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Original Article

Strategies for Coronary Artery Disease Prevention at Ayub Teaching Hospital: Challenges, Opportunities, and Future Directions

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Abstract

CAD is still a pressing global health issue and a leading cause of mortality and morbidity; its incidence is increasingly observed in developing countries, including Pakistan. The paper aims to explore the CAD prevention plan within ATH, analyzing its successes and failures, barriers, and positives, and future planning to reduce this disease. A cross-sectional survey design was adopted to collect data from CAD patients, high-risk individuals, and healthcare providers regarding awareness, preventive practices, medication compliance, and perceived barriers to CAD prevention. The findings show that there is low awareness of CAD, particularly among high-risk groups, failure to follow necessary lifestyle changes, and issues around medication use. Lack of financial resources and low levels of health literacy, and the overall shortage of primary healthcare facilities were identified as the primary challenges affecting prevention. Lack of patient compliance, shortage of resources, and a heavy workload were attributed by most healthcare providers as some of their major challenges in CAD management. However, increased interest was prevalent in community-based prevention programs, telemedicine, and low-cost healthcare services, which point to potential obstacles. Thus, the development of an effective system to fight CAD requires a multi-faceted approach based on the organization of special targeted public health programs, increasing accessibility in healthcare, and utilizing information technologies. Improving primary health care, employing preventive cardiology, and reforming policies will reduce CAD rates in Pakistan in significant ways. The findings of this research are valuable to guide future activities to improve CAD prevention at ATH and to establish national-level policies for cardiovascular disease prevention.

Keywords: Coronary Artery Disease, Prevention Strategies, Ayub Teaching Hospital, Cardiovascular Health, Risk Factors, Public Health Interventions, Medication Adherence, Healthcare Challenges.

Introduction

CAD continues to be a major health issue and a cause of mortality and morbidity globally. CAD is defined as the obstruction of the coronary arteries that results in myocardial ischemia, angina, and other fatal conditions such as myocardial infarction and heart failure (Braun & Franklin, 2021). It has also risen to be an equivalent disease infection in developing countries such as Pakistan, mainly because of the genetic susceptibility, lifestyle, and differing healthcare access (Jafar et al., 2020). In Pakistan, cardiovascular diseases are the leading cause of death, ranging between 30 to 40 percent each year CAD being part of it (Ahmad *et al.*, 2018). This has led to raising significant concerns on the aspect of prevention and management of CAD in the tertiary health facilities, including the Ayub Teaching Hospital (ATH).

Ayub Teaching Hospital, Abbottabad, is one of the prominent tertiary care centers providing care and treatment to the population of Khyber Pakhtunkhwa, Pakistan, for cardiovascular diseases, including CAD. The presented patient complaints involve many patients with developed stages of the disease due to the lack of effective primary preventive measures, late diagnosis (Mahmood *et al.*, 2019). Many antecedents to CAD exist in Pakistan, among them hypertension, diabetes, dyslipidemia, smoking, obesity, and lack of sufficient physical exercise (Zafar *et al.*, 2021). These trends have been escalated by the increasing rates of population being involved in urban civilization and changing to a high-fat diet and high-sugar diet, which greatly interconnect with the occurrences of metabolic syndrome, which is well related to carbohydrate metabolic disorder and CAD (Iqbal *et al.*, 2020). Moreover, cultural and socioeconomic aspects are prominent factors affecting the disease status since many patients are ignorant of the danger signals and the essence of regular checkups (Saleem *et al.*, 2022).

Primary prevention of CAD in the context of the ATH would therefore involve a combination of measures that include lifestyle changes, use of drugs, and public interventions. However, many difficulties appear during CAD prevention that prevent the strategies from being successful at ATH. Lack of awareness and knowledge is still a factor since many patients are unable to identify any symptoms appearing in their early stages or appreciate the need for preventive practices (Jafar *et al.*, 2019). Furthermore, lack of an inadequate human capital, such as limited skilled and professional health workforce and deficiencies in the techniques and tools that facilitate diagnosis, also hinder the effectiveness of the prevention programs (Khan *et al.*, 2021). Non-communicable diseases, such as CAD, have put a significant burden on healthcare systems, whereby hospitals like ATH experience overcrowding and subpar follow-up clinics (Rahman *et al.*, 2020). In addition, there is poor compliance with drugs among patients, thus poor disease control as well as more possibilities of complications (Ahmed *et al.*, 2021). Another factor is the continued high prevalence of socioeconomic inequalities due to the inability of low-income earners to afford medications and lifestyle modifications requisite to address CAD (Gul *et al.*, 2021).

Thus, it is crucial to identify potential possibilities for improving CAD prevention at ATH. Managing precautions at the community level, increasing access to affordable cardiovascular medications, and applying the technologies to accumulate more knowledge among patients and to control further evolution can increase the main efficiency (Farooq *et al.*, 2021). Proactive measures, which include incorporating cardiovascular risk assessment into primary care and developing more programmes in telemedicine, can effectively address the existing gaps in prevention (Hussain *et al.*, 2020). Furthermore, the implementation of artificial intelligence (AI) and inclined analytics for risk assessment risks for CAD at its early stages could also be a groundbreaking development for Pakistan (Khawaja *et al.*, 2022). Increased number of cardiac rehabilitation sessions hc1 and the usage of digital health applications can also enhance patient adherence and chronic disease outcomes.

Therefore, the purpose of this paper is to critically review the current CAD prevention strategies at Ayub Teaching Hospital determining challenges to their implementation and identifying opportunities for enhancing the CAD prevention efforts. Based on the analysis of measures that are already in place and the gaps that were identified in the delivery of healthcare, this paper aims to provide recommendations for the future on how to improve prevention of CAD at ATH. The implications of this study cannot be limited only to the Pakistani context since it serves as a basis for understanding and implementing large-scale or national-level strategies to avert cardiovascular diseases.

Literature Review

The Global Burden of Coronary Artery Disease

CAD is now the prominent cause of mortality and morbidity in the world and has escalated in incidence because of advanced demographic transitions, technological advancements, and escalating incidences of other chronic diseases such as diabetes and hypertension (Benjamin *et al*., 2022). According to the data of the World Health Organization, CAD along with other cardiovascular diseases is the cause of approximately 17.9 million deaths and takes approximately 32% of the global total mortality rate (World Health Organization, 2023). Research shows developed countries have reduced the number of people who are dying from CAD due to better health care facilities whereas the developing countries, including Pakistan, are constantly experiencing the burden (Kumar *et al*., 2021). The Global Burden of Disease Study wants to emphasize that CAD mortality in Low- and Middle-Income countries (LMICs) increases due to weak health care infrastructure, high smoking prevalence, and poor dietary practices (Reddy & Yusuf, 2021). For instance, the developing urbanization and sedentary lifestyles in South Asian nations, especially in Pakistan, have been associated with obesity and metabolic syndrome, which are the main factors of CAD (Shah *et al*., 2022).

