risk factors like hypertension, diabetes, smoking, obesity, and family history of CAD. Ejection fraction at the time of presentation was also noted. Patients were defined as hypertensive if they displayed a systolic blood pressure ≥140 mmHg, diastolic blood pressure >90mmHg, or self-report of physician diagnosis of hypertension and/or current use of antihypertensive medications.

Patients were considered diabetic if they presented with fasting glucose levels >126mg/dL, or glycated hemoglobin levels >6.5%, or self-report of physician diagnosis of diabetes mellitus and/or use of antidiabetic medications. Body-mass index (BMI) was estimated based on the height and weight measurements to identify obese patients (BMI >25kg/m$^2$). Patients were categorized as smokers if they reported smoking/tobacco consumption within last one year of study enrollment.

All patients included in the study group underwent coronary angiography, which was performed using standard percutaneous techniques. Generally, 6 or 7 Fr guide catheters were used and were introduced via the femoral artery. Angiographic severity of coronary artery stenosis was assessed visually using at least two orthogonal views. CAD was defined as the presence of a >70% lesion in one of the three major coronary arteries (i.e. left anterior descending coronary artery (LAD), left circumflex coronary artery (LCX), and right coronary artery (RCA)) or their major branches, or >50% luminal narrowing of the left main coronary artery (LMCA). Accordingly, patients were classified as having single-vessel, double-vessel or triple-vessel disease.

Patients were diagnosed with one of the following 1) ST segment elevation MI (STEMI), 2) Non-ST segment elevation MI (NSTEMI). STEMI was diagnosed by having elevated biochemical markers of myocardial necrosis and ECG changes demonstrating either: 1) ST segment elevation >1mm in two consecutive leads or 2)

new or presumed new left bundle branch block along with ischemic symptoms. NSTEMI was determined by elevated biochemical markers of myocardial necrosis and either ischemic symptoms compatible with ACS or ST-segment depression or T wave abnormalities.

## RESULTS

This is retrospective, cross sectional observational study carried out on acute CAD in young patients of age less than 40 yr. We studied the coronary angiographic findings of 170 cases. Out of them 20 cases were excluded based on exclusion criteria, sample size being 150 young CAD patients. Among the 150 cases included in the study, 128 (85.3%)were males and 22 (14.7%) were females (Table 1).

**Table 1: Distribution of cases according to sex.**

| Sex | n (150) | % |
|---|---|---|
| Male | 128 | 85.3 |
| Female | 22 | 14.7 |

**Table 2: Distribution of cases according to age.**

| Age | n (150) | % |
|---|---|---|
| 21 - 30 | 8 | 5.4 |
| 31 – 35 | 35 | 23.3 |
| 36 - 40 | 107 | 71.3 |

**Table 3: Distribution of cases type of vessel disease.**

| CAD | n (150) | % |
|---|---|---|
| SVD | 103 | 68.7 |
| DVD | 34 | 22.6 |
| TVD | 13 | 8.7 |

**Table 4: Distribution of cases according percentage of vascular occlusion.**

| % of stenosis | n (150) | % |
|---|---|---|
| 50-90 % | 40 | 26.7 |
| >90% | 110 | 73.3 |

**Table 5: Distribution of cases according to ECG criteria.**

| CAD | n (150) | % |
|---|---|---|
| STEMI | 88 | 58.7 |
| NSTEMI | 25 | 16.6 |
| Unstable angina | 37 | 24.7 |

Maximum number of cases i.e. 107 (71.3%) were in the age group 36-40 yr, while 35 (23.3%) were between 31-35 and 8 (5.4%) were between 25-30 age group (Table 2). Among 150 cases with critical CAD, SVD was most prevalent seen in 103 (68.7%) cases, followed by DVD in 34 (22.6%) and TVD in 13 (8.7%) cases (Table 3). Stenosis of coronary vessels was more than 90% in 110 (73.7%) cases and between 50-90% in 40 (26.7%) cases (Table 4). ST segment elevated myocardial infarction was seen in 88 (58.7%), Non-ST segment elevated myocardial infarction in 25 (16.6%) and Unstable angina in 37 (24.7%) cases (Table 5). We find smoking as a single most common risk factor seen in 98 (65.3%) cases. Other risk factor observed are hypertension in 40 (26.7%), diabetes in 23 (15.3), dyslipidemia in 14 (9.3), family history of CAD in 13 (8.7%) and obesity in 8 (5.3%) cases (Table 6).

