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Pattern of Coronary Artery Involvement in Patients Undergoing Coronary Angiography at Cardiac Center in Western Nepal

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Abstract

Background and purpose: Around the globe coronary artery disease (CAD) is the most prevalent cause of death which requires effective diagnosis and management. Coronary angiography (CAG) is the most trusted method for the diagnosis. This study aims to identify the indications, findings, and associated risk factors among the patients undergoing CAG and its correlation to gender and ethnicity.

Methods: The research involved a retrospective study of patients who underwent CAG from September 2017 to September 2023.

Result: A total of 2335 individuals were included in the study. The mean age was 58.99±11.60years. Male were 1463(62.7%) and females were 872(37.3%). The most common indication for CAG was acute coronary syndrome (ACS) 1270(54.8%) more common among males 860(67.24%). The most common arterial access was radial artery 2000(85.7%). Obstructive coronary artery disease was the most common finding, seen in 1,794 cases (76.8%), with a higher prevalence among males (1,202 cases, 67%). It was also more frequent among Muslims (84.3%), Terai/Madhesi (82.4%), and Dalits (82.3%). Multivessel involvement was the most common pattern, found in 1,060 cases (45.4%). It was more frequent in males (713 cases, 67.26%) and showed higher prevalence among Muslims (56.9%), Terai/Madhesi (53.2%), and Dalit groups (48.7%). The single vessel, double-vessel, and triple-vessel diseases were 734(40.91%), 516(28.76%), and 544(30.32%) respectively. The left main coronary artery disease was involved in 95(4.1%). Hypertension stood as the leading risk factor present in 903(38.7%) followed by Diabetes Mellitus in 714(30.6%) and Smoking in 563(24.1%).

Conclusion: The high prevalence of obstructive coronary artery disease and multivessel involvement, particularly among males, and individuals from the Terai/Madhesi, Dalit, and Muslim communities, underscores the need for targeted screening and early intervention strategies in these high-risk groups. Clinicians should maintain a high index of suspicion and prioritize timely diagnostic evaluation in these populations to improve outcomes and reduce cardiovascular burden.

Keywords: coronary angiography, coronary artery disease, acute coronary syndrome

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Introduction

The global burden of cardiovascular diseases is increasing day by day and the burden is disproportionately more among low and middle-income countries.[1,2] The disease burden is also on the rise in developing countries like Nepal. Cardiovascular disease has now emerged as a major public health problem in Nepal.[3] The most life-threatening disease among them is coronary artery disease. The presentation can be dramatic with patients presenting with acute coronary syndrome, including chest pain due to angina, or even be asymptomatic.[4]

A myriad of investigational tools is available nowadays for the evaluation of CAD. Among them, invasive coronary angiography has established itself as a gold standard method for the assessment of the presence of obstructive CAD both in stable CAD and for ACS.[4,5] This is the largest study of its kind conducted in this region of Nepal, addressing the existing gap in data on coronary angiographic profiles..

Materials and Methods

Study design

This was a hospital-based retrospective cross-sectional observational study performed for six years, from September 2017 to September 2023.

Inclusion criteria and exclusion criteria

A coronary angiogram of all the individuals was recorded. Both genders were included in the study. Patients aged below 18 years and those with incomplete records and missing data were excluded.

Sample size and sampling

A total of 2440coronary angiography cases were analyzed in this study. Due to missing data and incomplete records, 105 were excluded and 2335 were included in the study. A Non-probability convenience sampling method was used for the data collection. Coronary angiogram was reviewed by at least two experienced interventional cardiologists. Visual estimation of severity was done and the lesion was classified as normal (0% luminal stenosis in all vessels), mild coronary stenosis (1-49% luminal stenosis in at least 1 vessel), and obstructive CAD (≥50% in at least 1 vessel) as described by Pizzi C et al.[6] Findings were correlated with gender, ethnicity and their risk factors.

The ethnic classification of the individuals was by the Demographic and Health Survey. Population Division, Ministry of Health and Population, Government of Nepal, 2008.[7]

1. Brahmin and Chhetri
2. Terai/ Madhesi
3. Dalit
4. Newar
5. Janajati
6. Muslim
7. Others

Statistical analysis

The results are presented as mean (SD) for quantitative variables and as number (%) for categorical variables. For dichotomous variables, groups were compared using the Chi-square test. The means of the samples were compared using a t-test. A P-value of less than 0.05 was considered statistically significant. All statistical analyses were performed using the Statistical Package for Social Sciences, version 22.

