(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 5, Issue 1, Page No: 27-41
January-February 2022

IJMSCR

Pattern Of Coronary Artery Disease Among Indians– Snapshot From A Modern-Day High Volume Tertiary Cardiac Center. Insight From 10972 Coronary Angiograms

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Type of Publication: Original Research Paper
Conflicts of Interest: Nil

Abstract

Background: The Indian data on the angiographic distribution of coronary artery diseases (CAD) and clinical presentation are limited by small studies.

Methods: Coronary angiographic data of 10972 patients (all comers) between 1st June 2018 and 31st May 2019 were retrospectively collected, pattern and distribution of CAD were analyzed with respect to demographic and clinical presentation.

Results: Among the study population, the average age was 54.58 ± 10.9 yrs,77.4% were males. STEMI was the most common diagnosis (59.4%) followed by NSTEMI/UA in 26.8%, about 5% of CAGs had non-CAD indications. Normal/non-obstructive CAD was present in 24.7%, commonest vessel involved in obstructive CAD was LAD (62%). DVD commonly involved LAD/RCA (45.5%). TVD was present in 12.8% and LMCA disease in 3.1% of patients. TVD was common among patients with NSTEMI/UA (23%). The prevalence of LMCA disease among STEMI, NSTEMI, and SIHD was 1.1%, 6.3%, and 7.3% respectively. Normal/non-obstructive CADs were higher in the STEMI group compared to NSTEMI/UA (23.8% and 14.5%, p <0.001) whereas DVD, TVD, and LMCAD were higher in NSTEMI/UA group (P<0.001). There were more SVD (44.3% v/s 24.5%) and DVD (19.3% v/s 17.4%) among ACS compared to SIHD group (P<0.001), normal/non obstructive CAD (33.0% v/s 20.9%) and LMCAD (7.3% v/s 2.7%, p<0.001) were significantly higher in SIHD group.

Conclusion: TVDs were common among NSTEMI/UA and LMCAD among SIHD patients necessitating appropriate risk stratification. Nearly a quarter of CAG studies showed normal/non-obstructive CAD, proportion of which can be reduced by adequate clinical evaluation and use of appropriate non-invasive pre-CAG workup.

Keywords: Coronary artery disease, coronary angiogram, acute coronary syndrome, Triple vessel disease

Introduction

Coronary artery disease (CAD) has plagued the world in the 21st century. Cardiovascular(CV) deaths contribute to 31 % of deaths worldwide (1) and CAD accounts for 32% of adult deaths in India(2). The prevalence of CAD among subjects aged 40–70 years is 7.3%(3) and Left main coronary artery (LMCA) disease is 2.2%(4). The pattern of CAD distribution varies with its clinical presentation and such data helps in better understanding of the disease burden and also provides crucial information for planning resource allocation at various levels of healthcare

establishments in the community as well as among various departments in the healthcare setup. Such data by conventional coronary angiogram(CAG) among Indian population are sparseand limited by studies with small sample size (< 1500 patients)(5–7).

Aim

To study the pattern of CAD distribution and its correlation with clinical presentation among patients undergoing conventional CAG.

Materials And Methods

This is an observational study conducted at Sri Jayadeva Institute of cardiovascular sciences and research, Bangalore, from 1st June 2018 to 31st May 2019. The center is one of the largest tertiary care centers for CV diseases in South East Asia and acts as a referral center for most parts of Karnataka and adjoining areas of neighboring states in south India, catering services mainly to lower and middle socioeconomic class population with adult and pediatric cardiology, adult and pediatric cardiac surgery, electrophysiology and vascular surgery units with nearly3,80,000 outpatients and 36,000 inpatients every year. An average of 2100 catheterization procedures and 260 surgical procedures are performed every month. For this all-comer study, catheterization laboratory list of patients undergoing cardiac catheterization procedures from1st June 2018 to 31st May 2019 was collected **(Figure 1)**. Patients who did not undergo invasive CAG as a part of catheterization study were screened out. Data of patients who underwent CAG and uploaded in PACS were collected retrospectively. Demographic, clinical, and CAG data were tabulated and analyzed. CAGs were performed as per standard protocol.

