Clinical and Angiographic Profile of Women with Acute Coronary Syndrome from a Large Tertiary Cardiac Care Center in South India – An Observational Study

Chaitra Doddamadaiah[1], Veena Nanjappa[1], Hema Raveesh[1], Devaraju Chandagalu Javaregowda[2], Kanchanahalli Siddegowda Sadananda[1], Manjunath Cholenahalli Nanjappa[1]

Departments of [1]Cardiology and [2]Clinical Research, Sri Jayadeva Institute of Cardiovascular Science and Research Centre, Mysuru, Karnataka, India.

*Corresponding author:
Dr. Veena Nanjappa,
Department of Cardiology,
Sri Jayadeva Institute of
Cardiovascular Science and
Research Centre, Mysuru,
Karnataka, India.

drdchaitra84@gmail.com

ABSTRACT

Objectives: Acute coronary syndrome (ACS) is the leading cause of death in women. There are limited studies exclusively in Indian women presenting with ACS. This is the first largest study in south Indian women. To assess Demographic, clinical and angiographic profile of women with ACS.

Materials and Methods: We collected data regarding baseline clinical, demographics, laboratory investigations, electrocardiogram, echocardiographic assessment, coronary angiogram details, treatment data, and outcomes in women presenting with ACS.

Results: Majority were in the age group between 55 and 65 year (35.886%). Most common comorbidity seen in our study group is hypertension (59.90%), followed by Diabetes milletus (DM) (54.80%). ACS patients most frequently presented with ST-elevation myocardial infarction (STEMI)-AWMI in postmenopausal group, premenopausal women presented more commonly with non-STEMI. Though SVD is the most common presentation in our study, TVD is most commonly seen in premenopauasal (25.45%) compared to postmenopausal women (11.81%).

Conclusion: Hypertension is the most common comorbidity seen in our study group, followed by DM. STEMI is the most common presentation. Higher mortality is seen in patients presenting late to the hospital and with higher Killip's class. More studies are needed in women with ACS.

Keywords: Acute coronary syndrome, Coronary angiogram, ST-elevation myocardial infarction, Non-ST-elevation myocardial infarction, Unstable angina

ABSTRACT IMAGE
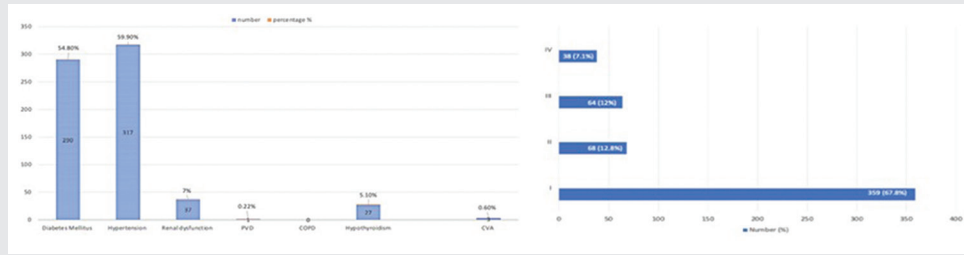
INTRODUCTION

Coronary artery disease is the leading cause of mortality in both developed and developing countries. Women have a longer time from symptom onset to presentation and are less likely to have guideline-directed treatment. This causes poor outcome in women as compared to men. There are limited studies regarding the clinical and angiographic profile of acute coronary syndrome in women in Indian scenario.

Cardiovascular disease has emerged as a major public health burden and a major cause of mortality in women in both developed and developing countries.[1,2] Significant differences in the prevalence of coronary artery disease (CAD) exist concerning gender, ethnicity, and age. It is predicted that more than half the worldwide cardiovascular disease risk burden will be borne by the Indian subcontinent in the next decade, according to a recent epidemiological study.[1] At any given age, the prevalence of CAD is greater in men than in women. As compared to men, women receive less medical attention in both rural and urban areas. Atherosclerotic plaque characteristics may differ by gender. It is said that women are protected from CAD by the protective hormones till menopause. However, recently, we are seeing a changing trend with acute coronary syndrome (ACS) increasing even in premenopausal women. Certain risk factors such as diabetes, metabolic syndrome, low high-density lipoprotein cholesterol and smoking are more causally related to CAD in women.[2,3]