Result

Of the total 2440 CAGs performed during the study period, 2335 were included. The mean age was 58.99±11.60 years. Of the total participants, 1,463 (62.7%) were male and 872 (37.3%) were female. The mean age of males was 59.26 years and females were 58.54 years.

Coronary angiogram results

Radial access was the most common vascular route 2000(85.7%) followed by femoral 327(14%) and ulnar 8(0.3%). Radial to femoral crossover rate was 4.5%.

Indications of CAG

The most common indication was ACS 1279(54.8%), followed by nonspecific chest pain 632(27.06%) and stable CAD 424(18.15%) as shown in Figure 1. Among the ACS, anterior wall MI was present in 539(42.14%), Inferior wall MI in 477(37.29%), NSTEMI in 165(12.9%) and unstable angina in 98(7.66%).

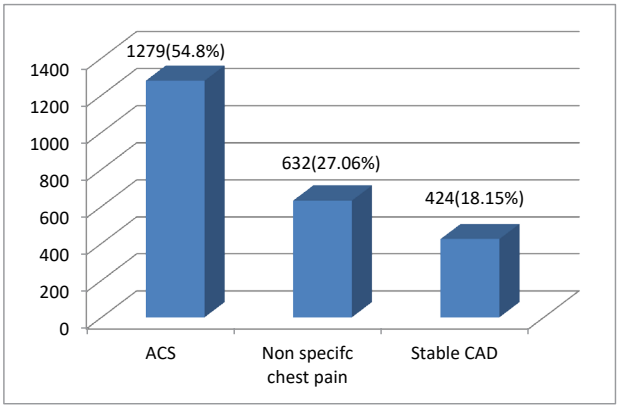

***Figure 1**: Distribution of indication for coronary angiogram*

Diagnosis

Normal CAG was 352(15.1%), mild coronary stenosis 189(8.1%) and obstructive coronary artery disease (CAD) was 1794(76.8%) as shown in figure 2.

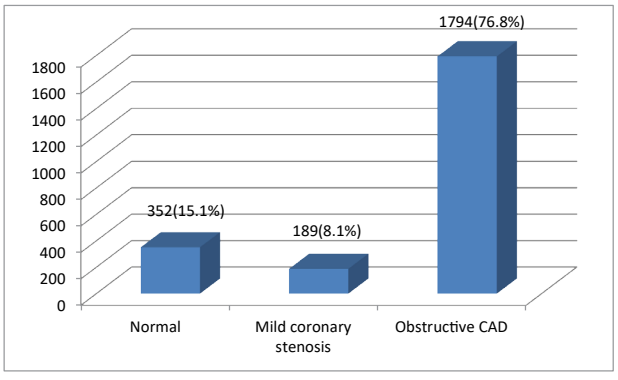

***Figure 2**: Coronary angiogram findings*

Among the obstructive CAD, Single vessel disease (SVD), double vessel disease (DVD), and Triple vessel disease (TVD) were seen in 734(40.91%), 516(22.1%), and 544(23.3%) respectively.

Among the patients with IWMI, the Right coronary artery (RCA) was involved in 360(75.5%) and left circumflex (LCX) in 117(24.5%). Multi-vessel involvement was seen in 1060(45.4%). In single vessel disease, the Left anterior descending artery (LAD) was involved in

406(55.31%) followed by RCA 222(30.24%) and LCX 106(14.44%). Left main disease (LMD) was present in 95 (4.1%) of the patients and among them, 10(0.4%) had isolated left main disease.

Risk Factor Evaluation

A total of 1680(71.9%) of patients had some risk factors. Hypertension (HTN) was the most common, present in 903(38.7%), followed by diabetes mellitus (DM) 714(30.6%), smoking status 563(24.1%), tobacco use 409(17.5%), alcohol use 337(14.4%) and dyslipidemia in 171(7.3%).