Definitions:

Obstructive CAD is defined as luminal stenosis > 50 % and non-obstructive CAD-luminal stenosis of <50% in epicardial coronary arteries(8). Anomalous coronary artery is defined by any variation in the origin/course of coronary artery(8). Dominant circulation is classified as a) Right dominant circulation –Posterior descending artery(PDA) and Postero-lateral branch(PLB) arising from Right coronary artery (RCA) b) Left dominant circulation – PDA and PLB from left circumflex (LCX) coronary artery and c)Co-dominant circulation – PDA from RCA and PLB from LCX(9). CAD is categorized as single (SVD), double (DVD) and Triple (TVD) vessel disease based on the number of vessels with obstructive CAD.

Statistical Analysis

The discrete qualitative variables such as frequencies of different types of diseases among males and female proportions were analyzed using the chi-square test. Continuous variables were compared using independent-samples t-test. P-value of<0.05 was considered significant. Data were analyzed using IBM SPSS Statistics for Windows, version 20 (IBM Corp., Armonk, N.Y., USA).

Results

Patient Characteristics

Study subjects were predominantly males (77.4 %; p<0.001)**(Table1)** with a mean age of 54.58 ± 10.96 years. There were 2585(23.5%) hypertensive patients with nearly equal male and female distribution (p=0.562). There were more females among the diabetic group (25.2% vs. 20.0 p<0.001) whereas males had higher rates of prior CABG (coronary artery bypass grafting) (1.2% vs.0.5% p=0.005).

Clinical Presentation And CAD Pattern

Among patients who underwent CAG, ST-elevation myocardial infarction (STEMI) was the most common diagnosis (59.4%) followed by non-ST elevation myocardial infarction/unstable angina (NSTEMI/UA) in 26.8% and stable ischemic heart disease(SIHD) in 8.1%, with no significant gender difference except in STEMI group where there were more males than females (61.9% v/s 51.4% p=0.001). Among STEMIs, Anterior wall MI (AWMI)(60.83%) was common than Inferior wall MI (IWMI). Among all the CAGs studied, nearly a quarter of patients had normal/non-obstructive CAD (24.7%), 41% had SVD, 18.5% DVD, 12.8% TVD and 3.0% had LMCAD **(Table 2).** Normal/non-obstructive CAD, DVD, TVD were more among females compared to males whereas males had more SVDs (p=0.001). Among SVDs, Left anterior descending (LAD) artery was most commonly involved vessel (58.2%) and LCX least common (15.7%) with higher LAD involvement among males compared to females (p<0.001). Most commonly DVD involved was LAD/RCA (45.5%) followed by LAD/LCX (38%)

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and RCA/LCX disease(14.9%) with no specific gender predilection. Among CAD patients, SVD was common than DVD and TVD (50.1%, 31.6%, and 24.5% respectively). TVD was common among patients with NSTEMI/UA (23%) followed by SIHD (17.8%). Prevalence of LMCA disease among STEMI, NSTEMI/UA, and SIHD was 1.1%, 6.3%, and 7.3% respectively. Normal/non-obstructive CAD was common among patients with SIHD than STEMI and NSTEMI/UA patients (33%, 23.8%, and 14.5% respectively)**(Table 3**). The "others" group which included a heterogeneous set of patients who underwent CAG for non-CAD indication as a part of their pre-procedural workup, majority had normal/non-obstructive CAD (70.6%) whereas 6.5% had TVD and 1.7 % LMCAD. There were more normal/non-obstructive CADs in STEMI group compared to NSTEMI/UA (p <0.001) whereas DVD,TVD, and LMCAD were more in NSTEMI/UA group (P<0.001)**(Table 4)**. Among SVD subgroup, LAD and RCA were involved more commonly in STEMI compared to NSTEMI/UA group whereas LCX involvement is significantly higher in NSTEMI/UA group (P<0.001).There were more SVD and DVDs in ACS group compared to SIHD (P<0.001), whereas normal/non-obstructive CAD and LMCADs were significantly higher in SIHD group (P<0.001).

Dominance and coronary anomalies

Right dominance was observed in 79.6%, left dominance in 16.3%, and co-dominant in 3.9% with no significant gender difference **(Table 3).**Among the CAGs studied, anomalous coronary artery was observed in 185 (1.7%) patients with higher male predilection (p=0.037).