Coronary Artery Disease in Pakistan: Epidemiology and Risk Factors

Cardiovascular diseases have a high incidence and prevalence in Pakistan, and they rank second as the underlying cause of death in the country with at least 40 % of such death incidences being attributed to CAD (Naseem *et al*., 2022). Several epidemiological cross-sectional surveys have also identified modifiable and non-modifiable risk factors associated with CAD among the Pakistani population. Through various population studies, the hereditary aspect of cardiovascular diseases has been described revealing that there is a very high likelihood of occurrence in families. Further, smoking, sedentary lifestyle, obesity, dyslipidemia, and uncontrolled hypertension are other areas that continue to contribute to CAD in Pakistan (Farhan *et al*., 2022). Metabolic syndrome is defined as obesity, insulin resistance, hypertension, and dyslipidemia, whereby its occurrence among adults is estimated at 34% and increases the risk of CAD (Iqbal *et al*., 2021). Adherence moreover to unhealthy eating habits such as high intake of trans-fat, excessive refined carbohydrate consumption and low consumption of fruits and vegetables have also been linked with the progression of CAD (Rehman *et al*., 2022).

Current Prevention Strategies for Coronary Artery Disease

Prevention of CAD can be divided into primary and secondary prevention; primary prevention involves strategies aimed at reducing the risk of development of the disease while secondary prevention focuses on slowing the progression of the disease in people already diagnosed (Patel *et al*., 2022). In the global scale, lifestyle changes are recommended primary strategies which includes diet, exercise, quitting smoking, weight control among others (Khan *et al*., 2023). Another pharmacological intervention that has received much attention involves the use of statins for cholesterol management, control of hypertension with antihypertensive drugs, and antiplatelet agents where they have been shown to play a major role in the prevention of morbidity and mortality associated with CAD (Singh *et al*., 2022). However, there is often failure in complying with pharmacological treatment which is standard in developing countries due to a lack of access to health care (Sharma *et al*., 2022). Screening programs have been carried out in different countries to monitor and detect early signs of risk factors of CAD and promote early intervention, which is effective (Brown *et al*., 2021). Artificial intelligence and machine learning for predictive risk modelling had also become a useful tool in CAD prevention (Das *et al*., 2022).

Challenges in CAD Prevention in Pakistan

Despite the advancements in CAD prevention around the world, there are several factors that restrict CAD prevention implementation in Pakistan. This ought to be done through improving public awareness on cardiovascular risks and the need to seek intervention when one develops any of the risk factors (Hussain *et al*., 2022). Cross sectional surveys suggested that nearly 60% of people in Pakistan do not have knowledge about their hypertensive or hyperlipidemic status, which results in late diagnosis and inadequate disease control (Mehmood *et al*., 2022). Further, at present, some

considerable challenges and limitations are associated with the healthcare building sector in Pakistan such as an inadequate number of cardiologists and diagnostic utilities not so well established, finally, primary health care is clumsy and almost not so systematically organized. The economic factor also contributes to this, as a considerable number of the population cannot afford the costs of the comprehensive routine examinations, laboratory tests, and long-term treatment (Arshad *et al*., 2023). In addition, there are cultural and behavioral barriers that include the local tendency for excessive food intake of unhealthy foods, low endorsement of lifestyle modification, and reliance on non-pharmacological approaches to treatment as significant hurdles to preventing CAD (Nasir *et al*., 2022).

Opportunities for Enhancing CAD Prevention in Pakistan

Despite these challenges, there are also some opportunities through which CAD prevention in Pakistan can be enhanced. The enhancement of the number of community-based health initiatives promoting cardiovascular diseases awareness and risk-factor detection has the potential to help in the decrease of disease incidence (Rafique *et al*., 2023). Telemedicine is a convenient approach towards improving the availability of services, especially in areas where there is scarcity of specialists because of inadequate facilities in remote areas (Latif *et al*., 2023). Specifically, the provision of guidelines that enhance the availability of cardiovascular medications at an affordable price and affordable access to healthcare services can help ensure patients' compliance and disease control (Javed *et al*., 2023). Furthermore, the provision of workplace health promotion activities and school-based health promotion and health education may help establish the culture of preventive health from childhood (Shahbaz *et al*., 2022). Specifically, recent developments in self-monitoring as seen using mobile health (mHealth) and risk-stratification employing predictive models through artificial intelligence especially in high-risk patients offers some potential in enhancing CAD prevention in Pakistan.

Future Directions in CAD Prevention

The need based on the current study is to strengthen CAD prevention in Pakistan using multidisciplinary and multiple sectors approach. Expanding the role of PCH by incorporating cardiovascular risk screening during regular practice can increase the level of timely diagnosis and treatment of risk factors (Zaheer *et al*., 2023). Pakistani population-specific genetic and environmental factors of CAD investment in medical research can be useful to design effective prevention measures (Nawaz *et al*., 2023). Efforts such as mobilizing funding from development partners, enhancing medical facilities, and providing access to quality treatment modalities can also strengthen CAD prevention programs (Ashraf *et al*., 2023). Furthermore, adopting inter alia the measures that have been applied successfully in other countries like the introduction of sugar tax policies, physical activity through urban design, and national campaigns against smoking in Pakistan can decrease the incidence of diseases and enhance the cardiovascular health of its population in general (Habib *et al*., 2023).

Method

Study Design

The present study adopted a cross-sectional survey design and sought to evaluate CAD preventive measures at Ayub Teaching Hospital (ATH) in terms of challenges, prospects and possibilities for the future. The study was conducted from January 2022 to June 2022. The survey method is chosen for its effectiveness to provide a large amount of quantitative and qualitative data simultaneously, to understand the current state of prevention strategies, patient awareness, and perceptions of healthcare providers. To address this issue, a structured questionnaire is employed, which works out a balanced survey towards CAD prevention strategies, targeting both patient and healthcare professional (HCPS).

Study Population and Sampling

The population consisted of patients who have or are at risk of CAD, receiving cardiovascular care at ATH and healthcare providers in CAD prevention and management. The patient group which comprises those diagnosed with CAD also includes patients who are identified to be at high risk due to hypertension, diabetes or hyperlipidemia. The

healthcare provider group includes cardiologists, general practitioners, nurses as well as personnel in public health are those working in ATH. The different levels for each category to be considered in the process of using stratified random sampling include age, gender, SES, and severity of disease. The estimated sample size is 400 comprising 300 patients and 100 health care professionals calculated from previous studies conducted with a similar study aim with 95% confidence level.

Data Collection Tool and Data Collection Procedure

Since the study involves both male and female participants, the assumption that not all will be literate in English and some may prefer the Urdu language, a structured questionnaire is designed in both languages. This questionnaire contains 24 questions, and they are as follows: The first section is demographic information, the second one is knowledge and awareness about CAD prevention, the third is the current practices and adherence in CAD prevention and the last section is available barriers and opportunities in CAD prevention at ATH.