Distribution according to the gender

Table 1. Gender distribution and its correlation

Gender	Total-2335 (%)	Male 1463(62.7%)	Female 872(37.3%)	P-value
Indications for CAG				
Nonspecific chest pain	632(27.1)	335(22.9)	297(34.1)	
Stable CAD	424(18.2)	268(18.3)	156(17.9)	
ACS	1279(54.8)	860(58.8)	419(48.1)	
ACS				
AWMI	539(42.14)	370(25.3)	169(19.4)	
IWMI	477(37.29)	328(22.4)	149(17.1)	
NSTEMI	165(12.9)	108(7.4)	57(6.5)	
Unstable Angina	98(7.76)	54(3.7)	44(5.0)	
Diagnosis				
Normal	352(15.1)	157(10.7)	195(22.4)	<0.05
Mild coronary stenosis	189(8.1)	104(7.1)	85(9.7)	
Obstructive CAD	1794(76.8)	1202(82.2)	592(67.9)	
Obstructive CAD				
SVD	734(31.4)	489(33.4)	245(28.1)	
DVD	516(22.1)	347(23.7)	169(19.4)	
TVD	544(23.3)	366(25)	178(20.4)	
Multivessel CAD	1060(45.4)	713(48.7)	347(39.8)	
Left main disease	95(4.1)	65(4.4)	30(3.4)	0.23
Isolated LM disease	10 (0.4)	5(0.3)	5(0.6)	0.40
Risk Factors present	1680(71.9)	1171(80)	509(58.4)	<0.05
HTN	903(38.7)	569(38.9)	334(38.3)	0.77
DM	714(30.6)	468(32)	246(28.8)	0.05
Smoking	563(24.1)	441(30.1)	122(14)	
Tobacco	409(17.55)	363(24.8)	46(5.3)	<0.05
Alcohol	337(14.4)	292(20)	45(5.2)	
Dyslipidemia	171(7.3)	105(7.2)	66(7.6)	0.72

The most common indication for CAG both in gender was ACS. Among the patients with ACS, most were male 860(67.24%). Normal CAG was more common in females 195(55%). Obstructive CAD was more common among males 1202(67%). The presence of SVD, DVD, and TVD was more common in males 489 (66.6%), 347(67.2%), and 366(67.27%) respectively. Multi-vessel CAD was also more common in male 713 (67.2%). The left main disease was more in males 65(68.42%) but this was not statistically significant. Isolated left main was found equally in both sexes which were also not statistically significant. Risk factors were more prevalent in males (1,171 cases, 69.7%) compared to females. Specifically, diabetes mellitus (468 cases, 32%), smoking history (441 cases, 30%), tobacco use (363 cases, 24.8%), and alcohol consumption (292 cases, 20%) were notably higher in males, with these differences being statistically significant..

According to the ethnicity

Of the total angiographies performed, Brahmin and Chettri were 949(40.6%), Terai/Madhesi 340(14.6%), Dalit 226(9.7%), Newar 76(3.3%), Janajati 459(19.7%), Muslim 255(10.9%) and others 30(1.3%). The distribution of ethnicity is shown in table 2.

The results show that the most common indication of CAG was ACS in all ethnic groups. Obstructive CAD was found more among the Terai/ Madhesi, Dalits, and Muslims 280(82.4%), 186(82.3%), and 215(84.3%) respectively. Multivessel involvement was the most common in 1060(45.4%), more common in Muslims, Terai/Madhesi, and Dalits 145(56.9%), 181(53.2%), and 110(48.7%) respectively.

At least one risk factor was present in >70% of all ethnic groups except the other group had risk factors in 66.7%. Smoking was most common among Dalits 81(35.84%). Chewing tobacco was more common among the Muslims 88(34.5%) and Terai/ Madhesi 110(32.35%). HTN was more common among Brahmin/Chhetri, Newar, and in the "Other" subgroup.

Table 2: Distribution according to the ethnicity:

Ethnicity	Total(2335)	Brahmin/ Chhetri (949)	Terai/ Madhesi (340)	Dalit (226)	Newar (76)	Janajati (459)	Muslims (255)	Others (30)	p-value
Indications for CAG (%) Nonspecific chest pain Stable CAD ACS	632(27.1) 424(18.15) 1279(54.8)	267(28.1) 172(18.1) 510(53.7)	75(22.1) 58(17.1) 207(60.9)	53(23.5) 37(16.4) 136(60.2)	16(21.1) 15(19.7) 44(57.8)	150(32.7) 73(15.9) 237(51.6)	64(25.1) 61(23.9) 130(51)	7(23.3) 8(26.7) 15(50)	
ACS AWMI IWMI NSTEMI Unstable Angina	539(42.14) 477(37.29) 165(12.9) 98(7.76)	190(20) 227(23.9) 60(6.3) 33(3.5)	101(29.7) 62(18.2) 31(9.1) 13(3.8)	56(24.8) 50(22.1) 18(8) 12(5.3)	16(21.1) 15(19.7) 9(11.8) 5(6.6)	104(22.7) 76(16.6) 29(6.3) 27(5.9)	66(25.9) 40(15.7) 16(6.3) 8(3.2)	6(20) 7(23.3) 2(6.7) 0	
Diagnosis Normal Mild coronary stenosis Obstructive CAD	352(15.1) 189(8.1) 1794(76.8)	162(17.1) 83(8.7) 704(74.2)	38(11.2) 22(6.5) 280(82.4)	26(11.5) 14(6.2) 186(82.3)	8(10.5) 11(14.5) 57(75)	92(20) 40(8.7) 327(71.2)	24(9.4) 16(6.3) 215(84.3)	2(6.7) 3(10) 25(83.3)	<0.05
Obstructive CAD SVD DVD TVD	734(31.4) 516(22.1) 544(23.3)	314(33.1) 200(21.1) 190(20)	99(29.1) 81(23.8) 100(29.4)	76(33.6) 49(21.7) 61(27)	22(28.9) 21(27.6) 14(18.4)	147(32) 100(21.8) 80(17.4)	70(27.5) 60(23.5) 85(33.3)	6(20) 5(16.7) 14(46.7)	
Multivessel CAD	1060(45.4)	390(41.1)	181(53.2)	110(48.7)	35(46.1)	180(39.2)	145(56.9)	19(63.3)	
Left main disease	95(4.1)	33(3.5)	13(3.8)	9(4)	3(3.9)	20(4.4)	16(6.3)	1(3.3)	0.64
Isolated LM disease	10 (0.4)	1	3	2	0	4	0	0	0.18
Risk Factors present	1680(71.9)	678(71.4)	239(70.3)	179(79.2)	58(76.3)	323(70.4)	183(71.8)	20(66.7)	0.22
HTN	903(38.7)	407 (42.9)	108 (31.8)	88 (38.9)	37 (48.7)	163 (35.5)	86(33.7)	14(46.7)	
DM	714(30.6)	276 (29.1)	123 (36.2)	83 (36.7)	26 (34.2)	112 (24.4)	82 (32.2)	12(40)	
Smoking	563(24.1)	258 (27.2)	58 (17.1)	81 (35.8)	14 (18.4)	117 (25.5)	33 (12.9)	2(8.7)	<0.05
Tobacco	409(17.55)	81 (8.5)	110 (32.4)	51 (22.6)	5 (6.6)	71 (15.5)	88 (34.5)	3(10)	
Alcohol	337(14.4)	82 (8.6)	20 (5.9)	47 (20.8)	10 (13.2)	174 (37.9)	4 (1.6)	0	
Dyslipidemia	171(7.3)	73 (7.7)	21 (6.2)	21 (9.3)	8 (10.5)	27 (5.9)	18 (7.1)	3(10)	0.53

Table 2 shows the distribution and correlation of different parameters with ethnicity.

Discussions

Accurate diagnosis is of utmost importance in the evaluation of CAD. The diagnosis of stable CAD is best achieved nowadays by invasive CAG, a current gold standard.[8] Our study showed the most common indication for CAG was ACS 1279(54.8%). The ACC/AHA guideline also recommends CAG with the intent to perform PCI as a treatment of choice in STEMI as well as in patients with NSTEMI with high-risk features.[9]

CAG findings

Abnormal CAG was 1983(84.9%) and the normal was 352(15.1%). The presence of normal coronary is not uncommon in both chronic and acute coronary syndrome.[10] In a study done in Philipines[11] the normal coronaries were noted in 14% which is comparable to our study. According to a study done by Drabaa ZK et al., the incidence of normal coronary arteries observed during cardiac catheterization was 17.3%.[12] Meanwhile, a separate study by Bradley SM et al., reported that 21.4% of patients undergoing elective CAG had normal coronaries.[13]

The presence of obstructive CAD in our study was 1794(76.8%) mild coronary stenosis was 189(8.1%) and more in males 1202(67%). The result is similar to the study done in the Philippines where obstructive CAD was found in 75% of the patients.[11] The rate of obstructive CAD in another study by Ouellette ML et al was 55.5% but no gender differences in outcomes were observed.[14] In a study conducted at 691 U.S. hospitals, involving 565,504 patients without a history of myocardial infarction or revascularization who underwent elective CAG, the incidence of obstructive coronary disease was found to range from 23% to 100%.[15] In a study by Shaw et al, of the 375 886 patients, 58.7% had significant CAD.[16]