A randomized sub-study of the Organization to Assess Strategies in Acute Ischemic Syndromes 5 trial in women presenting with an ACS suggests that women do worse with an early invasive strategy.[4] Although large trials including the women's health initiative and the women's ischemia syndrome evaluation have shed light on clinical characteristics, diagnosis, and outcome in women, they are largely western studies. In a study undertaken in Kerala at a tertiary center, women with ST-elevation myocardial infarction (STEMI) had higher mortality rates than males with STEMI.[5] In Kerala ACS registry,[6] the largest ACS data till date in the Indian scenario involving 25,748 patients over 2 years and across 125 centers had 22.6% women enrolment. There are limited studies on ACS exclusively in Indian women. Most of the data were taken from combined studies. In the present study, we aim to prospectively analyze the demographic, clinical risk factors, and angiographic profile of ACS in South Indian women presenting with the ACS in a tertiary cardiac care center.

Aim

The aim of this study was to assess the clinical profile, demographic factors, risk factors profile, angiographic profile, and severity of CAD in women presenting with the ACS and to compare the clinical profile, risk factors, and angiographic profile in premenopausal and postmenopausal age groups.

MATERIALS AND METHODS

It is a prospective observational single-center study conducted at Sri Jayadeva Institute of Cardiovascular Science and Research center, a tertiary cardiac center in Mysuru, Karnataka, India during the year 2020. Five hundred and twenty-nine consecutive women with a diagnosis of ACS after satisfying inclusion and exclusion criteria were chosen for the study. Baseline clinical, demographics, laboratory investigations, electrocardiogram, echocardiographic assessment, coronary angiogram (CAG) details, treatment data, and outcomes were recorded. STEMI, non-ST-elevation myocardial infarction (NSTEMI), and unstable angina (UA) were diagnosed following current guidelines. The data were collected from the patients and recorded in a pre-prepared case report form. Baseline data were recorded. The primary outcome was the overall rate of hospital admissions for ACS and deaths associated with ACS.

Inclusion criteria

The following criteria were included in the study:
1. Subjects willing to provide written informed consent.
2. All women presenting with ACS greater than 18 years of age were included in the study.

Exclusion criteria

Subject not willing to provide written informed consent.

Table 1: Baseline characteristics of the study population.

Variable	Frequency	Percentage
Age		
Range	28–91 years	
Mean±SD	43.94±6.85 years in premenopausal age and 63.89±9.51 in postmenopausal age group	
Less than 45 years	24	4.5
45–55	97	18.3
55–65 years	173	32.7
65–75 years	163	30.8
75 years and above	72	13.6
Diet		
Non-vegetarian	450	85.1
Vegetarian	79	14.9
Education		
10th or lower	393	74.3
Higher secondary	83	15.7
Degree	40	7.6
Postgraduation	2	0.4
Illiterate	11	2.1
BMI {kg/m^2}		
Range		
Mean±SD	22.16±5.29 kg/m^2	
Under weight (<18.5)	75	14.2
Normal weight (18.5–25)	262	49.5
Over weight (25–30)	147	27.8
Obese class I (30–35)	34	6.4
Obese class II (35–40)	10	1.9
Religion		
Hindu	475	89.8
Islam	51	9.6
Christianity	3	0.6
Occupation		
Home maker	519	98.1
Working	10	1.9
Area of living		
Rural	293	55.4
Urban	236	44.6
Marital status		
Not married	2	0.5
Married	527	99.5
Menstrual history		
Premenopausal	55	10.4
Postmenopausal	474	89.6
Socio-economic status		
Above poverty line	104	19.7
Below poverty line	425	80.3

Statistical analysis

The data are analyzed using Microsoft Excel and R-4.1.0 software. All the tests of significance are carried out at 5% level of significance. The descriptive results are displayed as subgroups of premenopausal and postmenopausal groups.

The numerical data are presented as mean and standard deviations. All the categorical data are presented as frequency and percentages. Descriptive statistics are used for frequency tables, summary statistics, and inferential statistics for independent sample *t*-test, which were used.

RESULTS

The mean age of patients is 43.94 ± 6.85 years in premenopausal age and 63.89 ± 9.51in the postmenopausal age group. There are 21 patients with age less than 45 years of age. There are 72 patients with age above 75 years. About 80.3% of patients belonged to the below poverty line group. About 89.6% of patients had attained menopause.

