Original Article

Exploring Trends and Burden of Coronary Artery Disease and its Risk Factors: A Case Control Study

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ABSTRACT

Background: Cardiovascular Disease (CVD) has emerged as the foremost non-communicable health challenge globally, accounting for the majority of deaths. This rising prevalence is driven by lifestyle transitions, demographic shifts, and under-recognized risk factors. Despite this growing concern, population-based evidence on CVD prevalence and its determinants remains limited. The present study aimed to estimate the prevalence of CVD and investigate the contribution of major risk factors in the development of coronary artery disease.

Methods: This case-control study was carried out among 216 adults aged above 30 years. Participants were recruited using consecutive sampling methods. Information on demographics, smoking, physical activity, diet, family history, and medical conditions was obtained through medical records. Patients with developed coronary artery disease (cases) and the participants who have not developed the disease (controls). Prevalence was expressed as percentages with 95% confidence intervals. Chi-square tests assessed group differences, while binary logistic regression identified independent predictors of CVD.

Results: Study participants were evenly distributed into cases and controls. The distribution of CVD was higher in males (69.4%) compared to females (39.6%) and rose sharply with increasing age (24.5% in > 50 years versus 10.6% in <40 years, $p < 0.05$). In regression analysis, hypertension (OR = 1.356), diabetes mellitus (OR = 1.706), dyslipidemia (OR = 2.733), obesity (OR = 1.00), and smoking (OR = 1.606) were independently associated with CVD, after adjusting for age and sex.

Conclusion: This study reveals that the most important independent risk factor for coronary artery disease in the studied population is dyslipidemia, found in cases in comparison to controls. Furthermore, the prevalence of CAD in older persons points to the necessity of focused screening initiatives in these demographics.

Keywords: *Cardiac condition, Heart Disease, Metabolic disease, Non-communicable Diseases, Socioeconomic Factors.*

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INTRODUCTION

A number of diseases that are non-communicable diseases (NCDs) are accountable for the majority of deaths across the globe. This includes cardiovascular disease, cancer, diabetes and chronic lung illnesses.[1] Of all NCDs mortality that occurs in middle and low income countries, cardiovascular diseases (CVDs) make up the greatest contribution.[2] CVDs comprise a wide range of conditions that includes ailments affecting heart musculature and the vascular system that carries blood and oxygen to the brain, heart, and other essential organs.[3] WHO has included coronary heart disease, peripheral artery disease, peripheral arterial disease, cerebrovascular disease, rheumatic heart disease, and deep venous thrombosis and pulmonary embolism in the classification of CVD.[1] According to the World Heart Federation (WHF), the term cardiovascular disease (CVD) refers to a group of illnesses that impact the heart or blood vessels, including the veins and arteries. It may result from a combined effect of environmental, behavioral, and socioeconomic risk factors. The World Health Federation has hinted at the causes of CVD such as a combination of environmental, behavioral, and socio-economic, risk elements, including high

cholesterol, high blood pressure, unhealthy diet, air pollution, diabetes, physical inactivity, obesity, tobacco use, stress and harmful use of alcohol. Ethnic background, age, family history apart from them some factors like socioeconomic status, sedentary lifestyle, smoking, dyslipidemia, HTN, DM, obesity are some modifiable risk factors for developing CVD.[4]

The modifiable factors of risk have been proven to play a major role in the occurrence of CVD and are commonly found in the Pakistani population.[5] The American Diabetic Association (ADA) has stated that Diabetes is among the main risk elements for CVD development and is the biggest contributing agent of type 2 diabetes mortality, which is accounting for 2/3 of all deaths from this condition. The risk of heart disease or a stroke is also twice as high in individuals who are with diabetes as compared with individuals without the disease.[6] According to the American Heart Association (AHA), there are studies which have shown the relationship between insulin resistance (a finding of diabetes) and high blood pressure. When patients have both elevated blood pressure and diabetes, which is a common combination, their risk for CVD increases even more.[7] As reported in a study of Khan et al., (2021), commonly the consequence of smoking is the fatal CVD event in comparison to those who did not smoke. Also, it is evident that dyslipidemia is more common in urban areas as compared to the rural regions and the population with dyslipidemia was at greater risk of having CVD.[8,9]

