

# Cardiovascular Risk Factors in Patients Undergoing Primary Percutaneous Coronary Intervention for ST-Elevation Myocardial Infarction and their Association with Left Anterior Descending Artery Involvement & Triple Vessel Disease

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## ABSTRACT

**Objective:** To determine the frequency of cardiovascular risk factors in patients presenting for primary percutaneous coronary intervention (P-PCI) and evaluate their association with left anterior descending artery involvement and triple vessel disease.

**Methodology:** This descriptive cross-sectional study was done at the Rawalpindi Institute of Cardiology, Rawalpindi from March 2019 to January 2021 after approval from the ethical review board. A total of 3000 patients with ST-elevation myocardial infarction (STEMI), who underwent P-PCI were enrolled by non-probability convenient sampling. The patient information including age, gender, predominant vessel, number of vessels involved, smoking status, left ventricular ejection fraction (LVEF), and history of diabetes mellitus and hypertension was noted on a proforma. Data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.

**Results:** Diabetes mellitus, hypertension, and smoking were present in 897(29.9%), 1216(40.5%), and 990(33%) of the patients, respectively. The left anterior descending artery (LAD) was involved in most of the cases (56.2%) followed by the right coronary artery (33.7%) while left circumflex was involved in 10.1% of the cases. Single vessel disease was present in 55.7% and triple vessel disease, (TVD) in 15.8% of the patients. Left anterior descending artery involvement was associated with age, gender, LVEF, triple vessel disease, and type of disease. However, there was no significant association found between the involvement of LAD and the occurrence of risk factors such as smoking, HTN, and DM. Triple vessel disease was associated with age, LVEF, predominance of vessel, and hypertension.

**Conclusion:** Risk factors such as diabetes, hypertension, and smoking are more common in patients presenting for P-PCI as compared to the general population. Triple vessel disease is associated with age, left ventricular ejection fraction (LVEF), the predominance of the vessel, and hypertension. Left anterior descending artery involvement is associated with age, gender, LVEF, triple vessel disease, and type of disease.

**Keywords:** ST-elevation myocardial infarction. Cardiovascular risk factors. Coronary artery disease.

## INTRODUCTION

Cardiovascular diseases (CVDs) are among the major cause of death, disability, and financial burden worldwide.<sup>1</sup> According to the data from 2018, the American Heart Association concluded that the death rate attributed to cardiovascular diseases was 217 per 100,000 people. In the United States, every 36 seconds a person dies due to myocardial infarction. Among the deaths caused by cardiovascular diseases, 42.1% are caused by coronary artery disease (CAD).<sup>2</sup> The World Health Organization reported that 16.49% of deaths are accounted to CAD leading to a mortality rate of 193 per 100,000 people. Cardiovascular diseases have declined significantly in western countries due to the scaling-up of preventive measures but they are still an important public health issue in developing countries.<sup>3</sup>

According to a study evaluating the burden of CVDs, it was estimated that cardiovascular diseases increased in

South Asia drastically from 1990 to 2019. The prevalence of CVDs increased up to 49.6% over the past 30 years. The relative increase in mortality was estimated to be about 30.3%. While ischemic heart disease was the major contributor to the mortality rate (56.51%), it was followed by stroke (29.77%) as the second most common cause.<sup>4</sup>

To curb the mortality rates attributed to CVDs worldwide, efforts are being put through timely intervention, medications, and public health measures in the past few years.<sup>5</sup> To further reduce the incidence, it is imperative to understand the role of modifiable and non-modifiable risk factors in the disease pathophysiology. According to the Framingham study, the emphasis should be to identify the risk factors and assess their role in disease causation. Some risk factors are non-modifiable risk factors such as gender, age, race, and family history. Modifiable factors such as smoking, diabetes mellitus, dyslipidemia, hypertension, and a sedentary lifestyle also have an important role in the disease pathogenesis and can be controlled.<sup>6</sup>

Studies done over the past three decades have associated triple vessel disease as an important risk factor for angina and myocardial infarction. A study reported that there is a significant association of TVD with major adverse cardiovascular events and mortality as compared to single or double vessel disease. The

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most common coronary artery being blocked is the left anterior descending. This artery supplies a large area of the heart muscle, including the interventricular septum, and the bundle branches. Its importance has been stressed with the acronym of ‘widow-maker’; because myocardial infarction due to blockage at the start of the left anterior descending artery has fatal consequences.<sup>7</sup> Non-modifiable risk factors make up more than 90% of the risk factors responsible for CVDs. Lifestyle changes and prevention regimes to combat the risk factors can reduce the burden of CVDs to a significant level. Triple vessel disease and left anterior descending artery dominance are the factors that increase the chances of developing the acute coronary syndrome.<sup>8</sup> However, risk factors leading to their development are still not widely studied individually. This study was designed to find out various risk factors which are present in patients undergoing primary percutaneous coronary intervention. Another aim was to find the risk factors which are responsible for LAD predominance and occurrence of TVD as angiographic finding in patients undergoing P-PCI.