The mean BMI in the premenopausal group is 22.16 ± 5.287 kg/m^2 and in the postmenopausal age group is 23.66 ± 4.584 kg/m^2. Underweight is seen in 27.27% in the premenopausal group and 12.66% in the postmenopausal group. Overweight is seen in 27.8% and class II obesity seen in 1.9% of the study population. There are 85.1% non-vegetarians. There are 55.4% patients from the rural area [Table 1].

Time of onset of symptoms to reach the hospital: 178 patients (33.65%) with ACS reached hospital in less than 24 hours after symptom onset. 119(22.49%) patients presented within 24-48hours time period. 95(17.96%) presented in 48-72hours time period. 25.9% patients presented late after 72 hours. Typical chest pain during presentation seen in 97.5% of the study population. Atypical chest pain seen in 2.5%. Exertional dyspnea and exertional fatigue seen in 23.5% and 50% of the patients, respectively. Hypertension (59.90%) followed by diabetes mellitus (DM) (54.80%) is the most common comorbidity in our study group [Figure 1].

The presentation of ACS in our study group is STEMI – 62.38%, followed by NSTEMI – 24% and UA – 13.6%. Most common presentation is acute Anterior wall MI in the STEMI group followed by Inferior wall MI. Killip I presentation seen in 67.8% of the study population [Figure 2], followed by Killip's III (5.8%) and Killip's class IV (3.6%). In STEMI patients, moderate LV dysfunction seen in 25.7% and severe LV dysfunction seen in 2.27% [Tables 2 and 3].

CAG is done in 240 patients, in which non-obstructive CAD seen in 10.83%. About 36.67% presented with single-vessel disease. About 5.83% had LMCA involvement. Most common vessel involved is left anterior descending artery (LAD) (76.25%). PTCA procedure done in 69.17% of the patients who underwent CAG. Only 1% underwent CABG. Postprocedure access site hematoma is seen in three cases (0.75%) [Table 4].

Diabetes is seen in 42.86% in premenopausal versus 54.59% in the postmenopausal age group. Hypertension was seen
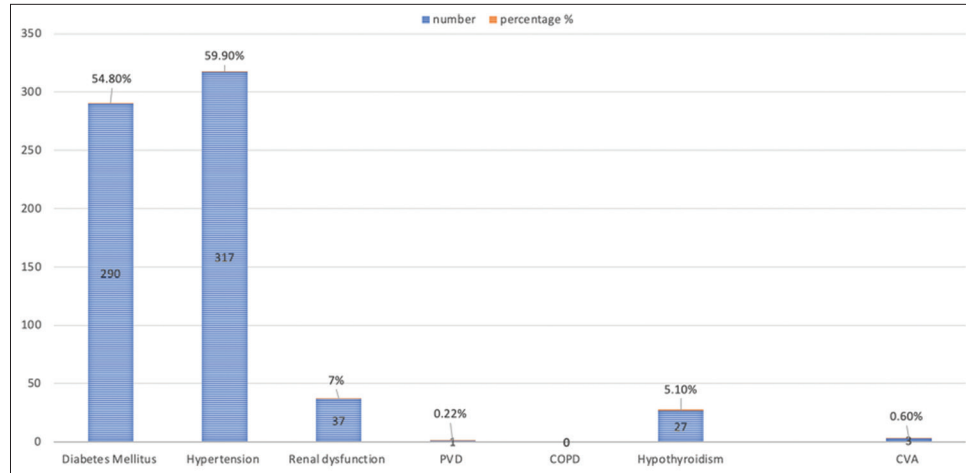
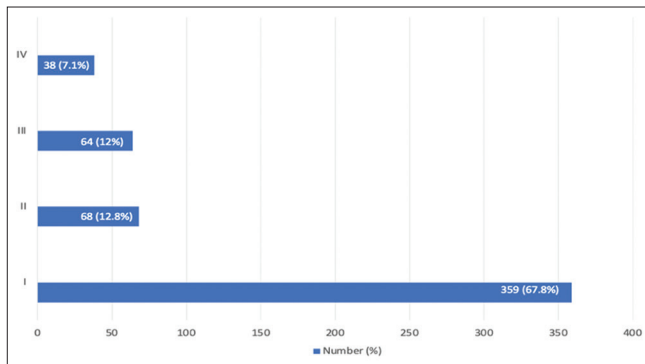**Figure 1:** Distribution of comorbidities among the study population.