Discussion

The risk factors for CAD are multifactorial(10). Prevalence of hypertension among our study population is comparable to previous Indian studies with ACS patients (ranging from 19.9% to 40.2 %) (6,7), reported prevalence of diabetes mellitus from studies with ACS patients ranges from 20.9% to 37% (6,7) and its prevalence in our study is 21.78%. Previous (both cadaveric and clinical) studies have reported right dominance in 61.3% to 89.1%, left dominance 8.4%-24.4% and co-dominance 2.5%-14.6% patients(9,11–13). Left dominance is associated with higher coronary calcification, bifurcation lesions, and peri-procedural MI(14) and is an independent predictor of increased long-term mortality in ACS patients(15). Left and co-dominant circulation are associated with higher in-hospital mortality among ACS patients undergoing Percutaneous Coronary Intervention(PCI)(16). Few studies have also demonstrated increased severity of CAD and higher incidence of TVD among right dominant patients (17,18). Prevalence of anomalous coronary artery is low among our study population compared to western studies (5.6%) (9), the significance of which lies with the fact that certain forms of anomalies can present with sudden cardiac death(SCD) especially in young and asymptomatic individuals(19).

Real-world data on indications for CAG from India are limited by small study samples and specific population subsets (i.e. STEMI/ NSTEMI/ SIHD, females/males, etc.). Our all-comer study demonstrated, STEMI (59.6%) as the most common indication for CAG followed by NSTEMI/UA (26.89%), SIHD (8.13%), and others (5.34%). Interestingly the heterogeneous "others" group constituted nearly 5% of CAGs (non CAD indications) in modern-day large volume cath lab like ours, as these tertiary care centers deal with diverse cardiac ailments other than CADs which necessitates CAG as a part of management. So we can expect difference in the proportion of CAG indications as it depends on center location, availability of round-the-clock cath lab and cardiologist, and also the financial status of patient. True Indian data depicting pattern of CAD distribution in modern-day tertiary care cath lab remains elusive and limited by small study sample, different cut-offs used to define obstructive CAD (i.e. > 50% v/s >70% v/s >75% stenosis), etc. Of all the patients who underwent CAG, we observed normal/non-obstructive CAD in nearly a quarter (24.7%) of patients, with TVD and LMCAD combined constituted 15%. These proportions which included both coronary and non-coronary indications for CAG provides an idea on the pattern and burden of CAD and in turn the proportion of patients eventually requiring either optimal medical therapy (OMT), PCI, or CABG, of course with several other considerations. We used 50% stenosis as the cut-off to define obstructive CAD. It is a surprising observation that the basic definition of obstructive CAD itself needs uniform and standardized cut-offs

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(at least in our country) among investigators as different cut-offs (Table 1 in supplementary appendix) would lead to a significant difference in the proportion of obstructive CAD patients between studies masking true CAD data, in turn affecting resource allocation and policy formulation in CAD management.

The pattern of CAD varies with clinical presentation. In our STEMI group**,** half of the patients had SVD and nearly a quarter (23.8%) had normal /obstructive CAD. Indian studies which included only STEMI patients have reported wide range i.e. SVD ranging from 44.7% to 88.3%, DVD 6.4%-31.3%, TVD 1%-13.9%, LMCAD 0-3% and normal /non obstructive CAD 7.8%-41.1%, with LAD involvement in 45.3% to 86.4%, RCA in 9.3%-34%, LCX in 6.4%-18.7%(Table 1 in supplementary appendix). As these studies (including our study) included patients withprimary, rescue, and pharmacoinvasive PCI, in reality, there could be less proportion of normal/non-obstructive CAD and more SVD or DVD or TVDs which can only be demonstrated by studies with primary PCI population, such large Indian studies are lacking till date. Among our STEMI- SVD subgroup, LAD was the most common culprit vessel and LCX least common, because of the known fact that AWMI is more common than IWMI.