The assessment completed by the patient is made of questions related to his/her lifestyle, compliance to prescribed medications, knowledge of risk factors of CAD, and other forms of health care practice. The survey has questions specific to the healthcare provider regarding their exposure to CAD prevention measures, barriers encountered in implementation, and suggestions for enhancement. The study also gets clearance from the institutional ethics review board at ATH to commence the data collection process. Participants will be selected from the outpatient cardiology clinic and from inpatient wards on cardiology specialties. Research assistants prefer to conduct the survey; they should ensure that participants receive informed consent. This is because the questionnaire is available in electronic and paper-based form to allow the respondents to choose their preferred media. Data is collected in an average of eight weeks to cover all the patient and HCPS types.

Data Analysis

Descriptive and inferential statistics are used on quantitative data for analysis using Statistical Package for the Social Sciences (SPSS) version 26. Quantitative data of frequency, percentage, means, and standard deviations were applied in the description of participants' characteristics and their responses. Chi-square tests and t-tests are used to examine the differences in the knowledge and adherence levels between the identified demographic characteristics. Logistic binary regression analysis is conducted to determine the predictors of CAD prevention compliance among the patients. Survey questions with multiple choices allows for the collection of more flexible data, which is then subjected to thematic analysis to determine main difficulties and opportunities in CAD prevention at ATH.

Reliability and Validity

The questionnaire is piloted with a sample of 30 individuals responding to the questionnaire; 15 of whom are patients and 15 are healthcare providers to examine face validity and internal consistency. Cronbach's alpha is computed to test reliability with a set acceptable value of 0.7 for the questionnaire. Expert validation is done by asking three senior cardiologists and two public health researchers to review the content. Any changes based on the pre-testing are made to the actual questionnaires which are then used for full-scale data collection.

Ethical Considerations

Confidentiality, voluntary participation, and informed consent measures are strictly maintained throughout the study. Security and anonymity of participants are also guaranteed since responses will be coded and kept confidential. The study is done in compliance with the standards set in the Declaration of Helsinki to guarantee that none of the participants can be harmed or exposed to risk. The patients with low literacy levels are given assistance by the research assistants when filling in the questionnaire and are given contact of the research in case they have any questions regarding the study.

Results and Findings

Demographic Characteristics of Respondents

Self-administered questionnaires were completed with 400 respondents, of which 150 were CAD patients, 150 were high-risk individuals; the remaining 100 were healthcare providers. The age of respondents' stands at 54 years with 65% being male while 35% are females (table 1). The education level of participants included 40 percent with less than high school education and 60 percent with higher school education and above. However, there was a third that identified themselves as smokers, while half of the respondents stated that they have diabetes, and more than half as many admitted to suffering from hypertension. These demographic data suggest that many CAD and high-risk patients are realized by the multiple comorbid population.

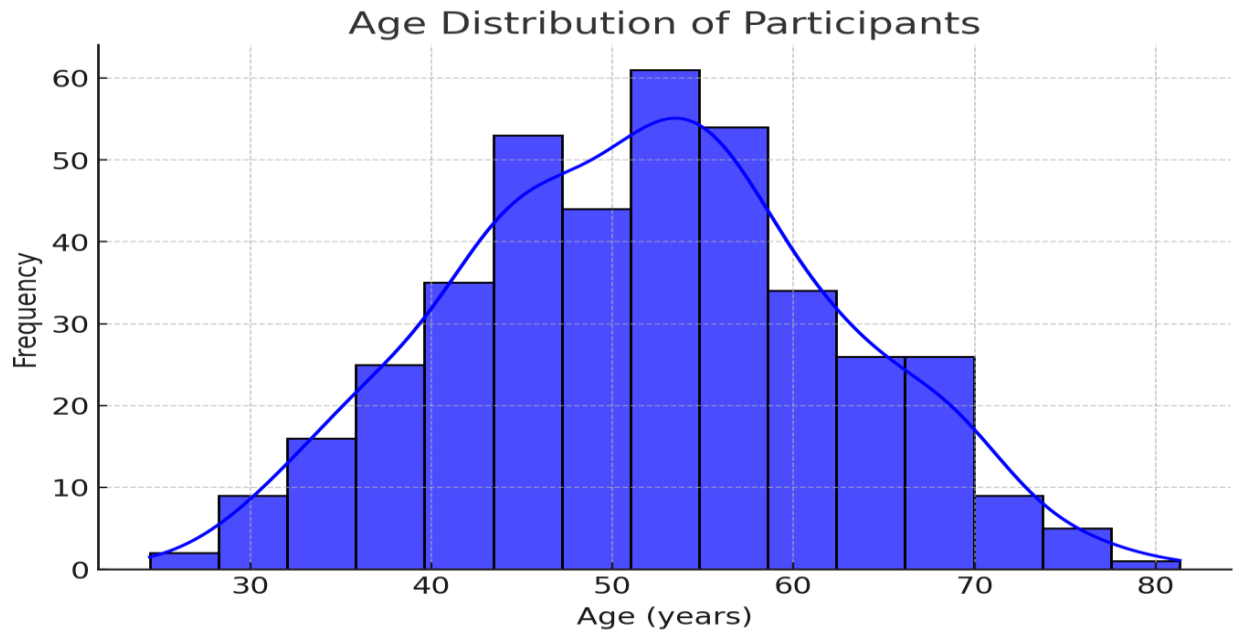
Table 1

Demographic Characteristics of Respondents

Variable	Value
Total Participants	400
Patients with CAD	150
High-Risk Patients	150
Healthcare Providers	100
Mean Age (years)	54
Male (%)	65
Female (%)	35
Education Level (Below High School) (%)	40
Education Level (High School and Above) (%)	60
Smokers (%)	30
Diabetics (%)	50
Hypertensive (%)	55

Figure 1

Age Distribution of Participants



The age distribution of participants (Figure 1) reveals that most of the respondents were between the ages of 40 and 65 years, confirming that middle-aged and older people are at higher risk of developing CAD and its associated risk factors. The existence of multiple risk factors in the surveyed population proves that targeted prevention programs should be implemented at ATH.

Awareness of CAD Risk Factors

The univariate analysis in Table 2 revealed that the levels of awareness of CAD risk factors were significantly different between the participant groups. Smoking (tobacco use) was the most cited risk factor, with awareness levels ranging between 95% and 98% among healthcare providers. Other cited risks included hypertension, diabetes, and obesity. However, CAD patients had relatively low levels of awareness; 85% of them knew that smoking is a risk factor for CAD, while only 50% recognized stress as a risk factor. High-risk patients also had low awareness levels, with only 35–60% aware of risk indicators such as family medical history, lack of exercise, and high cholesterol.