**Table 6: Distribution of cases according to risk factor association.**

| Risk factors | n (150) | % |
|---|---|---|
| Smoking | 98 | 65.3 |
| Hypertension | 40 | 26.7 |
| Diabetes | 23 | 15.3 |
| Dyslipidemia | 14 | 9.3 |
| Family history | 13 | 8.7 |
| Obesity | 8 | 5.3 |

**Table 7: Distribution of cases according to site of involvement.**

| CAD | Location | n (150) | % |
|---|---|---|---|
| SVD (103) | Left main coronary artery | 3 | 2 |
| | LAD | 62 | 41.3 |
| | LCX | 15 | 10 |
| | RCA | 23 | 15.3 |
| DVD (34) | LAD + LCX | 18 | 12 |
| | LAD + RCA | 10 | 6.7 |
| | LCX + RCA | 6 | 4 |
| TVD (13) | LAD + LCX + RCA | 13 | 8.7 |

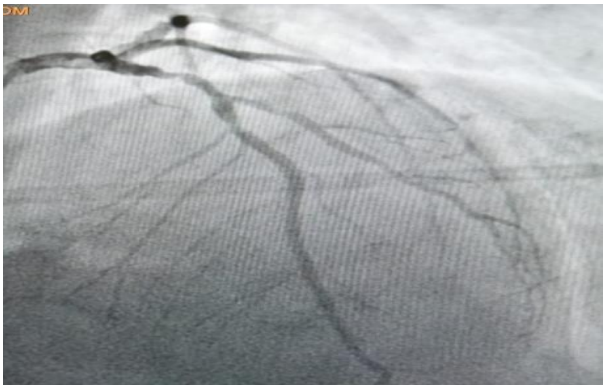

**Figure 1: Stenosis of proximal part of left anterior descending artery.**

Among the single vessel disease cases, location of stenosis was seen in LAD in 62 (41.3%), LCX in 15 (10%), RCA in 23 (15.3%) and left main coronary artery in 3 (2%) cases. Among the double vessel disease cases involvement of LAD + LCX was seen in 18 (12%), LAD

+ RCA in 10 (6.7%) and LCX + RCA in 6 (4%) cases. Triple vessel disease was seen in 13 (8.7) cases (Table 7).

In Figure 1 and 2 we have observed 80% and 90% stenosis of proximal part of left anterior descending artery respectively.

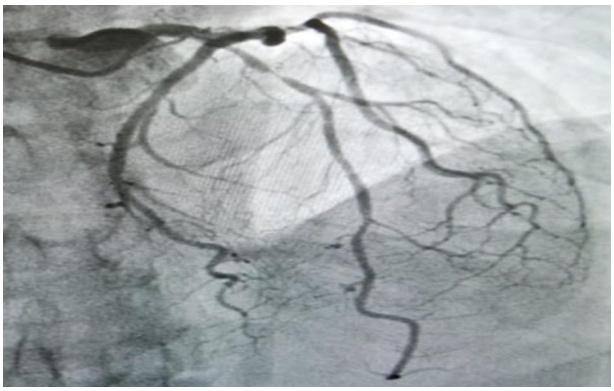

**Figure 2: Stenosis of proximal part of left anterior descending artery.**

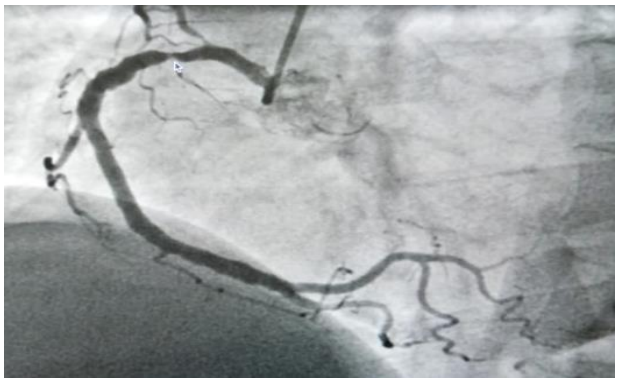

**Figure 3: Stenosis of proximal part of right coronary artery.**

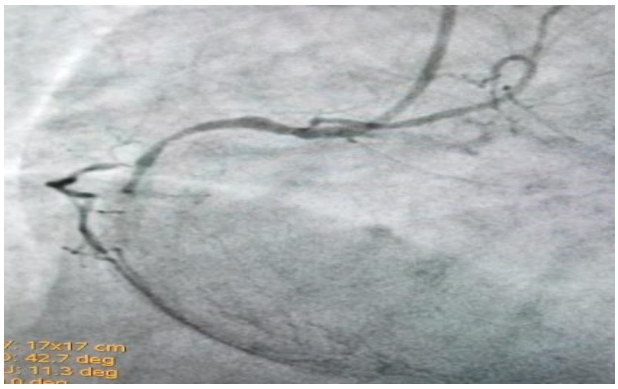

**Figure 4: Stenosis of middle part of right coronary artery.**

In Figure 3 and 4 we studied 80% and 100% stenosis of proximal part and middle part of right coronary artery respectively. So, all the figures from 1-4 demonstrates single vessel type of coronary artery disease.