NSTEMI/UA patients tend to have more diffuse CAD as they are older, have more comorbidities as compared to STEMI patients(20)**.**Indian studies which included only NSTEMI/UA patients are lacking, however, extracted data from studies of ACS patients revealed normal/non-obstructive CAD ranging from 18.9 to 43.5%, SVD in 30.6%-48.7%, DVD in 14.6%-17.1%, TVD in 8.2%-29.4%, and LMCAD in 2.6%-8.3%**.** Western data among NSTEMI patients showed, non-obstructive CAD in 15%, SVD in 20% (LAD most common in 40%), DVD in 20%, TVD in 35%, and LMCAD in 10% of patients(20)**.** Among our NSTEMI/UA group, 14.5% had normal/non-obstructive CAD, SVD in 31.6%, DVD in 24.6%, TVD in 23.0%, and LMCAD in 6.3% of patients. Among the NSTEMI-SVD subgroup, LAD is the most common and RCA is the least common vessel involved.

Western studies among SIHD patients revealed non-obstructive CAD in 15%, SVD, DVD, and TVD in 25% each and LMCAD in 5-10% of patients (20), more contemporary western data from nearly 4,00,000 patients reported obstructive CAD in 37.6% and LMCAD in 3.9% patients. Among obstructive CAD patients 46.7% had SVD, 30.5% DVD and 22.5% TVD(21). Similar large Indian studies are lacking. In our SIHD group, one-third had normal/non-obstructive CAD, nearly a quarter had SVD (LAD most commonly involved) and 7.3% had LMCAD. The high proportion of normal/non-obstructive CAD among SIHD patients may be related to a lack of aggressive pre-CAG risk stratification by non-invasive tests. Among the SVD subgroup, LAD and LCX were involved commonly in SIHD group whereas RCA involvement is common in ACS group compared to SIHD ($P<0.001$).

The true proportion of LMCAD in real world is difficult to assess as many critical LMCAD patients (especially with ACS presentation) will have SCD or die before reaching the hospital or cath lab. In our study, 334 patients had significant LMCA involvement and the majority were in NSTEMI/UA group (55.1%).Though the majority (70.1%) among the "others" group had normal/non-obstructive CAD, nearly 1/3rdhad significant CAD which would impact not only the management plan but also the prognosis, we have no previous Indian data on this subset.

These all-comer study observations i.e. the proportion of LMCAD, number of vessels involved, vessel preponderance (LAD v/s non LAD) are well-known predictors of mortality among both ACS and SIHD population.

Strengths And Limitations

Strengths are 1) Highest sample size than any similar Indian studies and 2) All comer study providing a snapshot of CAD burden and distribution among patients undergoing CAG in a modern-day large volume tertiary care catheterization laboratory. Limitations are 1) Being a tertiary cardiac care center, referral bias is of concern2) As it was a retrospective study, complete clinical profile and outcomes were not studied 3) The CAG data were reviewed by a single investigator.

Conclusion

TVDs are common among NSTEMI/UA, and LMCADs among SIHD patients necessitating adequate risk stratification. Nearly a quarter of CAG

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studies showed normal/non-obstructive CAD, this proportion can be reduced by proper clinical evaluation and appropriate non-invasive pre-CAG workup.

What is already known?

Smaller studies from India have shown varied proportions of single and multivessel disease among different CAD clinical presentations.

What does this study add?

This is the single largest all-comer Indian study to date providing insight into the patterns of CAD distribution among various CAD clinical presentations. Such robust data is essential for patient management as well as for formulating customized health care policies and fund allocation for the management of CAD patients. SIHD often goes under-investigated, physicians need to be sensitized regarding the need to risk stratify such patients for better CAD management and outcomes.

Acknowledgments: We sincerely thank Mr. Sachin K, M.Tech (IIT-Bombay) for helping with Figure: 1 and Dr. John Jose (professor of cardiology, CMC Vellore) for helping with manuscript revision.

Table And Figure Legends:

Table 1: Patient characteristics and Clinical presentation of CAD

Table 2: Angiographic findings.

Table 3: Coronary artery disease distribution and clinical diagnosis.

Table 4: Comparison of pattern of CAD distribution with CAD clinical presentation.

Table 5-CAG findings from previous Indian studies.