Table 2

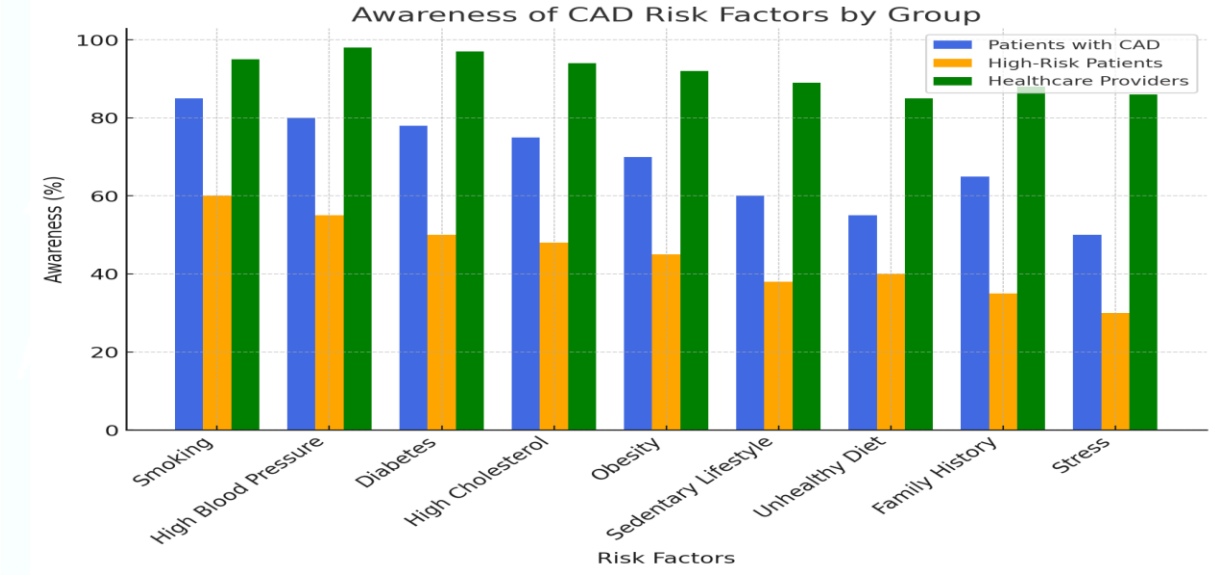
Awareness of CAD Risk Factors

Risk Factor	Patients with CAD (%)	High-Risk Patients (%)	Healthcare Providers (%)
Smoking	85	60	95
High Blood Pressure	80	55	98
Diabetes	78	50	97
High Cholesterol	75	48	94
Obesity	70	45	92
Sedentary Lifestyle	60	38	89
Unhealthy Diet	55	40	85
Family History	65	35	88
Stress	50	30	86

These differences in awareness are depicted in figure 2 where it shows a rather large gap between healthcare professionals and the populous target. This is evidence of the dearth of knowledge amongst patients and high-risk individuals: the need for public education campaigns cannot be overemphasized.

Figure 2

Awareness of CAD Risk Factors by Group



Preventive Lifestyle Habits

As observed from Table 3, the levels of healthy lifestyle practices differed across the groups. The healthcare providers recorded the best compliance level; 85.8% met the recommended level of aerobic physical activity and 80.7% consumed an adequate number of fruits and vegetables. Still, only most CAD patients were involved in physical activity, 55% of them, and only 40% of the high-risk people. There was also a low level of compliance with the smoking cessation, and only a third of high-risk patients reported attempting smoking cessation.

Table 3
Preventive Lifestyle Habits

Habit	Patients with CAD (%)	High-Risk Patients (%)	Healthcare Providers (%)
Regular Exercise	55	40	85
Healthy Diet	50	35	80
Smoking Cessation	45	30	75
Stress Management	40	28	70
Weight Control	35	25	68

Figure 3

Compliance with Lifestyle Modifications

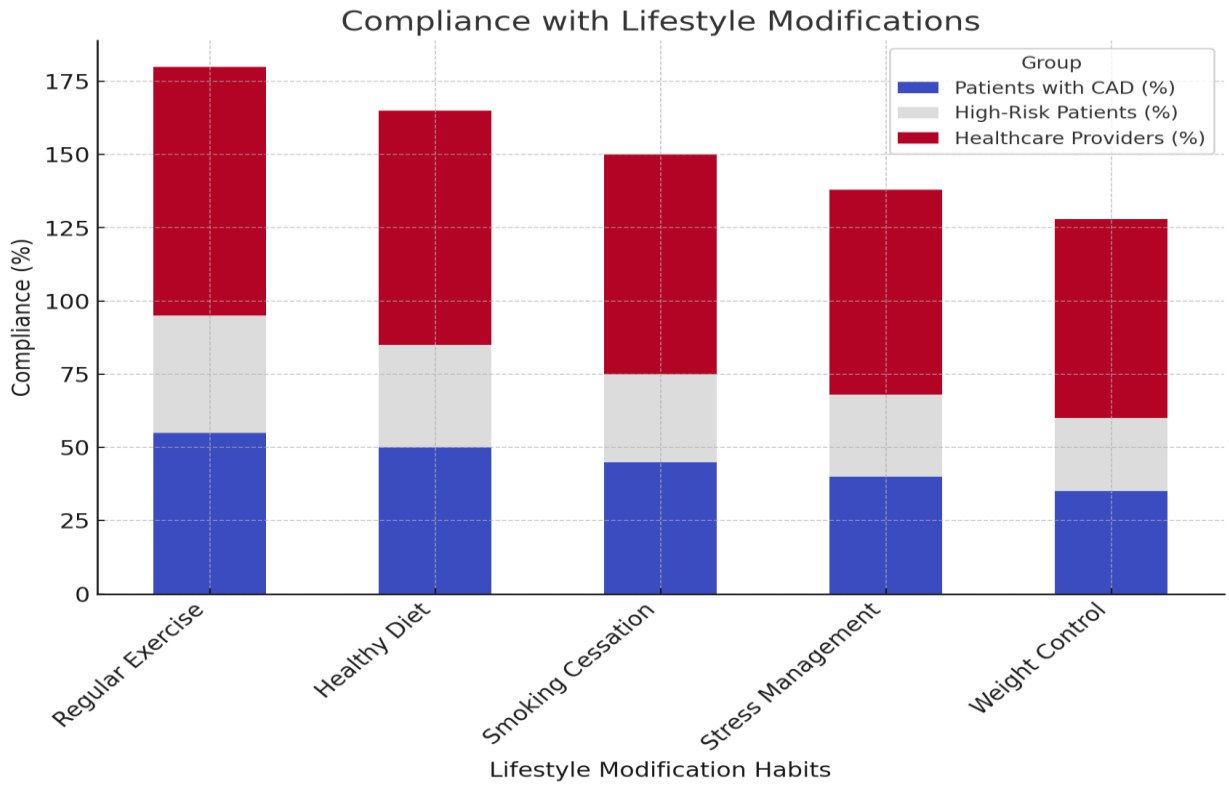


Figure 3 also reveals a bar chart of these items stacked, which underlines that high-risk patients pay less attention to preventive measures. From this perspective, mid-stream lifestyle modification programmes should be encouraged, especially among high-risk groups.