Among the obstructive coronary artery disease, the most common was SVD (40%). In a similar study, SVD was the most common finding (31%).[17] similar results were also seen in a study done in Iraq where SVD was 23.3%.[18] Left anterior descending artery (LAD) was the most frequently involved with 406 instances (55.31%), while RCA was affected in 222 cases (30.24%) and LCX in 106 cases (14.44%). A similar pattern was shown in other studies.[18,19]

Multivessel CAD

Multivessel CAD in our study was seen in 1060(45.4%). The findings are similar to the studies done in various other parts of the world. Meda JR et al 46%.[20] Baumann AA et al., reported a 42% prevalence of multivessel coronary artery disease in NSTEMI patients and about 40 to 50% prevalence observed in patients with STEMI.[21]

Left main disease

The prevalence of left main disease in our study was 4.1%, comparable to the 3.4% reported in a study by Ezhumalai B et al.[22]

Route of CAG

Femoral artery access is the time-tested method of performing percutaneous coronary interventions with some disadvantages like access site complications, and the need for recumbancy.[23] Majority of the CAG we performed was from the Radial artery 2000(85.7%). The findings are comparable to a study done by Lee Oh et al where the success rate of radial access was 83.3%.[24]

Risk factors

Coronary artery disease has been associated with various risk factors, including abnormal lipids, smoking, hypertension, diabetes, and alcohol consumption.[25] The most prevalent risk factors were HTN (38.7%). A 2014 study of residents aged 40-80 in Lamjung District, Nepal, reported a 42.9% prevalence of hypertension.[26] Similarly, research conducted in Iraq found hypertension to be the most common risk factor for CAD in patients undergoing CAG.[18]

Gender distribution

Among the total individuals who underwent CAG, male-dominated with 1463(62.7%) vs female 872 (37.3%). This shows gender differences in the utilization of the diagnostic procedure. Evidence suggests that women are less likely to undergo angiography and percutaneous coronary interventions, even in ACS situations.[27] Nonspecific chest pain, stable CAD, and ACS all were more common in males. STEMI NSTEMI and Unstable angina were more common in males (68.7%), (65.45%) and (55%) respectively. It has been shown in earlier studies that women are more likely to experience atypical chest pain than their male counterparts.[28] Among females, the common presentation of CAD was STEMI, in other studies the most common presentation was unstable angina or NSTEMI.[29] Normal coronaries was found mostly in females 195(55.4%) in our study. In a study done by Dave et al normal coronaries were found in 30.7%.[30] Obstructive CAD was more common in males (67% vs 33%). In a study done by Ezhumalai B et al[22] the prevalence of obstructive CAD was 45.4% in females. The study by Kim HL indicated that obstructive CAD was more prevalent in men (37%) compared to women (28.4%).[31] Similarly, Shaw et al., reported that the significant CAD affected 48.8% of women and 66.7% of men.[16] Almost 2/3rd of the females had obstructive CAD. In contrast to previous findings, which showed that nearly two-thirds of women undergoing elective CAG had non-obstructive CAD, this study presents a different outcome.[32] The reason could be the higher prevalence of increasing severe CAD among women of our population or early presentation at healthcare facilities. The presence of disease in a single, double, and triple vessel, is all significantly high among male SVD (66% vs 44%), DVD (67% vs 33%), and TVD (67% vs 33%). Similar presence of TVD among males was found in other studies.[33] The Multivessel CAD was high among the males (67% vs 33%). Studies conducted in the past have found multivessel disease and complex lesions are significantly less common in female patients compared to male patients.[33] Although the prevalence of left main disease was higher in males (68% vs 32%), the difference was not statistically significant. The findings align with a study by Kim et al., which also observed a higher prevalence of left main in men.[31]

Ethnic distribution

Ethnic variation in disease prevalence and presentation has been documented globally. According to cardiovascular registry data published by Shaw et al., there were notable variations in presentation and angiographic findings across different ethnic groups.[16] The proportion of CAG utilization differed significantly among the various ethnic groups. The majority of individuals undergoing CAG belonged to the Brahmin and Chhetri ethnic groups (949, 40.6%), while the lowest representation was from the 'other' category which primarily included individuals from the Marwari community. Ethnic differences in invasive cardiac procedure utilization have been documented in studies done across different parts of the world.[34] Studies have shown that cardiovascular disease presents differently among the different ethnic groups.[35,36] The most common indication for CAG was ACS across all ethnic groups. ACS was most common among Terai/Madhesi (60.9%) and Dalit (60.2%). There were wide variation in the findings of coronary angiograms across different ethnic groups. The study done by Shaw et al. revealed significant

variations in the likelihood of significant CAD at CAG and in-hospital mortality based on ethnicity and gender.[16] In the study conducted by Zaman MJ et al., there was a greater prevalence of CAD among South Asians.[37] This along with our study highlights the importance of doing further larger studies among the various ethnic groups. Obstructive CAD was highest among Muslims (84.3%), Terai/Madhesi (82.4%), Dalit (82.3%), and the individuals in the others category (83.3%). Of the total obstructive CAD, TVD was most common among Muslims (33.3%) and also in other categories (63.3%). The Multivessel CAD was highest among Muslims (56.9%) and others (63.3%).