Figure 2: Killip's score distribution among the study population.

in 47.61% of premenopausal women and in 63.5% of post menopausal women. About 66.67% presented with STEMI in premenopausal group versus 54% in the postmenopausal group. NSTEMI seen in 36.5% of the postmenopausal group. About 9.07% patients presented with Killip's IV in the postmenopausal group [Table 5].

Antiplatelets aspirin and clopidogrel are given as loading doses across all ACS groups; it was switched over to ticagrelor in 57.28% of cases. About 0.75% was on Prasugrel. Rest of the patients were continued on clopidogrel. About 59.35% were on beta-blockers and 51.22% were on ACE inhibitors. All patients received Statins.

Eighty-three patients died in hospital. Most common age group is 65–75 years (38.55%). No mortality seen in patients aged <45 years. Eighty-one (97.59%) patients were postmenopausal. About 87.95% belonged to below poverty line socioeconomic group. In patients who died, 56.62 % were hypertensive and 60.24% were diabetics. About 24.09% of patients had prior IHD. Chronic kidney disease seen in 3.61%. Fourteen (16.86%) patients had free wall rupture. Two (2.4%) patients had ventricular septal rupture.

Twenty-nine (34.93%) and 34 (40.96%) patients had severe and moderate LV dysfunction, respectively. Twenty-three (27.71%) were in Killip's class III and 55 (66.26%) were in Killip's IV at presentation. About 89.15% had STEMI, with majority having AWMI (57.83%). Sixty-six patients (79.5%) patients died within 24 h of admission. About 33.73% of patients died within 6 h of admission. Of the ten patients in the mortality group who underwent CAG, four of them had triple-vessel disease. Killip's classes III and IV, moderate LV dysfunction, underweight patients, and those from the urban area were found to be independent predictors of death on risk estimate analysis of in-hospital mortality.

DISCUSSION

The present study is the largest single-center data of ACS in women from the country. Cardiovascular disease is presently the most common cause of mortality in women. The major ACS trials that guide daily clinical practice disproportionately enrolled men. Women with ACS have more comorbidities than men and traditional risk factors affect the cardiovascular system differently in women[7] due to which the prognosis is also very poor in women. Receptors for estrogen, progesterone, and testosterone are expressed in varying numbers in both the endothelium and vascular smooth muscle of multiple vascular systems[8] and are one of the proposed mechanisms responsible for gender difference in vascular tone.

The mean age of presentation in the present study is 43.94 ± 6.85 years in premenopausal age and 63.89 ± 9.51 years in the postmenopausal age group as compared to 64.4 + 11 years in a study done by Nanjappa *et al.*[8] The mean age is higher when compared to a study done by Mahajan *et al.*[8,9] Most women, in our study, were postmenopausal (84.25%), whereas it was 79.7% in a study by Mahajan *et al.*[10] and Rissam *et al.*[11]

Table 2: Classification of the data based on type of MI and Killip's score.

	KILLIPS I	KILLIPS II	KILLIPS III	KILLIPS IV
STEMI (330 [62.38%])				
AWMI	143 (27.0%)	40 (7.5%)	31 (5.8%)	19 (3.6%)
IWMI	16 (3.0%)	3 (0.56%)	3 (0.56%)	2 (0.37%)
IWMI+RVMI	14 (2.6%)	6 (1.1%)	5 (0.9%)	3 (0.56%)
PWMI	5 (0.9%)	1 (0.1%)	3 (0.56%)	0
IWMI+PWMI	14 (2.6%)	4 (0.7%)	7 (1.3%)	11 (2.0%)
NSTEMI				
Total 127 (24%)	104 (19.6%)	11 (2.0%)	9 (1.7%)	3 (0.56%)
UA				
Total 72 (13.6%)	63 (11.9%)	3 (0.56%)	6 (1.1%)	0

STEMI: ST-elevation myocardial infarction, NSTEMI: Non ST-elevation myocardial infarction, UA: Unstable angina

Table 3: Classification of the data based on type of MI and LV function on echocardiography.