Certainly, a number of studies have shown the positive relation in the development of CVD and the modifiable risk factors. These factors, in combination or in isolation, affect cardiovascular health, although extent might vary. Our study will put light on to the extent to which the Pakistani population is exposed to develop CVD. There are certain modifiable risk factors through which we can limit the development and progression of non-communicable diseases such as cardiovascular disease by modifying their risk factors. The purpose of this study is to evaluate the association of dyslipidemia, diabetes mellitus, obesity, hypertension, smoking and lifestyle among patients with cardiovascular disease in comparison to the control group.

METHODOLOGY

Study Design

The present study is a multicenter retrospective case-control study.

Study Setting

The data for this study was collected from the tertiary care hospitals of Karachi and Hyderabad, Pakistan.

Sampling Technique

The Consecutive Sampling method was used

Selection Criteria

Patients with developed coronary artery disease (cases) and the participants who have not developed the disease (controls), that include the participants who came for regular checkups, and in-patients who are admitted for other than coronary artery disease, had been entitled and through their records, exposure to risk factors (hypertension, obesity, dyslipidemia, diabetes mellitus, smoking and sedentary lifestyle) was determined.

Sample Size

The sample size was calculated by using OpenEpi software. By using the reference article "Burden of Cardiovascular Diseases in South Asian Region from 1990 to 2019: Findings from the Global Burden of Disease Study." The confidence level was kept at 95% and power of study as 80%. The calculated sample size came out to be 216 (108 in each group.

Data Collection Procedure

In order to measure the association and extent of frequency of exposure to risk factors (dyslipidemia, DM, HTN, obesity, smoking and sedentary lifestyle) in the development of cardiovascular disease, we conducted a case-control study. The cases were patients with coronary artery disease, aged > 30 years. Participants were designated as cases and control groups on the basis of Coronary Artery Disease presence. The controls were recruited

from the same region as the patients. Control patients did not have experienced coronary artery disease in relation to the risk factors.

Ethical Considerations

Ethical approval was obtained from Ethical Review Committee of Ziauddin University (9020824ASREH). All data was anonymized before analysis to protect participant privacy and confidentiality, and no individual could be identified from the findings. In order to guarantee adherence to best standards in research ethics, especially with regard to privacy, and confidentiality, ethical review was sought through an exemption process.

Data Analysis

Data was entered and analyzed through SPSS v.22. Descriptive statistics were used to measure demographic characteristics of participants. P-value < 0.05 is considered statistically significant. Risk of exposure determined through odds ratio.

RESULTS

Demographic Characteristics

The study had collected data from 216 participants. The recruited participants were evenly distributed between the case group (individuals diagnosed with coronary artery disease) (n = 108, 50.0%) and the control group (Individuals with no CAD) (n = 108, 50.0%). The demographic analysis showed male predominance (n = 150, 69.4%), while females were 30.6% (n = 66). The population was recruited equally from two tertiary care centers. The age distribution analysis showed the highest prevalence among age group 51-60 (53; 24.5%) followed by age group 41-40 (35; 16.2%) and then age group 31-40 (23; 10.6%) (Table-1).

Table 1: Age Group Distribution

Age Group	Frequency	Percentage
31-40	23	10.6%
41-50	35	16.2%
51-60	53	24.5%
Above 61	105	48.6%

Gender Distribution

The demographic analysis showed male predominance (n = 150, 69.44%), while females were 30.56% (n = 66) (Fig.1).

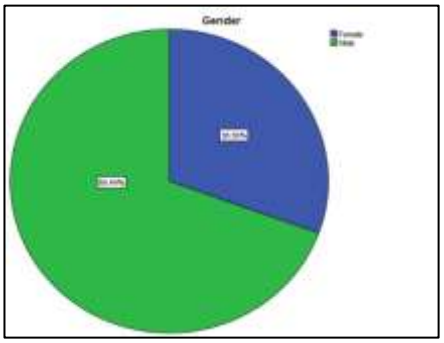

Fig.1 Demographic Distribution of Participants by Gender

Distribution of Risk Factor

A greater frequency of metabolic risk aspects was observed: Hypertension (58.3%), Diabetes Mellitus (60.6%), Dyslipidemia (55.1%), and Physical Inactivity (51.6%) (Fig.2).