The findings suggest that complex and severe CAD are common findings among Muslims, Dalits, and in the "other" category. One of the reasons could be the habit of chewing tobacco is quite prevalent in this part of Nepal and it was high among Muslims (34.50%) and Terai/Madhesi (32.35%). This association and other factors need to be studied in large randomized studies. The consumption of smokeless tobacco is prevalent in numerous regions globally, with WHO data highlighting South-East Asia as having the largest number of users.[38] In the case-control INTERHEART study, the odds ratio for non-fatal AMI was 2.23 (1.41-3.52) for chewing tobacco alone, while smokers who chewed tobacco had the highest increase in risk, with an OR of 4.09 (2.98-5.61).[39] A meta-analysis conducted in 2016 found that smokeless tobacco use was associated with an odds ratio (OR) of 1.40 (95%CI: 1.01-1.95) for non-fatal cardiac disease in Asia, but showed no significant effect in Europe (OR 0.91, 95% CI: 0.83-1.01). this association was confirmed by a 2018 study, which found a significant link between smokeless tobacco use and non-fatal cardiac disease in Southeast Asia (relative risk (RR) 1.30, 95%CI: 0.39-2.21), especially in Pakistan (RR 1.59, 95% CI: 1.34-1.83).[40] Similar associations with increased CAD risk in smokeless tobacco were also reported in the meta-analysis.[41]

A noteworthy observation was the occurrence of severe CAD among the "Other" groups. The majority of the group belonged to the Marwari community which is a strict vegetarian population. Studies have shown that a vegetarian diet is associated with an increased prevalence of hyperhomocysteinemia and decreased levels of serum vitamin B12.[42] Hyperhomocysteinemia has emerged as a significant risk factor for cardiovascular disease and atherosclerosis, with evidence showing that even mild levels can independently contribute to the risk of atherosclerosis and thromboembolic disorders.[43] In a Meta-analysis conducted by Sumit V. Unadkat et al, a significant association was found between higher homocysteine levels with CAD, although the certainty of the evidence was rated low. Additionally, the study noted that Asian and African populations had a stronger association compared to their European and American counterparts.[44] There is no direct causal relationship between homocysteine levels and cardiovascular outcomes, despite the evidence. Additionally, efforts to reduce plasma homocysteine through folate and vitamin B12 supplementation have not impacted cardiovascular outcomes.[45]

Study limitations

This study has several limitations that should be considered when interpreting the findings. First, the retrospective and observational nature of the study limits the ability to establish causal relationships between risk factors and outcomes. Data were collected from existing medical records, which may be subject to incomplete documentation, potential biases, and variability in diagnostic and treatment approaches over time. Second, as a single-center study, the findings may not be generalized to other institutions or populations with different demographic, geographic, or clinical characteristics. Third, the absence of randomization introduces the possibility of selection bias, as patients were not assigned to groups in a controlled manner. Finally, due to the limited sample size and non-prospective design, certain confounding factors may not have been adequately controlled.

Conclusions

The study highlights that ACS was the most frequent clinical indication prompting CAG, indicating its critical role in the early diagnosis and management of patients with suspected coronary artery disease. Among the angiographic findings, obstructive coronary artery disease emerged as the most common pathology. Notably, the prevalence of this condition was disproportionately higher among male patients and individuals belonging to the Terai/Madhesi, Dalit, and Muslim communities, suggesting potential sociodemographic and genetic predispositions. These findings underscore the importance of considering both clinical and population-based risk factors in cardiovascular assessment. However, to establish a definitive causal relationship between these risk factors and the angiographic outcomes—as well as to assess their impact on prognosis—larger, multicenter studies employing prospective, randomized methodologies are essential. Such studies would provide more robust evidence to guide risk stratification, prevention, and management strategies in diverse populations.

Conflict of Interest

The authors report no conflicts of interest.

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