EF %	Normal	Mild LV Dysfunction (40–49%)	Moderate LV Dysfunction (30–39%)	Severe LV Dysfunction (<30%)
STEMI				
AWMI	31 (5.8%)	70 (13.23%)	124 (23.44%)	8 (1.5%)
IWMI	8 (1.5%)	11 (2.0%)	4 (0.75%)	1 (0.18%)
IWMI+RVMI	12 (2.2%)	12 (2.2%)	4 (0.75%)	0
PWMI	4 (0.75%)	5 (0.94%)	0	0
IWMI+PWMI	15 (2.8%)	16 (3.0%)	2 (0.37%)	3 (0.56%)
NSTEMI	85 (16.0%)	31 (5.8%)	10 (1.8%)	1 (0.18%)
UA	58 (10.9%)	8 (1.5%)	6 (1.1%)	0

STEMI: ST-elevation myocardial infarction, NSTEMI: Non ST-elevation myocardial infarction, UA: Unstable angina

Table 4: Assessment of angiographic parameters among the population.

	Total	Percentage
CAG	276	52.17
n=276		
Normal Coronaries	5	1.81
Mild CAD	24	8.7
SVD	128	46.38
DVD	67	24.28
TVD	70	25.36
LMCA	10	3.62
LAD	217	78.62
LCX	120	43.47
RCA	134	48.55
RI	7	2.54
Advised – PTCA	182	65.94
Advised – OMT	66	23.91
Advised – CABG	28	10.14

and 90.2% in Nanjappa et al.[8] About 36.1% patients had obesity (BMI >25 kg/m²).

About 40% of premenopausal and 56.54% of the postmenopausal group had DM and 45.45% of premenopausal and 61.6% in the postmenopausal group had hypertension.

These were the most common comorbidities, which were comparable other studies.[9] This contrasts with Mahajan et al.[10] study, in which the prevalence of diabetes was only 20.6% and hypertension was 69.7%. This shows that diabetes was more prevalent in women in South India compared to North India. About 30.4% and 37.7% in CREATE registry[12] and 30.2% and 29.6% in INTERHEART[7] study had diabetes and hypertension, respectively. These registries encompassed both men and women.

In our study, LDL cholesterol level is above 100 mg/dl in both pre- and post-menopausal women with P-value being significant. We could not find significant increase in total cholesterol triglyceride level in our study which highlights that though there is no major dyslipedimia, but still females in our study group suffered ACS.

Majority of our patients were in postmenopausal age group. Killip class IV presentation is predominantly seen in postmenopausal women. About 38.6% of women had Killip's class II–IV in SWEDEHEART study.[13] Associations between higher androgen and lower estrogen levels with CAD risk factors in postmenopausal women, including, insulin resistance, C-reactive protein, and blood pressure exist.[15-16] In the present study, anemia is seen in 55% of cases and dyslipidemia with elevated LDL cholesterol was seen in 66% cases.

Table 5: Comparison between pre- and post-menstrual groups with respect to various variables.

	Premenopausal group (*n*=55)	Postmenopausal group (*n*=474)	*P*-value
Age	43.95±6.85	63.88±9.51	<0.05
BMI	22.16±5.29	23.66±4.58	>0.05
Troponin T	0.87±1.44	1.09±1.7	
EF %	48.53±9.50	44.57±10.54	<0.05
RBS	160.0 9±101.54	201.29±126.15	<0.05
Total cholesterol	177.05±33.36	177.6±44.32	>0.05
LDL	105.42±17.76	116.26±34.6	<0.05
HDL	41.93±4.90	41.71±10.91	>0.05
TG	181.07±61.30	184.3 9±99.54	>0.05
Hb %	12.2±1.69	12.1±1.67	>0.05
Blood urea	34.49±13.94	33.92±17.29	>0.05
Serum creatinine	0.99±0.40	1.04±0.41	>0.05
STEMI			
AWMI	13 (23.64%)	220 (46.41%)	
IWMI	6 (10.9%)	18 (3.8%)	
IWMI+RVMI	3 (5.45%)	25 (5.27%)	
PWMI	1 (1.82%)	8 (1.69%)	
IWMI+PWMI	5 (9.09%)	31 (6.54%)	
NSTEMI	15 (27.27%)	112 (23.63%)	
UA	12 (21.82%)	60 (12.66%)	
DM	22 (40%)	268 (56.54%)	
Hypertension	25 (45.45%)	292 (61.6%)	
Hypothyroidism	3 (5.45%)	24 (5.06%)	
Killip's score I	49 (89.09%)	310 (65.4%)	
Killip's score II	4 (7.27%)	64 (13.5%)	
Killip's score III	0	64 (13.5%)	
Killip's score IV	2 (3.64%)	48 (9.07%)	
Normal LV function	29 (52.73%)	180 (37.97%)	
Mild dysfunction	14 (25.45%)	136 (28.69%)	
Moderate dysfunction	12 (21.82%)	144 (30.38%)	
Severe dysfunction	0	14 (2.95%)	
CAG			
SVD	8 (14.55%)	102 (21.52%)	
DVD	9 (16.36%)	58 (12.24%)	
TVD	14 (25.45%)	56 (11.81%)	
Mild disease	10 (18.18)	14 (2.95%)	
Normal Coronaries	1 (1.82%)	4 (0.84%)	
PTCA	22 (59.46%)	160 (66.95%)	
OMT	12 (21.81%)	54 (11.39%)	
CABG	4 (10.81%)	24 (10.04%)	
Death	2 (3.64%)	81 (17.09%)	<0.05