Figure 1: Map showing similar studies reported from various Indian states

Abbreviations List:

CAD- coronary artery disease

STEMI- ST Elevation Myocardial Infarction

NSTEMI - ST elevation myocardial infarction

UA - Unstable angina

SVD – single vessel disease

DVD – Double vessel disease

TVD – Tripple vessel disease

LAD – left anterior descending artery

RCA- Right coronary artery

LCX- left circumflex artery

SIHD – stable ischemic heart disease

LMCAD – Left main coronary artery disease

Table 1: Patient characteristics and Clinical presentation of CAD

	Total N (%) 10972(%)	**Male N (%) 8497 (77.44)**	**Female N (%) 2475 (22.55)**	**P valve**
Age (yrs. ± SD)	54.58 ± 10.96	54.12±11.16	56.12±10.14	<0.001
Hypertension	2585(23.56)	1992 (23.4)	593 (24)	0.562
Diabetes	2391(21.79)	1767 (20.8)	624 (25.2)	<0.001
Post CABG	113(1.29)	100 (1.2)	13 (0.5)	0.005
Post PCI	290(2.64)	229(2.69)	61(2.46)	0.096
Diagnosis [Ω]				
STEMI	6518(59.6)	5248(61.97)	1270(51.45)	0.001
• **AWMI**	3965(60.83)	3232(61.59)	733(51.72)	0.883
• **IWMI**	2553 (39.17)	2016{23.81)	537(42.28)	0.816
NSTEMI/UA	2941 (26.89)	2226 (26.29)	715(28.97)	0.500
SIHD	889 (8.13)	620(7.32)	269(10.89)	0.170
Others	588 (5.34)	374(4.42)	214(8.67)	0.045

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ΩValues are based on total 10936 patients, 8468 (77.43%) males and 2468 (22.56%) females

Table 2: Angiographic findings.

	Total N (%) 10972 (%)	**Male (8497) (%)**	**Female (2475) (%)**	**P valve**
Normal coronaries/ Non obstructive CAD	2705(24.7)	1967(23.1)	738(29.8)	<0.001
SVD	4503(41)	3657(43.1)	845(34.1)	0.001
DVD	2027(18.5)	1559(18.3)	468(18.9)	0.003
TVD	1403(12.8)	1067(12.6)	336(13.6)	0.043
LMCA	334(3.0)	246(2.9)	88(3.6)	0.849
SINGLE VESSEL DISEASE				
Diseased artery	**N=4503 (%)**	**Male N=3679(%)**	**Female N=845(%)**	**P valve**
• **LAD**	2620(58.2)	2131(57.9)	489(57.8)	<0.001
• **LCX**	707(15.7)	574(15.6)	133(15.7)	0.981
• **RCA**	1176(26.1)	973(26.5)	223(26.4)	0.990
DOUBLE VESSEL DISEASE				
Diseased arteries	**N=2027 (%)**	**Male N=1559 (%)**	**Female N=468(%)**	**P valve**
LAD/LCX	770(38.0)	586(37.6)	184(39.3)	0.887
LAD/RCA	923(45.5)	713(45.7)	210(44.9)	0.579
RCA/LCX	302(14.9)	236(15.1)	66(14.1)	0.477
RCA/RI	9(0.4)	6(0.4)	3(0.6)	0.514
LAD/RI	23(1.1)	18(1.2)	5(1.1)	0.811
CORONARY DOMINANCE				
• **Right dominant**	8753 (79.8)	6729 (79.2)	2024 (81.8)	0.951
• **Left dominant**	1794 (16.3)	1438 (16.9)	356 (14.4)	0.771
• **Co-dominant**	425 (3.9)	330 (3.9)	95 (3.8)	0.997
ANOMALOUS CORONARY ARTERY	185 (1.7)	155 (1.8)	30 (1.2)	0.037

Table 3: Coronary artery disease distribution and clinical diagnosis

	STEMI N= 6518(%)	**NSTEMI/UA N=2941(%)**	**SIHD N=889(%)**	**Others N=588(%)**	**Missing diagnosis N=36(%)**	**Total N=10972(%)**
Normal/ non obstructive CAD	1551(23.8)	427(14.5)	293(33.0)	415(70.6)	19(52.8)	2705(24.7)
SVD	3266(50.1)	929(31.6)	218(24.5)	83(14.1)	7(18.9)	4503(41.0)
LAD	2045(62.6)	386(41.6)	136(62.4)	47(56.6)	6 (85.7)	
LCX	300(9.2)	347(37.4)	38(17.4)	22(26.5)	0	
RCA	921(28.2)	196(21.1)	44(20.2)	14(16.9)	1(14.3)	
DVD	1101(16.9)	725(24.6)	155(17.4)	42(7.1)	4(10.8)	2027(18.5)
TVD	525(8.1)	676(23.0)	158(17.8)	38(6.5)	6(16.2)	1403(12.8)
LMCAD	75(1.1)	184(6.3)	65(7.3)	10(1.7)	0	334(3.0)

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Table 4: Comparison of pattern of CAD distribution with CAD clinical presentation.