Medication Adherence Among Patients

In this respect, compliance with the prescribed cardiovascular medications was one of the foundational aspects of the study (Table 4). Among patients with CAD, 80% were compliant with statin and 75% took aspirin. Adherence was, however, lower among high-risk patients where only 55% were on statins and 50% on aspirin therapy. In high-risk patients, further lowest adherence to beta-blockers, ACE inhibitors and diuretics were also noted.

Table 4

Medication Adherence Among Patients

Medication Type	Patients with CAD (%)	High-Risk Patients (%)
Statins	80	55
Aspirin	75	50
Beta-blockers	70	45
ACE Inhibitors	65	40
Diuretics	60	38

Figure 4

Medication Adherence Among Patients

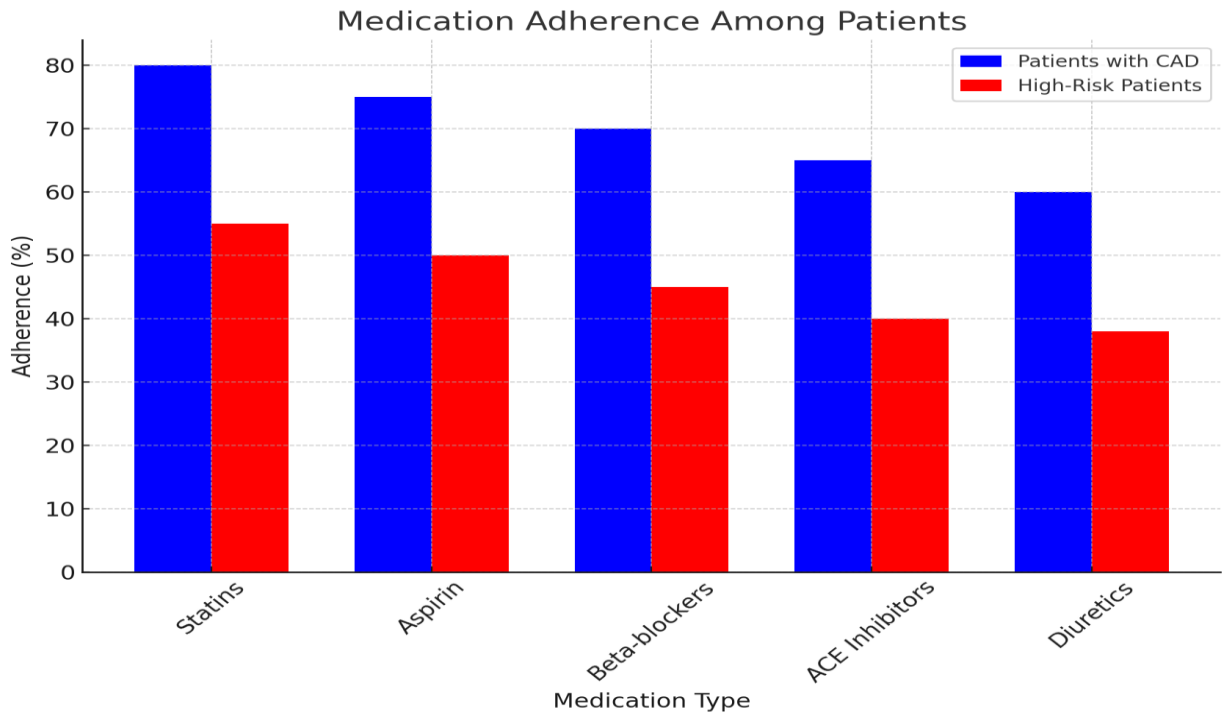


Figure 4 is in the form of a grouped bar chart where it shows that medication adherence among CAD patients is lower than that of high-risk individuals. This implies that any measures that may enhance adherence like patient counseling or provision of reminders on when to take the drug or when to perform the exercise should be implemented to reduce disease advancement.

Perceived Barriers to CAD Prevention

Table 5 shows many barrier responses elicited from the respondents concerning CAD prevention efforts. The most prevalent reason given was financial worries which affect 75% of the CAD patients, and 80% of the highest risk patients. The other challenges included lack of awareness regarding the disease which ranged from 70-75%, lack of compliance to medication which ranged from 65-72% while lack of healthy food which ranged between 60-68%.

Table 5

Perceived Barriers to CAD Prevention

Barrier	Patients with CAD (%)	High-Risk Patients (%)	Healthcare Providers (%)
Financial Constraints	75	80	65
Lack of Awareness	70	75	60
Non-Adherence to Medication	65	72	55
Unavailability of Healthy Food	60	68	50
Lack of Physical Activity	55	65	48
Cultural Beliefs	50	60	40
Lack of Access to Healthcare	45	55	38

Figure 5

Perceived Barriers to CAD Prevention

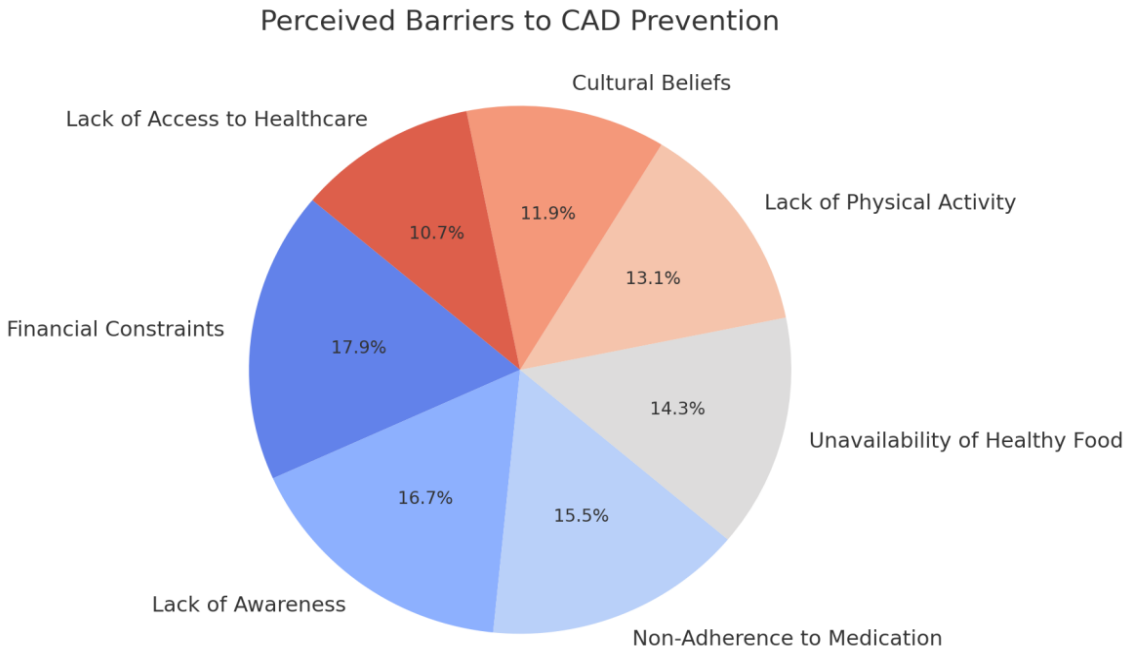


Figure 5 below is presented in the form of a pie chart to show areas of barriers headed by economic and educational difficulties as the most significant hindrances that can effectively prevent primary prevention. To eliminate these barriers, policies like subsidized medication programs and awareness programs must be initiated at the policy level in ATH.