STEMI: ST-elevation myocardial infarction, NSTEMI: Non ST-elevation myocardial infarction, UA: Unstable angina, CAG: Coronary angiogram, DM: Diabetes mellitus

STEMI (62.38%) is the most common presentation in our study, followed by NSTEMI (24%) and UA (13.6%) which are comparable to other studies.[8] About 50.9% of premenopausal women and 54% of postmenopausal patients had STEMI at presentation.

In the present study, 45.36% of patients underwent CAG; the rest were treated medically. This contrasts with Nanjappa *et al.*[8] study. The reason could be that the present study involved more of rural than urban population compared to the latter study which was conducted in purely urban population. Among patients who underwent CAG, majority had single-vessel disease (76.25%) with LAD being the most common culprit vessel in 36% of cases, which is comparable to a study from Singapore, where 90% of women with Indian ethnicity had single-vessel disease.[14] Double-vessel disease and triple-vessel disease were seen in 25.83% and 25.41%, respectively. About 69.17% of CAG patients underwent percutaneous coronary intervention

(PCI) procedure. In comparison, PCI was done in only 11.9% of patients in the Kerala ACS registry and 7.5% in CREATE registry. About 47.8% underwent PCI in a study by Sadowski *et al.*[15]

LMCA involvement was seen in 5.83% which is comparable to Mahajan *et al.*[9] study and 3.4% in a study by Ezhumalai and Jayaraman[16] In the CADILLAC trial,[17] female gender was an independent predictor of MACE and bleeding complications, although comorbid risk factors and body surface area, and not gender, predicted 1-year mortality.

Eighty-three deaths were noted. Deaths noted in our study were higher compared to the registry data. This could be explained by the fact that our center caters to 5–6 surrounding districts with a predominantly agrarian population. Most of the deaths happened within 24 h of admission. About 75.89% were in Killip's classes III and IV at presentation. Delayed recognition of symptoms and presentation to the hospital at a later severe stage of the illness could explain the higher deaths. This study period overlapped with the COVID pandemic, and this could have also influenced the health-seeking behavior of patients. About 3.9% in the Kerala ACS[6] registry had in-hospital mortality with 8.2% in the STEMI group. In the AMI-FLORENCE registry, the in-hospital mortality for women was 16%.[18]

CONCLUSION

This prospective observational study in a large tertiary cardiac care center of South India illustrates significant differences in the clinical risk profile and angiographic disease pattern among premenopausal and postmenopausal women. Majority of the patients belonged to 55–65 years age group. Majority of the patients had typical chest pain and fatiguability as clinical manifestation. The most common comorbidities seen in our study group which is hypertension followed by DM. There is only a marginal difference in distribution of patients from urban and rural areas which are alarming, highlighting the fact that CAD is no more a disease limited to urban population. This fact will have cascading effect on health economic policies and the need for stringent addressal of risk factors and prevention of these risk factors at primary health-care level and robust system of linking the primary care to tertiary centers for better health-care delivery. The most common presentation is STEMI. Higher mortality is seen in patients presenting late to the hospital and with higher Killip's class. More studies involving women with the focus on demographic, clinical risk profile, CAD, and treatment strategies pattern would help in the formulation of evidence-based guidelines to prevent and treat optimally.

"A heart-healthy woman for a healthy society."

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Nil.

Conflicts of interest

There are no conflict of interest.