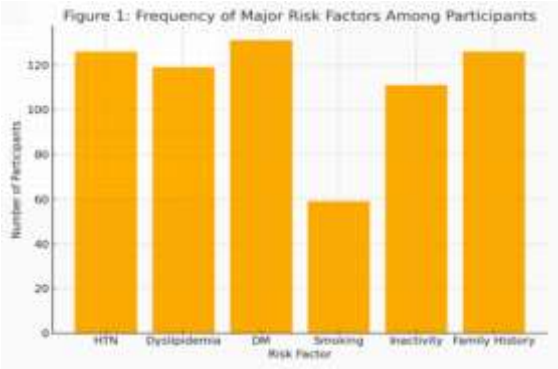

Fig.2 Frequency of Major Risk Factors among Participants

Risk Factor Association

To evaluate the association between different risk factors and the chance of developing coronary artery disease (cases), odds ratios were computed in this study. With the odds ratio of 3.306 (95% CI: 1.886 - 5.794), those who had dyslipidemia had a considerably increased chance of becoming a case, suggesting a strong and statistically significant relation. Smoking status also showed a statistically significant association, with smokers having 1.848 times higher odds of being a

case (95% CI: 1.004 - 3.401), though the result was marginally significant given the lower confidence bound just above 1. Other variables, including BMI, diabetes mellitus, hypertension and physical activity did not show statistically significant associations.

Specifically, the odds ratios and confidence intervals were as follows: BMI (OR = 0.830, 95% CI: 0.486 - 1.418), DM (OR = 1.535, 95% CI: 0.886 - 2.660), HTN (OR = 1.357, 95 % CI: 0.789 - 2.335), physical activity (OR = 1.480, 95% CI: 0.864 - 2.533). (Table-2).

Table-2. Odds Ratio of cardiovascular disease risk

Variable	p-value	OR (Cases)	95% CI	
			Lower limit	Upper limit
HTN	0.270	1.357	0.789	2.335
BMI	0.495	0.830	0.486	1.418
Dyslipidemia	0.000	3.306	1.886	5.794
DM	0.126	1.535	0.886	2.660
Smoking	0.047	1.848	1.004	3.401
Physical Activity	0.153	1.480	0.864	2.533

Logistics Regression

To account for potential confounders, a binary logistic regression was performed, including hypertension (HTN), BMI, dyslipidemia, DM, smoking status, and physical activity as predictors.

Among these, only Dyslipidemia remained statistically significant, with an adjusted odds ratio of 2.733 (p = 0.001), indicating a robust independent association. Although DM (OR = 1.706, p = 0.087), smoking (OR = 1.606, p = 0.176).

Table-3 Binary Logistics Regression

Risk Factor	p-value	Adjusted OR	95% CI	
			Lower limit	Upper limit
HTN	0.318	1.356	0.778	2.514
BMI	0.999	1.000	0.546	1.734
Dyslipidemia	0.001	2.733	1.55	5.04
DM	0.087	1.706	0.874	2.864
Smoking Status	0.176	1.606	0.820	3.12
Physical activity	0.139	1.565	0.822	2.608

DISCUSSION

This case-control study aimed to explore the burden and trends of CVD and its associated risk elements among patients of Karachi and Hyderabad. The findings revealed a high prevalence of modifiable risk factors to consider such as diabetes mellitus, hypertension, dyslipidemia, and physical inactivity among individuals diagnosed with CAD. Among these,

dyslipidemia emerged as the only statistically significant independent predictor of CAD, with the odds ratio of 2.73 (p = 0.001), suggesting that individuals with dyslipidemia were nearly threefold more inclined to have CAD in comparison to those without this risk factor. Goyal et al., (2017) conducted a study on rural Punjab for the period of two decades. The aim of the study was to determine the changes in the occurrence of coronary artery disease and its risk factors. Significantly increased risk factors include sedentary lifestyle, hypertension, diabetes, obesity, and hypercholesterolemia.