	STEMI v/s NSTEMI/UA N= 6518/2941	P valve OR (95% CI)	ACS v/s SIHD N=9459/889	P valve OR (95% CI)
Normal/ non obstructive CAD	1551/427 (23.8%/14.5%)	<0.001	1978/293 (20.9%/33.0%)	<0.001
SVD	3266/929 (50.1%/31.6%)	0.62 1.03(0.90-1.17)	4195/218 (44.3%/24.5%)	<0.001 0.35(0.29-0.42)
LAD	2045/386 62.6%/37.2%	<0.001 0.30(0.27-0.34)	2431/136 57.9%/62.4%	<0.001 0.43(0.36-0.53)
LCX	300/347 9.2%/37.3%	<0.001 1.87(1.58-2.20)	647/38 15.4%/17.4%	<0.001 0.46(0.32-0.64)
RCA	921/196 28.2%/21.1%	<0.001 0.34(0.29-0.40)	1117/44 26.6%/20.2%	<0.001 0.30(0.22-0.42)
DVD	1101/725 (16.9%/24.7%)	<0.001 2.39(2.07-2.75)	1826/155 (19.3%/17.4%)	<0.001 0.57(0.46-0.70)
TVD	525/676 (8.1%/23.0%)	<0.001 4.67(4.0-5.46)	1201/158 (12.7%/17.8%)	0.26 0.8(0.72-1.09)
LMCAD	75/184 (1.2%/6.3%)	<0.001 8.91(6.67-11.89)	259/65 (2.7%/7.3%)	0.001 1.69(1.25-2.28)

Table 5

Sl no	Author	Year of study/ publication	Place	Sample size	Obstructive CAD definition	Age group/Mean age (years)	CAG findings				
							Normal/Non obstructive CAD	SVD	DVD	TVD	LMCA
1.	Gopalakrishnan A et al (22)#	1978 - 2017	Kerala	159	>50	<30(26.6)	-	70.4	7.5	11.9	6.9
2.	Kaul U et al (23) $	1986	Delhi	104	NA	<40	22.1	25.2	20.2	30.1	-

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3.	H S Wasir et al(24)	1988	Delhi	1150	>75	<75	9.2	12.7	16.2	61.9	-
4.	J Dhawan et al (25)	1990	Delhi	30	>50	50	18	27	47	8	-
5.	~ T H Dave et al(26)#	1991	Delhi	101	NA	NA	30.7	15.8	12.9	39.6	-
6.	~R J pinto et al(27)#	1992	Bombay	47	NA	Premenopausal	64	17	6.9	13	-
7.	P K Biswas (28)#	1995	Calcutta	124	<40	NA	-	48.4	-	-	-
8.	~ A Oomman et al (29)#	1996 - 1998	Chennai	660	NA	Premenopausal	-	33	44.3	22.3	-
						Postmenopausal	-	22.1	31.2	46.6	-
9.	Naveen kumar et al (30)*	2008	Ludhiana	846	>70	<70	-	42.7	31.3	26	-
10.	Suresh G et al(31)#	2008 - 2014	Karnataka	154	>70	<40 (36.5±3.5)	27.6	48.1	15.8	8.5	-
11.	JayeshPrajapathi et al (32)$	2008 - 2012	Gujarat	109	NA	<40 (34.5)	25.7	52.3	13.8	5.5	2.8
12.	SurenderDeora et al (33)$	2010 - 2011	Karnataka	820	>70	<40	[A] 29	56.6	10.8	3.6	-
						<40	[B] 43.6	30.6	15.3	10.5	-
13.	Sricharan et al(34)*	2012	Karnataka	49	NA	<40 (37.03)	22.5	57.1	16.3	4	-
14.	Wani et al(35)$	2012 - 2014	Kashmir	30	>50	<35	23.3	60	10	6.7	-
15.	~ Nagamallesh et al(36)$	2012 - 2016	Karnataka	68	NA	<45	7.3	70.6	11.8	11.8	-
16.	~ Ezhumalai B et al (37)#	2013	Pondicherry	500	>70	53.7	54.6	17.4	16	12	-
17.	Sinha et al(38)*	2013 - 2015	Kanpur	1061	>70	<30(26.3)	17.4	57.6	12.9	5.3	2.6