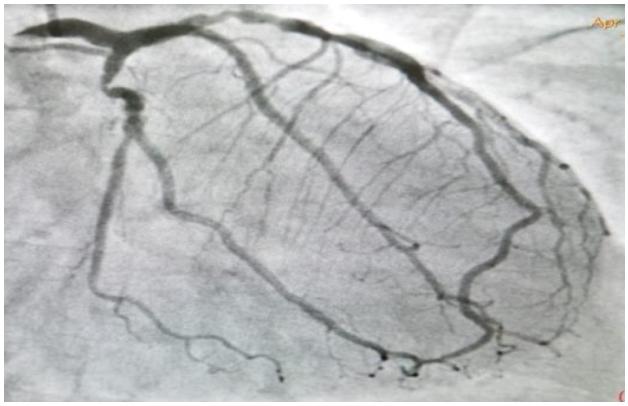

**Figure 5: Stenosis of proximal part of left anterior descending artery and left circumflex artery.**

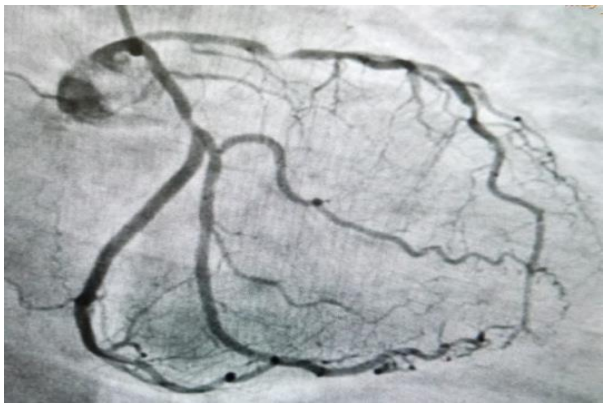

**Figure 6: Stenosis of proximal and middle part of left anterior descending artery and proximal part of left circumflex artery.**

**Figure 7: Stenosis of proximal and middle part of left anterior descending artery.**

In Figure 5 authors found 80% stenosis of proximal part of left anterior descending artery and 90% stenosis of left circumflex artery. In Figure 6 we observed 80% stenosis of proximal part of left anterior descending artery, 70% stenosis of middle part of left anterior descending artery and 70% stenosis of proximal part of left circumflex artery. Hence in both Figure 5 and 6 we found double vessel type of coronary artery disease. In Figure 7 we

observed 70% stenosis of proximal part of left anterior descending artery, 99% stenosis of middle part of left anterior descending artery with distal part diffusely diseased. Though same patients have triple vessel disease, we could not have demonstrated that in two dimensional figures.

## DISCUSSION

The present study determines the demographic characteristics and angiographic extent of coronary artery lesions in young adults having acute coronary syndrome, with comparative analysis focusing on patients presented with STEMI vs. NSTEMI/UA. This retrospective, cross sectional observational study was carried out on acute CAD in young patients of age less than 40 yr. We studied the coronary angiographic findings of 170 cases. Out of them 20 cases were excluded based on exclusion criteria, sample size being 150 young CAD patients.

Among the 150 cases included in the study, 128 (85.3%) were males and 22 (14.7%) were females. In this study we observed that maximum number of cases i.e. 107 (71.3%) were in the age group 36-40 yr, while 35 (23.3%) were between 31-35 yr and 8 (5.4%) were between 25-30 yr and the mean age of presentation was 37.8 yr. We found SVD as the most common variety of CAD being seen in 103 (68.7%) cases, followed by DVD in 34 (22.6%) and TVD in 13 (8.7%) cases. In accordance with us, Suresh G et al, in their angiographic study on coronary artery disease in young adults, found 87.5% of cases with critical CAD were male and 12.5% were female. They observed 69.6%, 23.2%, 7.1% of cases in the age group 36-40 yr, 31-35 yr and 21-35 yr respectively and the mean age of presentation was 36.5yr. They found SVD in 66.07%, DVD in 22.32% and TVD in 11.61% of cases.[14]