There was an overall rise from 1994 to 2014 in age-standard prevalence of coronary artery disease. They also reported that over these two decades the prevalence of cigarette smoking and the use of "desi ghee" has decreased. This study supported the outcome of our study and testified that sedentary lifestyle, hypertension, diabetes, obesity, and hypercholesterolemia increase the risk for CAD. However, this study did not report any association of CAD with dyslipidemia.1[0] Another study conducted by Hosseini et al., (2021) in Tehran, analyzed 90094 adult populations suffering from CAD. The aim of the study was to determine the prevalence and patterns of CAD risks and their impact on age of diagnosis for CAD. 68.5% of male population was found to be CAD patients with mean age of 60.1 years whereas, 31.5% of female have CAD with mean age of 63.2 years, which is older than male population. Over the study period, the mean age of CAD diagnosis showed an overall increasing trend. Aligning with the current study, they also reported that increased body mass index, hypertension and DM were profound risk factors. In contrast, the data showed that all components of the lipid profile have declined over time, including triglycerides, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, and total cholesterol. Therefore, most risk factors were linked to a younger diagnostic age, and it was anticipated that serum lipid levels would gradually decline.[11,12] A registry based serial cross-sectional study was conducted on 3655 diagnosed CAD patients with age less than 50. The study aimed to assess the major adverse cardiovascular events and its associated factors over a decade time frame. The common risk factors observed were smoking status, hypertension, and positive family history of CAD.[13] Similar to our findings, Zeitouni et al., (2020) reported that During follow-up, a concerning number of patients continued to exhibit uncontrolled risk factors: smoking, had low-density lipoprotein cholesterol levels above the recommended goal of 70 mg/dL, and 16% developed new-onset diabetes mellitus.[14] Sandi et al., (2019) conducted an observational study with a cross-sectional design. The study's objective was to determine Indonesia's modifiable risk factors for coronary heart disease. The data was collected with 72 diagnosed patients. The study found that most respondents were male (70.84%) and between 56-65 years old (43.05%). The most prevalent modifiable risk factors identified were smoking (84.72%), followed by poor physical activity (77.77%), diabetes mellitus (81.94%), hypertension (72.22%), and hyperlipidemia (68.05%),[15] unlike our study, where dyslipidemia showed a statistically significant association with CAD. Wang et al., (2025) published analyses for the Global Burden of Cardiovascular Diseases Study 2021. The result reported that between 1990 and 2021, global age-standardized incidence, DALY, and mortality rates for CVDs showed a declining trend, with estimated annual percentage changes of -0.39, -1.30, and -1.11, respectively. Regions with a high-middle socio-demographic index (SDI) have shown the highest incidence and mortality rates, while the high SDI regions experienced the greatest declines. Male gender had higher age-standardized rates of CVD incidence, DALY, and mortality compared to female. Higher systolic blood pressure was identified as the leading modifiable risk factor, contributing to over half of the CVD-related DALY globally. Other major risk factors included high serum LDL cholesterol, smoking, and ambient particulate matter pollution.[16,17] This study reported higher occurrence of the following modifiable risk factors, diabetes mellitus (60.6%), hypertension (58.3%), dyslipidemia (55.1%), physical inactivity (51.6%), and smoking (27.3%). Dyslipidemia was a statistically significant independent predictor (OR = 2.73, p = 0.001), indicates a nearly threefold increased risk. Hypertension and diabetes were common, but not have

statistical significance, possibly due to overlapping risk profiles or sample size limitations. Physical inactivity and smoking showed elevated odds but were not significant in the logistic model.[15] However, their clinical importance remains clear, aligning with other population studies such as those by Goyal et al., (2017), Hosseini et al., (2021), and Zeitouni et al., (2020).