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18.	Bhandari et al(39)*	2013 - 2014	Calcutta	55	NA	<35	8	64	24	4	-
19.	Sharma et al(7)$	2014	Karnataka	1443	>50	54.7 ± 19.9	[A]20.3	51.7	19	7.9	-
							[B]26.03	54.1	18.4	9.1	-
20.	Bhardwaj R et al(40)$	2014	Shimla	124	>50	<40 (35.9)	23.5	45.9	24.2	5.6	0.8
21.	Mohit Gupta et al(41)$	2014 - 2015	Delhi	97	NA	<35 (28.5)	19.6	67	11		-
				104		>35 (52.4)	6	65	33		-
22.	Prakash B et al(42)#	2015 - 2020	Jamshedpur	117	>70	<40 (35.8)	29.1	55.6	11.9	3.41	-
23.	Navdeepsingh et al(43)$	2015 - 2016	Karnataka	503	>50	56	[A]16.1	49.5	22.6	13.3	1.2
							[B]18.1	32.2	16.7	29.4	8.3
24.	Narayanswamy et al (44)#	2015 - 2018	Imphal	100	NA	58.58		71	20	9	-
25.	Vijay Pathak et al(45)$	2016	Jaipur	111	NA	<40	8	67.3	14.5	10.2	-
26.	Tejaspandya et al (46)*	2016 - 2017	Karnataka	300	>70	38.4 ±4.7	34.7	46	15.3	1	3
27.	Swain L et al(47)$	2016 - 2017	Odissa	150	>70	<40		68.7	22.6	8.7	-
28.	Iragavrapu et al(6)$	2016 - 2018	Andrapradesh	1151	>70	<40(36.11)	15.8	67.5	17.5	3.3	-
						>40 (56.4)	3.1	48.5	26.6	19.3	-
29.	Sajjanar et al(48)$	2017 - 2019	Karnataka	133	NA	<40(36.23)	5.2	76.6	18.2	-	-
30.	Pruthvi C et al(49)$	2018 - 2019	Chandigarh	182	>70	<40(35.5 ± 4.7)	26	53	12	13	4
31.	JayeshPrajapathi et al	2008 -	Gujarat	100	NA	<40	22	55	15	8	0
				100		>40	5	46	31	18	0

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	(50)$	2012									
32.	Kumbhalkar et al(5)#	2019	Nagpur	70	>70	<40 (32.9±3.9)	24.3	57.1	11.5	7.1	-
33.	P PDeshmukh et al(51)*	2019	Nagpur	41	>70	<30	39	53.7	4.9	2.4	0
34.	Karrapathi H et al(52)$	2020	Andrapradesh	208	>70	<80	6.48	45.4	24.1	17.6	-
35.	Present study¥	2018 - 2019	Karnataka	10972	>50	54.58 ± 10.96	24.7	41	18.5	12.8	3
36.	Alexander T et al (53)*	2012 - 2014	Tamilnadu	249		<40(39.2)	-	88.3	6.4	5.2	0
				813		>40(59.7)	-	70	12.1	13.9	0.3
37.	Shukla A N et al (54)*	2012 - 2014	Gujarat	757	>50	<40	41.17	44.73	9.6	4.5	
38.	Rajan B et al (55)*	2015 - 2016	Kerala	150	>70	<35	7.8	79.3	8	3.3	2
39.	Farhin Iqbal et al (56)$	2011 - 2012	Assam	704	>50	56.5	[A]8.6	63.3	20.1	5.7	2.4
							[B]30.4	35.3	14.6	16.6	3.6
40.	Kumar V et al(57)*	2019 - 2020	Delhi	75	>70	<35	13.3	68	9.3	9.3	0
41.	Battula et al(58)$	2015 - 2016	Andra	872	-	-	-	59.5	33.3	7.2	-
42.	~ HemaMalathi et al (59)$	2020	Kolkata	50	>50	<65	-	48	18	34	-
43.	~Manzil A et al (60)$	2017 - 2018	Kerala	179	>50	<55	16	24	28	32	-