#### METHODOLOGY

After taking approval from the institution ethics committee and informed consent, the study was done at the Rawalpindi Institute of Cardiology, Rawalpindi from March 2019 to January 2021. It was a descriptive cross-sectional study, in which 3000 patients who underwent P-PCI were enrolled by non-probability convenient sampling technique. The patient information including age, gender, predominant vessel, number of vessels involved, smoking status, ejection fraction, and history of diabetes mellitus and hypertension was noted on a proforma. Blood pressure greater than 130/80 mmHg on two separate occasions within 4 hours apart was labeled as hypertension. Diabetes mellitus was defined as HbA1C greater than 6%. According to the WHO’s smoking and tobacco use policy, a person who smokes any tobacco product on either a daily or occasional basis is defined as a smoker. The patients who presented with chest pain, diaphoresis, or apprehension as their primary symptoms, underwent electrocardiography and cardiac enzymes as per protocol. Based on the results, the patients were given medical treatment as per hospital protocol. Patients with ST-elevation myocardial infarction who presented within 12 hours duration of symptoms underwent P-PCI.

Contrast injected in coronary ostia following cannulation allowed imaging and subsequent assessment of the coronary arteries which facilitated the planning of further intervention. Vessels that were categorized as unsuitable for PCI included those that had diffuse disease not amenable to PCI or severely calcified or referred for coronary artery bypass grafting.

Vessels that fulfilled the criteria for further intervention were the ones with significant stenosis; major epicardial vessels or their branches with >70% stenosis or left main stem stenosis with >50% stenosis. Intervention for these cases involved PCI with percutaneous transluminal coronary angioplasty±stenting using drug eluting stents.

#### STATISTICAL ANALYSIS

Data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 25 and frequency & percentages were calculated. The involvement of LAD and the occurrence of TVD formed the basis of data stratification. Post-stratification Chi-square test was performed. A significant p-value was  $\leq 0.05$ .

#### RESULTS

Among the 3000 patients who presented with STEMI, 349(11.6%) were less than 40 years, 1803(60.1%) were between 40 to 60 years of age, while 848(28.3%) were greater than 60 years. Among the patients, 2563(85.4%) were males while 437(14.6%) were females. Diabetes mellitus, hypertension, and smoking were present in 897(29.9%), 1216(40.5%), and 990(33%) of the patients, respectively. Left anterior descending artery was involved in most of the cases (56.2%) followed by the right coronary artery (33.7%) and left circumflex artery was involved in 10.1% cases. Single vessel disease was present in 55.7% and TVD in 15.8% of the patients.

Left anterior descending artery involvement was more common among males when compared to females (57.1% versus 51%,  $p=0.018$ ). Similarly, LAD involvement was 67.3% in the age group <40 years followed by 56.6% in the age group 40-60 years, and 50.8% in >60 years age group. These differences were highly significant with a p-value <0.001. The lower the left ventricular ejection fraction (LVEF), the greater was the frequency of LAD involvement. In patients with LVEF <31%, the frequency of LAD involvement was 56.2% whereas, LAD was involved in 54.9% in patients with LVEF 31-50%. In cases with LVEF  $\geq 51\%$  LAD was involved in 47.3% of the patients. The association of LVEF and LAD involvement was statistically significant ( $p=0.029$ ). Similarly, the involvement of LAD was more common in single vessel disease while decreased with an increase in the involvement of vessels; single vessel disease (63.1%), double vessel disease (49.8%), and triple vessel disease (43.7%),  $p < 0.001$ . However, there was no significant association found between the involvement of LAD and the occurrence of risk factors such as smoking, HTN, and DM.