Huang et al. has reported that hypertension was significantly associated with a greater risk of cardiovascular events (OR 1.28, p = 0.006), also our study has shown similar findings that has shown association of hypertension with CVD (OR 1.356, p = 0.318), this shows that patients who have exposure to risk factor (hypertension) are one and almost half times more prone to develop cardiovascular disease in comparison to the individuals who have no exposure to this risk factor.[18] Also, Nazarzadeh et al. have found the positive association of hypertension with the progression of CVD (OR = 1.30 [95% CI 1.23 to 1.38]) but they only studied the association of systolic blood in comparison our study has considered the elevated values of both systolic and diastolic readings.[19]

A cohort study in Japan also found the relationship of hypertension with incidence of cardiovascular events, regardless of the blood glucose levels.[20] The synergy index was calculated between hypertension and diabetes in relation to coronary artery disease 1.43 found, this indicates the individuals who have both conditions experience a greater risk of developing CVD greater than what would be predicted if each condition's effects were considered separately. In comparison, our study has taken into account solely the exposure of hypertension and their odds were calculated in the diseased individuals.[21] Smoking is also another risk factor of cardiovascular disease. Exposure to smoking has been reported to increase the chances of cardiac disease (OR 3.2 [95% CI 1.7 to 6.3]) in a study conducted by Attard et al.[22]. Our study findings have shown similar results OR = 1.606, p = 0.176, the exposure of smoking in comparison to no smoking among the population doubled the possibility of occurrence of heart disease.[23]

This association of smoking was further discussed in another study that reported the odds of various disease outcomes in cigarette consumers, showing the odds range from 1.20 to 1.41.[24] Chang et al. study has shown reduced risk of heart disease in smokers who switch from heavy to mild smoke (RR = 0.78, 95% CI: 0.67 to 0.89) but not in those who reduced by more than 50% and reduced smoking from heavy to moderate.[25]

Overall, the findings highlight dyslipidemia as a key modifiable target for CAD prevention, while also underlining the need for early screening and lifestyle interventions to address the broader cluster of cardiovascular risk factors. These results are consistent with existing literature indicating a strong association between dyslipidemia and atherosclerotic cardiovascular disease. Although other risk factors such as smoking, diabetes, physical inactivity, and hypertension were prevalent among cases, they did not show statistically significant result in the adjusted logistic model. This could be attributed to overlapping risk profiles or sample size limitations. Notably, the female predominance among participants may reflect changing epidemiological trends in South Asia, where cardiovascular risk among women is increasingly recognized. The study supports global evidence that coronary artery disease is driven by complex interactions among metabolic, behavioral, and lifestyle factors. Furthermore, the significant burden of disease among individuals above 60 years of age reinforces age as a crucial non-modifiable determinant. The high proportion of participants with suboptimal ejection fraction (<40%) indicates advanced cardiac involvement, which may reflect late diagnosis or poor preventive care. Collectively, these findings call for strengthened screening and preventive strategies tailored to high-risk populations.

Limitations

This study is subject to several limitations. First, its case-control design limits causal inference. Second, the data was retrospectively collected from medical records, which may introduce reporting and selection bias. Additionally, the study relied on hospital-based participants, which may limit generalizability to community populations.

Recommendations

Although the logistic model identified significant associations, the modest Nagelkerke R^2 value (0.170) suggests other unexplored variables might contribute to CAD risk in this population.

CONCLUSION

The present study concludes that dyslipidemia has been the single most significant independent risk factor associated with coronary artery disease in the studied population. Despite high frequencies of other modifiable risk factors— hypertension, diabetes, smoking, physical inactivity—only dyslipidemia showed a statistically significant association with cardiovascular disease in the multivariate model. These findings underscore the significance of lipid monitoring and early action. Moreover, the concentration of CAD cases among older adults suggests the need for targeted screening programs in aging populations. The moderate predictive power of the logistic model also highlights the multifactorial nature of CAD, suggesting the need for integrated risk assessment approaches.

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None.

Author Contributions

Ayesha Sonia contributed to the study design, data collection, and manuscript drafting. **Qurat-ul-Ain Adnan** supervised the research process and provided critical feedback throughout the study. **Muhammad Ather Hashmi** contributed to data analysis and manuscript revisions. **Farzana Amir Hashmi** assisted in data interpretation, literature review, and final editing of the manuscript. All authors reviewed and approved the final version of the manuscript.

Ethical Approval

The study received approval from the Ethical Review Board of Ziauddin University, Karachi, Pakistan (Ref. No.9020824ASREH).

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None.

Conflict of Interests

None.

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