Table 5: CAG findings from previous Indian studies. # indicates studies with STEMI+ NSTEMI/UA+ SIHD patients; $ is studies with STEMI+NSTEMI/UA; * is studies with STEMI; ¥ is study with STEMI+NSTEMI/UA+SIHD/others:: ~ is studies included only females:: A= STEMI , B= NSTEMI/UA , C=SIHD:: NA- data not available

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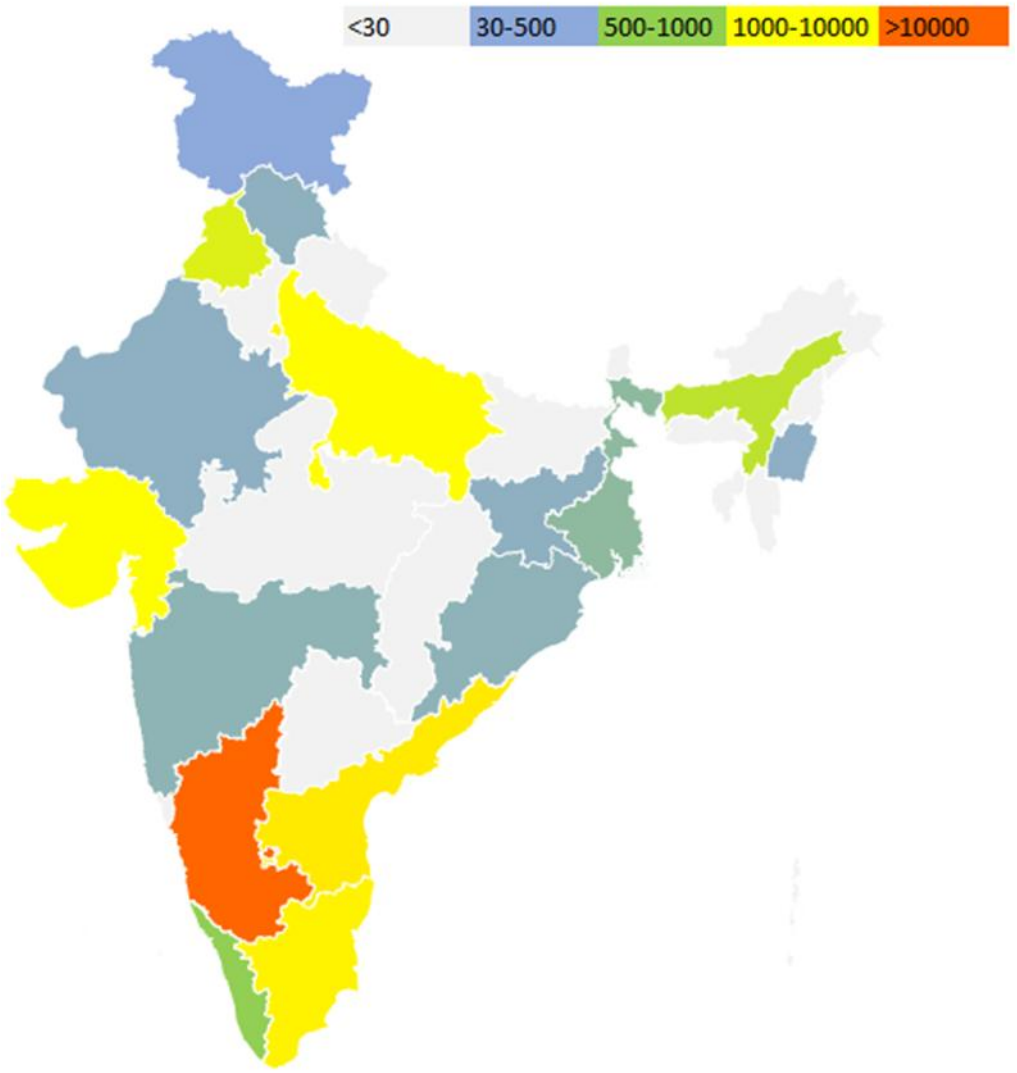
Figure 1:Map showing similar studies reported from various Indian states (Graded colour with number represents combined sample size from studies from each state)



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