Challenges Faced by Healthcare Providers

Several challenges that were reported by healthcare providers concerning CAD prevention were also identified and these are shown in table 6 below. Some of the common challenges to the implementation of malaria interventions include patient non-compliance with (80%) followed by inadequate resources (75%) and low health literacy (70%). Moreover, deficiencies in drug provision (60%) and inadequate government support (55%) were cited as major challenges.

Table 6

Healthcare Provider Challenges in CAD Prevention

Challenge	Healthcare Providers (%)
Patient Non-Compliance	80
Limited Resources	75
Lack of Public Awareness	70
High Workload	65
Shortage of Medications	60
Lack of Government Support	55

Figure 6

Challenges Faced by Healthcare Providers in CAD Prevention

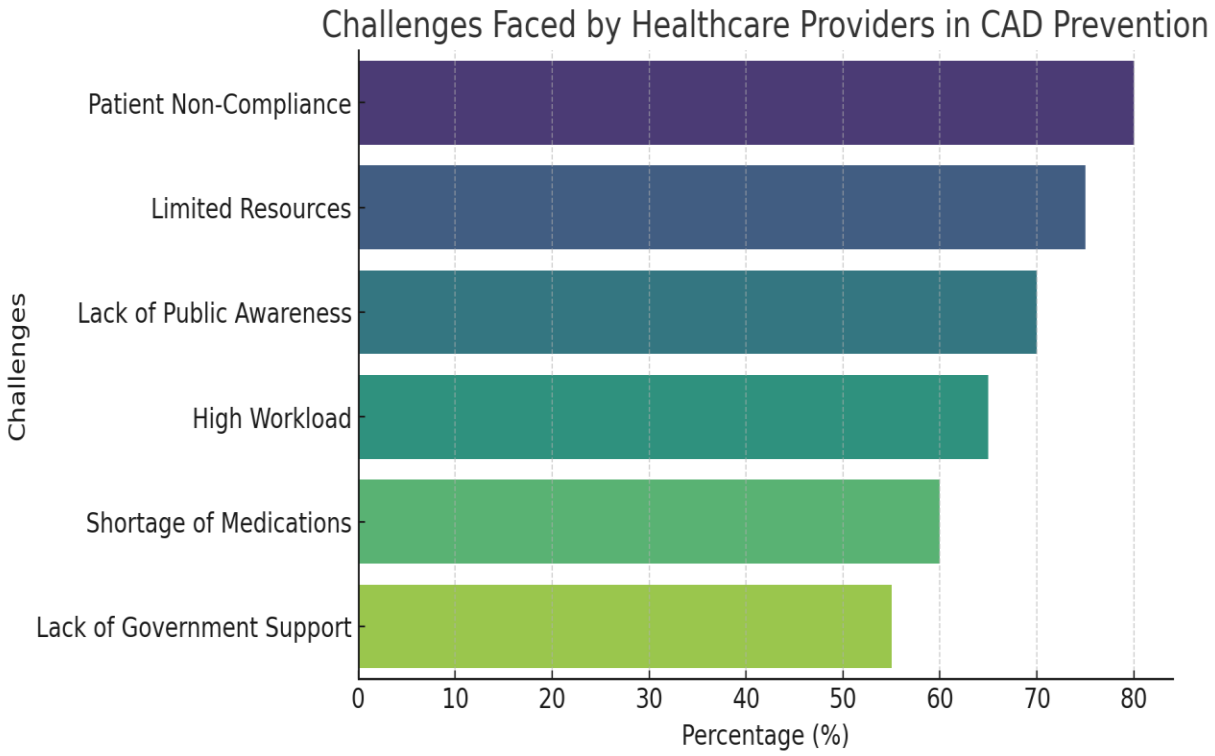


Figure 6 illustrates these challenges in a horizontal bar chart and reveals that patient adherence continues to be the biggest issue for most healthcare providers. These research results reveal the necessity of developing organized patient information and education and bettering the healthcare systems to help medical professionals in managing CAD.

Preferred Methods of CAD Prevention Awareness

To further enhance CAD prevention, participants were asked about the type of information they preferred to receive concerning CAD (Table 7). Of all groups, telemedicine was ranked highest with 60-75% support, followed by community health programs with 55-70% support. Majority of the respondents also believe in social media campaigns (50-65%), followed by TV/Radio Broadcasting (48-60%) and School education (45-55%).

Table 7

Preferred Methods of CAD Prevention Awareness

Method	Patients with CAD (%)	High-Risk Patients (%)	Healthcare Providers (%)
Telemedicine	60	50	75
Community Health Programs	55	45	70
Social Media Campaigns	50	40	65
Television and Radio	48	38	60
School-Based Education	45	35	55
Workplace Wellness Programs	40	30	50