In this study the location of stenosis among the single vessel disease cases was seen in LAD in 62 (41.3%), LCX in 15 (10%), RCA in 23 (15.3%) and left main coronary artery in 3 (2%) cases. Deora S et al, observed stenosis of LAD in 55.3%, LCX in 11.8%, RCA in 19%, left main coronary artery in 0.5% in cases of STEMI group and LAD in 40.2%, LCX in 23.4%, RCA in 23.4%, left main coronary artery in 2.9% in NSTEMI/UA group patients. They studied on demographic and angiographic profile in premature cases of acute coronary syndrome and observed that majority of the patients in both STEMI (96.4% vs 3.6%) and NSTEMI/UA (81.8% vs 18.2%) group were males. They have seen 82.3% and 17.7% (STEMI), 86.6% and 13.4% (NSTEMI/UA) cases were in the age group 31-40yr and 20-40yr with mean age 35yr and 36yr respectively. In contrast to us, they observed SVD, DVD, TVD in 56.6%,10.8%, 3.6% of cases in STEMI group and 30.6%,15.3%,10.5% of cases in NSTEMI/UA group.[15]

Authors find smoking as the single most common risk factor seen in 98 (65.3%) cases. Other risk factor observed are hypertension in 40 (26.7%), diabetes in 23 (15.3), dyslipidemia in 14 (9.3), family history of CAD in 13 (8.7%) and obesity in 8 (5.3%) cases. Deora S et al, observed association of risk factors with smoking habits 67.9%, hypertension 10.0%, diabetes 8.9%, dyslipidemia 82.4%, obese 11.9%, family history of CAD 7.9% in STEMI group and association of risk factors with smoking habits 69.9% hypertension 37.8% diabetes, 29.2% dyslipidemia 86.6% Obese 18.1% family history of CAD 6.7% in NSTEMI/UA group.[15]

We studied double vessel disease cases with involvement of LAD + LCX in 18 (12%), LAD + RCA in 10 (6.7%) and LCX + RCA in 6 (4%) cases. So combination of LAD + LCX variety of DVD is most common and LCX + RCA is least common. Triple vessel disease was seen in 13 (8.7) cases. Tamrakar R et al, observed involvement of LAD + LCX in 18.4%, LAD + RCA in 10.7% and LCX + RCA in 7.6% of cases. They found triple vessel disease in 6.1% cases. They also observed association of risk factors like smoking 64.3%, hypertension 27.8%, diabetes 15.6%, dyslipidemia 9.6%, family history 9.6% and obesity 4.3% of cases, higher incidence of CAD in males (74%) in compare to females (26%), stenosis of LAD in 27.6%, LCX in 10.7%, RCA in 15.3% of single vessel disease cases and 4.3% cases below 30 yr and rest 95.7% of cases in the age group 30-45 yr.[16]

In this study we found stenosis of coronary vessels was more than 90% in 110 (73.7%) cases and between 50-90% in 40 (26.7%) cases. We had observed ST segment elevated myocardial infarction in 88 (58.7%), Non ST segment elevated myocardial infarction in 25 (16.6%) and Unstable angina in 37 (24.7%) cases. Similarly Ewa M et al, in their study on coronary obstructive lesion group observed 50-90% stenosis in 27.1% of patients and ≥90% stenosis in 72.9% of patients and ST segment elevated myocardial infarction in 52.8%, Non ST segment elevated myocardial infarction in 17.6% and Unstable angina in 269.6% cases. They also found most of the patients presented with CAD were males (86.2%) and mean age of presentation of CAD in younger patients was 35.1yr and involvement of SVD, multivessel disease and left main coronary artery disease in 61.9%, 34.7% and 3.4% of cases respectively.

Prajapati J et al, observed SVD, DVD, TVD and normal vessels in 55%, 15%, 8% and 22% of cases in younger age group (<40yr age). They also observed association of risk factors like smoking 34%, hypertension 16%, diabetes 11%, dyslipidemia 47%, family history 19% and obesity in 3% of cases in their study on younger patients and stenosis of LAD in 44%, LCX in 26.6%, RCA in 29.4% of cases.[18] In accordance to us Foroughi M et al, had also observed combination of LAD + LCX lesions more than LAD + RCA or LCX + RCA lesions, 11.9% vs 3.5% and 1.5% respectively and risk factors association of smoking 65.5%, hypertension 31.9%, diabetes 22.4%, dyslipidemia 36.6%, family history 38.4% in case of males and smoking 15%, hypertension 56.8%, diabetes