Triple vessel disease was frequent among patients in the age group greater than 60 years, while least among the age group <40 years (>60 years:23%, 40-60

years:14.4%, <40 years:5.7%, p <0.001). Similarly, a greater percentage of participants with decreased ejection fraction had TVD (<31%:27.7%, 31-50%:12.1%, ≥51%:1.4%). Triple vessel disease was more common in patients with the predominant right coronary artery (20.5%) followed by the left circumflex

artery (19.9%) and left anterior descending artery (12.3%), p <0.001. While the occurrence of TVD did not have a significant difference among gender, smoking, and DM but was significantly associated with HTN (14.1%, p=0.031) (Table 1).

**Table 1: Association of Various Demographic Variables and Risk Factors with Left Anterior Descending Artery Involvement and Triple Vessel Disease**

Variables		Total Numbers of Patients	Left Anterior Descending Artery Involvement			Triple Vessel Disease		
			Yes	No	p-value	Yes	No	p-value
Age Groups (Years)	<40	349(11.6%)	235(67.3%)	114(32.7%)	<0.001*	20(5.7%)	329(94.3%)	<0.001*
	40-60	1803(60.1%)	1021(56.6%)	782(43.4%)		259(14.4%)	1544(85.6%)	
	>60	848(28.3%)	431(50.8%)	417(49.2%)		195(23%)	653(77%)	
Gender	Male	2563(85.4%)	1464(57.1%)	1099(42.9%)	0.018*	395(15.4%)	2168(84.6%)	0.158
	Female	437(14.6%)	223(51%)	214(49%)		79(18.1%)	358(81.9%)	
Left Ventricular Ejection Fraction	<31%	967(32.2%)	543(56.2%)	424(43.8%)	0.029*	268(27.7%)	699(72.3%)	<0.001*
	31-50%	1665(55.5%)	914(54.9%)	751(45.1%)		201(12.1%)	1464(87.9%)	
	≥51%	368(12.3%)	174(47.3%)	194(52.7%)		5(1.4%)	363(98.6%)	
Triple Vessel Disease	Yes	474(15.8%)	207(43.7%)	267(56.3%)	<0.001*	474(100%)	0(0%)	-
	No	2526(84.2%)	1480(58.6%)	1046(41.4%)		0(0%)	2526(100%)	
Type of Disease	Single	1672(55.7%)	1055(63.1%)	617(36.9%)	<0.001*	0(0%)	1672(100%)	-
	Double	854(28.5%)	425(49.8%)	429(50.2%)		0(0%)	854(100%)	
	Triple	474(15.8%)	207(43.7%)	267(56.3%)		474(100%)	0(0%)	
Predominant Vessel	Right Coronary Artery	1011(33.7%)	0(0%)	1011(100%)	-	207(20.5%)	804(79.5%)	<0.001*
	Left Anterior Descending Artery	1687(56.2%)	1687(100%)	0(0%)		207(12.3%)	1480(87.7%)	
	Left Circumflex Artery	302(10.1%)	0(0%)	302(100%)		60(19.9%)	242(80.1%)	
Diabetes Mellitus	Yes	897(29.9%)	492(54.8%)	405(45.2%)	0.318	152(16.9%)	745(83.1%)	0.261
	No	2103(70.1%)	1195(56.8%)	908(43.2%)		322(15.3%)	1781(84.7%)	
Smoking Status	Yes	990(33%)	567(57.3%)	423(42.7%)	0.421	151(15.3%)	839(84.7%)	0.564
	No	2010(67%)	1120(55.7%)	890(44.3%)		323(16.1%)	1687(83.9%)	
Hypertension	Yes	1216(40.5%)	688(56.6%)	528(43.4%)	0.753	171(14.1%)	1045(85.9%)	0.031*
	No	1784(59.5%)	999(56%)	785(44%)		303(17%)	1481(83%)	
DM and Smoking	Yes	280(9.3%)	156(55.7%)	124(44.3%)	0.854	47(16.8%)	233(83.2%)	0.635
	No	2720(90.7%)	1531(56.3%)	1189(43.7%)		427(15.7%)	2293(84.3%)	
Hypertension and Smoking	Yes	424(14.1%)	242(57.1%)	182(42.9%)	0.706	58(13.7%)	366(86.3%)	0.196
	No	2576(85.9%)	1445(56.1%)	1131(43.9%)		416(16.1%)	2160(83.9%)	
DM and Hypertension	Yes	139(4.6%)	78(56.1%)	61(43.9%)	0.977	17(12.2%)	122(87.8%)	0.237
	No	2861(95.4%)	1609(56.2%)	1252(43.8%)		457(16%)	2404(84%)	
All Three Present	Yes	139(4.6%)	78(56.1%)	61(43.9%)	0.977	17(12.2%)	122(87.8%)	0.237
	No	2861(95.4%)	1609(56.2%)	1252(43.8%)		457(16%)	2404(84%)	

\*Significant p-value ≤ 0.05

## DISCUSSION

This study was done to determine the risk factors present in patients undergoing PCI for STEMI. The male to female ratio in our study was found to be 5.800:1.000, while according to prevalence studies in Pakistan, the male to female ratio was 1.033:1.000.<sup>9</sup> This shows that males are more likely to present for P-PCI as compared to women.