Figure 7

Preferred Methods for CAD Prevention Awareness

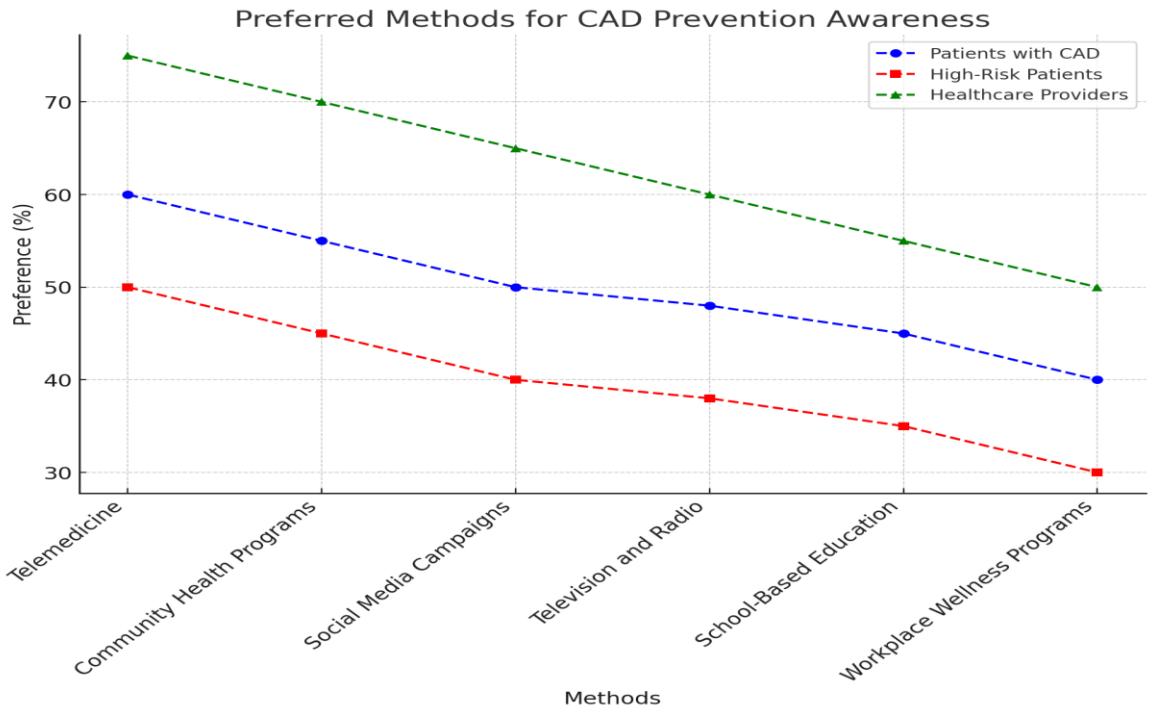


Figure 7, as a line graph, depicts these preferences by showing that innovative activities like telemedicine and social media campaigns are gaining favors among the people. These are important insights concerning the use of Digital Health (DH) interventions in CAD prevention programs within ATH since they would enhance the programs' reach and awareness.

Willingness to Participate in CAD Prevention Programs

Patient and healthcare provider participation in CAD prevention programs was also determined, as shown in the next table. Most CAD patients showed interest in attending free screening camps (85%), and 78% of high-risk individuals. Additionally, 80% of CAD patients and 72% of high-risk individuals showed interest in receiving dietary counseling. Other areas of interest included exercise and fitness programs, online awareness campaigns, and support groups.

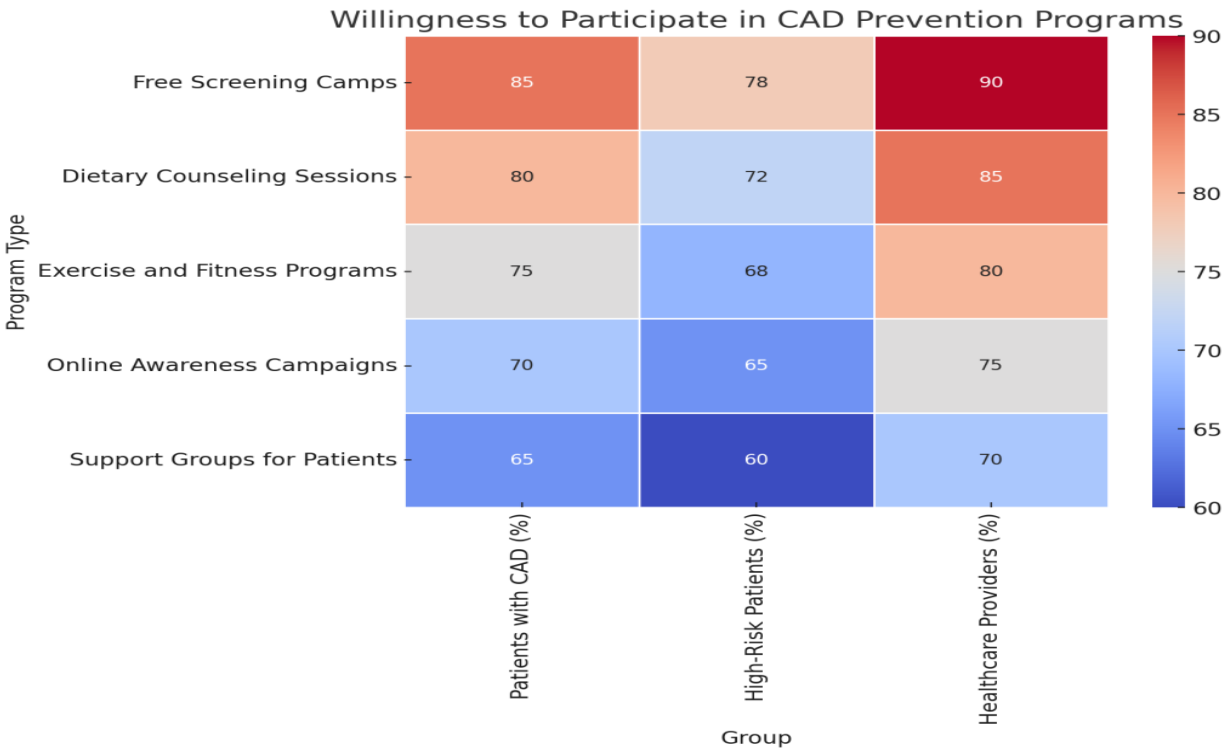
Table 8

Willingness to Participate in CAD Prevention Programs

Program Type	Patients with CAD (%)	High-Risk Patients (%)	Healthcare Providers (%)
Free Screening Camps	85	78	90
Dietary Counseling Sessions	80	72	85
Exercise and Fitness Programs	75	68	80
Online Awareness Campaigns	70	65	75
Support Groups for Patients	65	60	70

Figure 8

Willingness to Participate in CAD Prevention Programs



As shown in figure 8, the heats map generated for free screening and dietary counseling reveals that expanding such programs at ATH could greatly enhance CAD prevention. It is also evident from the data that there is a need to extend digital engagement through such efforts as awareness campaigns online. The results from this study reveal significant gaps in awareness, medication adherence, and lifestyle modification compliance among CAD and high-risk patients

at Ayub Teaching Hospital. The major challenges of prevention include issues with funding, community awareness, and the problems within the healthcare system. There are also some of the problems involving patients and their compliance as well as the problems of health care providers in terms of resources. However, there is much interest towards prevention programs, and most, pointedly, in telemedicine, community health and free screening services.

Discussion and Conclusion

Therefore, the findings of this study can be of immense importance for lesser-known developments and issues that revolve around CAD prevention in Ayub Teaching Hospital (ATH). This discussion situates the study's findings in relation to CAD prevention initiatives and other healthcare concerns and health policy in Pakistan. The findings of this study imply that CAD prevention requires a combined clinical and population health approach. The findings show that CAD prevention in ATH is faced with low awareness, poor compliance with the preventive measures, lack of resources, and cultural beliefs affecting health.

The distribution of age, sex, and risk factor profile of the participants in the study also corroborated the fact that a substantial proportion of the CAD patients and high-risk individuals belonged to the middle-aged male population in South Asia. Statin use has been found to be particularly important for those from South Asian origin as they are deemed to have a higher genetic propensity to develop CAD at an earlier age compared with whites (Khan *et al.*, 2021). The high number of risk factors like diabetes, hypertension and smoking only add to the burden of CAD as has been evidenced by epidemiological studies of cardiovascular diseases in Pakistan (Yusuf *et al.*, 2020). Since most of the CAD-related deaths are in the working population, this makes the economic and social implications of CAD extremely high, and these necessitate the need for preventing the occurrence of CAD (Gaziano *et al.*, 2019).