REFERENCES

1. Gupta R, Joshi P, Mohan V, Reddy KS, Yusuf S. Epidemiological and causation of coronary heart disease and stroke in India. Heart 2008;94:16-26.
2. Huxley R, Barzi F, Woodward M. Excess risk of fatal coronary heart disease associated with diabetes in men and women: Meta-analysis of 37 prospective cohort studies. BMJ 2006;332:738.
3. Gami AS, Witt BJ, Howard DE, Erwin PJ, Gami LA, Somers VK, *et al.* Metabolic syndrome and risk of incident cardiovascular events and death: A systematic review and metaanalysis of longitudinal studies. J Am Coll Cardiol 2007;49:40314.
4. Swahn E, Alfredsson J, Afzal R, Budaj A, Chrolavicius S, Fox K, *et al.* Early invasive compared with a selective invasive strategy in women with non-ST-elevation acute coronary syndromes: A sub study of the OASIS 5 trial and a meta-analysis of previous randomized trials. Eur Heart J 2012;33:51-60.
5. Misiriya KJ, Sudhayakumar N, Khadar SA, George R, Jayaprakasht VL, Pappachan JM. The clinical spectrum of acute coronary syndromes: Experience from a major center in Kerala. J Assoc Physicians India 2009;57:377-83.
6. Mohanan PP, Mathew R, Harikrishnan S, Krishnan M, Zachariah G, Joseph J, *et al.* Presentation, management, and outcomes of 25 748 acute coronary syndrome admissions in Kerala, India: Results from the Kerala ACS Registry. Eur Heart J 2013;34:12129.
7. Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanas F, *et al.* Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): Case-control study. Lancet 2004;364:937-52.
8. Nanjappa V, Aniyathodiyil G, Keshava R. Clinical profile and 30-day outcome of women with acute coronary syndrome as a first manifestation of ischemic heart disease: A single-centre observational study. Indian Heart J 2016;68:164-8.
9. Mahajan K, Kandoria A, Bhardwaj R, Negi PC, Asotra S, Gupta G. Clinical and coronary angiographic profile in women presenting with anginal chest pain: Results from a single-centre prospective observational study J Nat Sci Biol Med 2019;10:60-7.
10. Mahajan K, Negi PC, Merwaha R, Mahajan N, Chauhan V, Asotra S. Gender differences in the management of acute coronary syndrome patients: One year results from HPIAR (HP-India ACS Registry). Int J Cardiol 2017;248:1-6.
11. Rissam HS, Kishore S, Trehan N. Coronary artery disease in young Indians: The missing link. J Indian Acad Clin Med 2001;2:128-32.
12. Xavier D, Pais P, Devereaux PJ, Xie C, Prabhakaran D, Reddy KS, *et al.* Treatment and outcomes of acute coronary syndromes in India (CREATE): A prospective analysis of

registry data. Lancet 2008;371:1435-42.

13. Lawesson SS, Alfredsson J, Fredrikson M, Swahn E. Time trends in STEMI-improved treatment and outcome but still a gender gap: A prospective observational cohort study from the SWEDEHEART register. BMJ Open 2012;2:e000.

14. Xie CB, Chan MY, Teo SG, Low AF, Tan HC, Lee CH. Acute myocardial infarction in young Asian women: A comparative study on Chinese, Malay and Indian ethnic groups. Singapore Med J 2011;52:835-9.

15. Sadowski M, Gasior M, Gierlotka M, Janion M, Poloński L. Gender-related differences in mortality after ST-segment elevation myocardial infarction: A large multicentre national registry. Euro Interv 2011;6:1068-72.

16. Ezhumalai B, Jayaraman B. Angiographic prevalence and pattern of coronary artery disease in women. Indian Heart J 2014;66:422-6.

17. Lansky AJ, Pietras C, Costa RA, Tsuchiya Y, Brodie BR, Cox DA, *et al.* Gender differences in outcomes after primary angioplasty versus primary stenting with and without abciximab for acute myocardial infarction: Results of the controlled abciximab and device investigation to lower late angioplasty complications (CADILLAC) trial. Circulation 2005;111:1611-8.

18. Carrabba N, Santoro GM, Balzi D, Barchielli A, Marchionni N, Fabiani P, *et al.* In-hospital management and outcome in women with acute myocardial infarction (data from the AMI-Florence Registry). Am J Cardiol 2004;94:1118-23.