46.6%, dyslipidemia 47.9%, family history 38% in case of females. Their angiographic study on coronary artery disease in Iranian young adults revealed 1% patients had left main coronary disease, 68% patients had single vessel disease, 17% patients had two-vessel disease and 14% patients had three-vessel disease.[19]

Khadkikar GD et al, observed SVD, DVD, TVD and no vessel disease in 50%, 13.6%, 4.5% and 31.8% of cases respectively and association of risk factors like smoking 25%, hypertension 15.6%, diabetes 11%, dyslipidemia 32.1% and family history 37.5% of cases.[20] Arumugam C et al, observed diabetes mellitus 10.5%, hypertension 14.8 %, dyslipidemia 2.4%, smoking 2.8 and alcohol consumption 0.5% of cases and observed SVD in 24.5% patients, DVD in 12.5% patients and TVD in 11.5% patients and non-obstructive/minimal lesion in 20% patients.[21] Saghir T et al, had also observed SVD as the most common type of CAD in patients <40yr age in 39% cases followed by DVD in 20%, TVD in 12% and left main coronary artery in 2% of cases. They also observed smoking as the most common risk factor being seen in 62% cases followed by dyslipidemia in 51%, hypertension in 34%, family history of coronary artery disease in 30% and diabetes as the least common association seen in 14% of cases studied in young patient group and LAD as the most common artery involvement in obstructive type of CAD in patients <40yr age, seen in 47% of RCA in 43% and LCX in 10% cases.[22] Colkesen AY et al, in their study on coronary artery disease in young adults under 35 years of age also found LAD was the most commonly involved vessel, followed by RCA, LCX, and LMCA.[23] Cole et al, in their long-term follow-up of coronary artery disease presenting in young adults identified single vessel disease as the most common type seen in 58% of CAD patients below 40 years of age.[24] Similar observations of predominantly single vessel disease in young adults compared to more common 2- or 3-vessel disease in older populations were made in multiple studies in Europe, United States and also Asia.[25] Zimmerman et al, also found history of smoking in 73% to 90% of cases in their study among AMI patients <40 years old.[26] Yusuf S et al, had also found LAD as the most common vessel involved (60), followed by RCA (52), left circumflex (41), and left main.[27] Sricharan KN et al, in another study from South India observed majority of the patients (57.14%) had SVD, followed by normal coronaries (22.45%); 16.3% had DVD and 4% had multivessel disease.[28] Badran HM et al, had also identified more incidence of SVD (66%) than DVD (21%) and TVD (9%) and no vessel disease in 4% of cases in their study on <45 yr age group patients. They observed involvement of LAD in maximum number of cases (71%), followed by RCA (24%), LCX (13%) and left main (1%) of cases, Cigarette smoking as the most prevalent risk factor, with 79% of ACS subjects being smokers, followed by dyslipidemia; 76% had low HDL, 53% of patients had hypertriglyceridemia, followed by the prevalence of positive family history (44%).[29] Christus T et al, had also found that history of smoking to be the most important risk factor in 71% of the patients followed by hyperlipidemia in 56%, family h/o IHD in 27%, H/o hypertension in19.5%, obesity in 20% and H/o diabetes mellitus 17% of cases and also studied higher percentage of SVD (32.5%) than DVD (19%) and TVD (12.5%) and left main coronary artery in 1.5% of cases. They also observed 100% occlusion of one vessel in 19%, two vessel in 2% and three vessel in 1% of cases.[30]

## CONCLUSION

Incidence of critical CAD in young adults is quite high. Young patients with CAD are mainly males, and SVD is more common. Comparative analysis of young patients with STEMI and NTEMI/ UA revealed that single-vessel disease was predominantly involved in STEMI group, whereas triple-vessel disease was predominant in NSTEMI/UA group. LAD was the most commonly involved coronary artery in both the groups. Affected patients were predominantly the male and showed a high prevalence of smoking/tobacco consumption. Emphasis should be given on diagnosis and management of risk factors in this vulnerable group. CAD is increasing in our young population due to im-perfect life style. It leads to the loss of work days, transition from an active to sedentary working life and de-creased efficiency. Preventing the disease is probably the best way to improve results by modifying life style, dietary habits, public awareness programs and regular exercise. Prevention and treatment of obesity must become a major public health priority in the prevention of premature CAD.

*Funding: No funding sources*
*Conflict of interest: None declared*
*Ethical approval: The study was approved by the Institutional Ethics Committee*

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**Cite this article as:** Swain L, Routray PN. Demographic and clinic-angiographic profile of coronary artery disease in young adults: a retrospective observational study. Int J Res Med Sci 2018;6:2264-70.