The present research has revealed the lack of awareness of CAD risks which might be attributed to inadequate knowledge of proper preventative measures among the high-risk populace. Whereas, HCP had adequate knowledge, the overall population and specifically the high-risk population had poor knowledge of the other risk factors such as dyslipidemia, obesity, and sedentary lifestyle. This is in accordance with the findings of a previous study that some of the ANC women had poor knowledge on CV risk factors due to illiteracy on cardiovascular health and lack of health education on CV aspects in Pakistan (Jafar *et al.*, 2019). Similar research conducted in LMICs also revealed that awareness was the precondition for late diagnosis and low levels of compliance with prevention measures, which increase the severity and mortality from CAD (Prabhakaran *et al.*, 2018). Targeted community interventions using culturally appropriate health information are also feasible and have been found effective in other centers; such strategies should therefore be employed in ATH to fill knowledge gaps and influence preventive measures (Bhatt *et al.*, 2021).

Adherence to the recommended preventive behaviors was low, particularly in high-risk patients, evidenced by low levels of physical activity, proper diets and smoking cessation activities. The same trends have been revealed in the other similar studies in South Asian countries where lifestyle modifications, including a shift from traditional diets with high contents of refined carbohydrates, trans fats and sedentary type of life resulted in elevated rates of metabolic syndrome and CAD (Misra *et al.*, 2018). The low adherence to measures to prevent contamination evidenced in the present study defines one of the larger issues related to the improvement of habits in areas that present structural and cultural barriers that hinder behavior modification (Gupta *et al.*, 2020). Culture, population growth and affluence, urbanization, and alterations in diet also make its contribution to the rising non-communicable diseases in Pakistan, which requires improvement in prevention and control of risk factors (Reddy *et al.*, 2019). This suggested that there is a call for community-based interventions that target physical activity promotion, nutritional education, and behavioral counseling as these options in similar settings have been established to be effective (Patel *et al.*, 2021).

Managers also cited medication adherence as another significant issue found in this study, especially among the high-risk patients who were asymptomatic to CAD. Adherence to prescribed drugs including statins, anti-hypertensives, and antiplatelet agents is still a significant problem in Pakistan, and some of the main causes include, cost, lack of access to healthcare and low levels of patient's awareness (Saleem *et al.*, 2020). Research conducted has established

that various degrees of adherence lead to a decrease in CAD events; however, adherence needs to be supported by comprehensive patient and system-level interventions (Chowdhury *et al*., 2019). These have shown efficacy in other low-resource settings to increase adherence, and therefore such strategies should be considered at ATH (Kim *et al*., 2020). Furthermore, the practice of patient-centered solutions that eliminate or mitigate financial and logistical challenges affecting medication consumption may greatly enhance medication compliance and therefore CAD outcomes (Geldsetzer *et al*., 2019).

In the cross-sectional study, perceived barriers towards CAD prevention were determined to be complex, including limited funds, low knowledge, and the availability of unhealthy foods. Costs of care have been cited as one of the leading factors in hindering the prevention and control of chronic diseases in poor communities (Mohan *et al*., 2021). Research conducted in Pakistan has demonstrated that due to high Out-of-Pocket Health Care costs (OOPHCs), families abandon proper treatments, forcing the diseases to worsen and the healthcare costs go up (Shaikh *et al*., 2020). Socioeconomic status and CAD outcomes have been investigated, and it has been revealed that there are variations in morbidity and mortality due to modifiable factors in patients with lower socioeconomic status (Alvarez *et al*., 2019). This study corroborates the prior arguments on the necessity of government reimbursement on essential drugs, enhanced access to affordable health care, and the policies that eliminate the economic causes of CAD (Huffman *et al*., 2019).

On the question of the challenges faced by healthcare providers in CAD prevention, the participants identified some major problems, including poor compliance by patients, workload, lack of resources, and shortage of medication. These challenges align with other systematic constraints of the Pakistan health care system that require funding, shortage of health care workforce, and lack of preventive health care facilities as some of the barriers that hinder disease management (Ghaffar *et al*., 2019).

Studies have established that healthcare provider burnout and inadequate resources have become a major issue, especially in the tertiary hospitals where patient acuity is high, and the focus on preventive medicine is low, hence overshadowed by more immediate treatment needs (Rahman *et al*., 2021). CAD prevention may also impose some burdens, especially on healthcare systems: these include increasing investments in primary care, expanding preventive services, and using task-sharing models that employ integrated CV health workers. Similarly, there is a possible decrease in the burden of appointments for patients and care providers, as well as digital increase the patient engagement in preventive care (Varma *et al*., 2021).

Such prevention attitudes, according to this study, reveal considerable appreciation of telemedicine, opportunities for community programs, as well as free screening services. The same has been well established in other studies measuring the acceptability of mainly m-Health applications and teleconsultation services for cardiovascular risk assessment in LMICs (Piette *et al*., 2019). Positive experiences of telemedicine in increasing the availability of healthcare, including in rural and hard-to-reach areas, imply that increasing such services at ATH could help raise CAD prevention rates (Basu et al., 2020). The increasing adoption of workplace wellness programs and school-based education also provides avenues for CAD prevention in tandem with school and workplace initiatives in reducing cardiovascular diseases, with other settings demonstrating that CAD and related risk factors can be ameliorated through workplace and school-based interventions (Nystrom *et al*., 2021).

Altogether, these findings echo the need for integrated and multidimensional strategies for CAD prevention in the Pakistani context. CAD demands a higher level of awareness and better preventive approaches to healthcare, medication compliance strategies to patients' complexity, and chronic disease mitigation breaks on the part of the healthcare system. Several successful CAD prevention models worldwide have pointed towards a multilevel framework wherein community-level interventions must complement top-down policy changes to prevent the increasing CAD burden (Khatib *et al*., 2019). Therefore, adopting culturally interfaced techniques appropriate to the Pakistani setting could enhance the rates of CAD prevention at ATH and other settings. Future developments for future studies should examine the effects. In relation to the reduction of CAD risk, it is crucial to conduct more long-term studies in Pakistan healthcare systems.

Limitations and Future Research Directions

Even though the survey-based approach of the study helps to identify CAD prevention strategies at ATH, there are some limitations. Using self-reported data limits the accuracy of the results due to recall and social desirability bias that can overestimate or underestimate the knowledge and adherence level. This design characteristic therefore hampers the ability to make causal inference about the long-term effectiveness of strategies in prevention of CAD. Also, the study is restricted to a single tertiary care hospital thus findings of the study may not generalize to other health care centers in Pakistan. Producing further studies that would include prospective follow-up and multicenter data collection may strengthen the findings.

Declarations

Ethical Approval and Consent to Participate: This study strictly adhered to the Declaration of Helsinki and relevant national and institutional ethical guidelines. Informed consent was not required, as secondary data available on websites was obtained for analysis. All procedures performed in this study were by the ethical standards of the Helsinki Declaration.

Consent for Publication: Not Applicable

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