In our study, 15.8% of the patients suffered from triple vessel disease, 28.5% had double vessel involvement, and 55.7% had a single vessel disease. A study reported a much higher frequency of triple vessel disease in patients with non-ST-elevation MI patients (30.3%) as compared to single vessel disease (69.7%).<sup>10</sup> Similarly, another study conducted on 2225 patients revealed that 31.9% of patients had TVD and among them, the predominance of LAD was 58.4%.<sup>7</sup> This was similar to the current study as LAD predominance was reported in 56.2% of the patients. A study conducted by Sinha and colleagues reported that LAD was the dominant vessel blocked in 58.1% of the patients while TVD occurred in 6.6% of the patients.<sup>11</sup> Although, the prevalence of LAD blockage was comparable to our study but TVD was in higher proportion in our study.

Our study reported that diabetes mellitus, hypertension, and smoking were present in 29.9%, 40.5%, and 33% of the patients, respectively. The prevalence of smoking was 13.4%, diabetes mellitus was 30.8%, and hypertension was 26.34% in the general population in Pakistan.<sup>12-14</sup> This analysis shows that the patients who presented for PCI had these risk factors in a greater proportion than the general population. Shang et al. reported that hypertension was the most common risk factor (71.1%), followed by smoking (63.8%) and overweight/obesity (63%). Other risk factors were dyslipidemia (39%), diabetes mellitus (35.8%), and a history of previous CAD (14.2%).<sup>15</sup> The frequency of risk factors is quite high as compared to our study. An Indian study also reported the incidence of smoking at 78.5%, hypertension at 20.5%, and diabetes at 17.2%. These were not comparable to our study and this is attributable to the different age groups of the sample populations.<sup>16</sup>

In addition to determining the prevalence of risk factors and angiographic findings among the patients in this study, the association of various factors was seen with TVD and LAD involvement. Triple vessel disease was significantly associated with age, LVEF, the predominance of the vessel, and hypertension ( $p < 0.05$ ). Although the current study did not find significant differences with diabetes, another study conducted on non-ST-elevation MI patients reported that patients with triple vessel disease had a higher incidence of diabetes (90.4% vs 33%,  $p < 0.001$ ). The study did not find any significant association with age, gender, smoking, and hypertension.<sup>10</sup> A study

conducted in Mexico reported a prevalence of 18.2% of patients with TVD and it had an association with gender, hypertension, diabetes mellitus, previous episodes of myocardial infarction, and heart failure.<sup>17</sup>

Our study showed that left artery involvement was associated with age, gender, LVEF, TVD, and type of disease. Left anterior descending predominance was more common in younger patients (67.3%) as compared to older patients (50.8%). This difference was significant. It was more common among males (57.1% vs 51%,  $p < 0.001$ ) and less common among patients with triple vessel disease (43.7%). Adding further, it was more common among patients with a single vessel disease as compared to the double vessel or triple vessel disease ( $p < 0.001$ ). Another study showed a strong relationship between LAD blockage and subsequent development of myocardial infarction but still was not been able to isolate factors that determine the increased probability of LAD involvement.<sup>18</sup> Hence, the current study adds important aspects to the present literature.

## CONCLUSION

Risk factors such as diabetes, hypertension, and smoking are more common in patients presenting for P-PCI as compared to the general population. Triple vessel disease is associated with age, left ventricular ejection fraction, the predominance of the vessel, and hypertension. Left anterior descending artery involvement is associated with age, gender, left ventricular ejection fraction, triple vessel disease, and type of disease.

## LIMITATIONS & RECOMMENDATIONS

The study determined the frequency of cardiovascular risk factors, triple vessel disease, and LAD involvement in patients presenting for P-PCI for STEMI but it did not evaluate the association of these factors with major adverse cardiovascular events and mortality. Future studies are required at a multicenter level which not only determine the prevalence of risk factors but also evaluate their association with adverse outcomes.

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