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Epidemiology and management of cardiovascular diseases in Kashmir, India: prevalence, risk factors and strategies for improved outcomes

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ABSTRACT

Cardiovascular diseases (CVD) represent a considerable public health challenge in India, particularly in regions such as Kashmir, where unique socio-environmental factors result in a scarcity of localized data. This study examines the prevalence, risk factors, and management strategies for cardiovascular disease (CVD) in Kashmir, India, utilizing a cross-sectional survey of 400 patient respondents. Data was gathered on demographic characteristics, health and lifestyle factors, environmental and socio-cultural influences, CVD management practices, awareness, and readiness for emergencies. Initial results show that CVD'S are very common. Some of the main risk factors are smoking, not getting enough exercise, being under a lot of stress, and having a family history of CVD or related conditions. Cold weather and limited access to health care in rural areas were all important factors. Management Problems include costs, long distances to healthcare facilities, and lack of knowledge about how to prevent problems. The study suggests specific actions to improve CVD outcomes, such as health education in the community, subsidized screenings, better emergency response systems (like ambulances and telemedicine), and lifestyle programs that are tailored to different cultures. These results highlight the need for region-specific public health strategies to mitigate the escalating CVD burden in Kashmir.

Introduction

Cardiovascular diseases (CVDs) continue to be a primary cause of morbidity and mortality globally, resulting in approximately 17.9 million deaths each year, with low- and middle-income countries, including India, experiencing an inequitable burden [1]. In India, cardiovascular diseases account for more than 25% of all fatalities, influenced by a multifaceted interaction of genetic, lifestyle, and environmental factors [2]. The Kashmir region in northern India is a unique place to study CVD because of its different social and cultural practices, cold weather, and changing access to healthcare, all of which could make the disease more common and harder to treat [3]. Although cardiovascular disease (CVD) is significant both globally and nationally, there is a lack of region-specific data for Kashmir, hindering the formulation of targeted public health interventions. This research, entitled

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"Epidemiology and Management of Cardiovascular Diseases in Kashmir, India: Prevalence, Risk Factors, and Strategies for Improved Outcomes," seeks to fill this void by examining the prevalence, risk factors, and management approaches for CVD among 400 patient respondents in Kashmir. The burden of cardiovascular disease (CVD) in India is well-documented, with rising incidence attributed to increasing rates of hypertension, diabetes, obesity, and tobacco use [4]. In Kashmir, distinctive environmental conditions, including extended cold temperatures may increase cardiovascular disease risk by elevating blood pressure and vascular stress [5]. Socio-cultural practices, such as high-fat diets and sedentary lifestyles shaped by cultural norms, exacerbate the issue [6]. Furthermore, healthcare Access in Kashmir, especially in rural regions, is frequently restricted due to geographic isolation and economic limitations, obstructing prompt diagnosis and treatment [7]. Emergency Response systems, which are very important for improving outcomes in cardiac events, are also not very good. For example, not enough people know how to do cardiopulmonary resuscitation (CPR) and ambulance services are not very good [8].

Objectives

1. To determine the prevalence of cardiovascular diseases among respondents in Kashmir.
2. To identify key risk factors (demographic, lifestyle, environmental, socio-cultural) contributing to CVD.
3. To propose strategies for effective management and prevention of cardiac events to improve outcomes.

Literature Review

Prabhakaran et al. (2018): This important research gives a broad picture of the CVD epidemic in India, revealing that CVDs currently cause more than 25% of all fatalities, which is a big change from the past. The study reveals a troubling trend of early onset of heart disease, particularly among Indians in their 30s and 40s, in contrast to the later onset observed in Western nations. There is a clear difference between urban and rural locations, with more cases of CVD in rural areas due to changes in lifestyle that come with urbanization. The paper talks about the main risk factors, which are high blood pressure, diabetes, smoking, eating poorly, and not being active. It points out systemic problems including broken health delivery, policies that aren't always followed, and public health systems that don't get enough money. The authors emphasize the necessity for multi-sectoral strategies that incorporate health promotion, screening, and policy-level interventions, especially within primary care environments [2].

Misra et al. (2017): The researchers concentrated on the heightened susceptibility of South Asians, particularly Indians, to diabetes, cardiovascular disease, and chronic kidney disease, characterized by a significant tendency of early onset and elevated mortality rates. Heart attacks and other events happen 5 to 10 years earlier than they do in Western populations. The study elucidates that the fundamental causes include genetic predispositions and prevalent environmental/lifestyle exposures, encompassing elevated stress, suboptimal food, and insufficient physical activity. South Asians also have distinct metabolic risk factors, like being overweight around the middle and having insulin resistance. In India, the disease burden is even higher since there aren't enough early detection programs, people aren't aware of them, and access to care is limited, especially in rural and underserved areas. The authors suggest that cost-effective, scalable interventions like community-based screening, education, and campaigns to change people's lifestyles are the best way to go. They also want to improve primary healthcare so that it can better handle chronic conditions [9].

Rehman et al. (2021): This data-driven research use a non-homogeneous discrete grey model (NDGM) to examine and forecast the cardiovascular disease (CVD) mortality trend in India from 2005 to 2027. The model predicts that by 2027, there would be 15.4% more deaths from CVD in India. This is mostly because the population is becoming older, the population is growing, and progress in reducing risk factors is poor. It is a comparison of six countries, suggesting that India is behind in taking steps to avert problems. The paper points out that eating too little fruits and whole grains, eating too much sodium, and not being active are all major causes. The report calls for rapid changes to policies, like statewide programs to regulate blood pressure, taxes on sugary and processed foods, and efforts to raise awareness, especially in places with a lot of risk. It also suggests using AI and predictive modeling in public health surveillance to help with targeted interventions [10].

Bhat et al. (2019): This study provides region-specific insights, highlighting the concerning rise in ischemic heart disease and stroke cases in Jammu and Kashmir, particularly in rural and hilly districts. The main risk factors are smoking, eating a lot of calories and fat, not moving around much, and cold weather stress on the blood vessels. Cold weather, especially in the winter,

has been related to greater blood pressure and a higher chance of blood clots, which can lead to cardiovascular disease (CVD) events. The publication also talks about how there aren't enough places to get heart care, especially outside of Srinagar and Jammu, and how most people don't know much about health. Preventive cardiology is still not very advanced, with little lifestyle counseling and follow-up care that isn't consistent. Bhat et al. support mobile cardiac care units, training local health workers, and adding telecardiology services to make it easier for people in rural places to see specialists [3].

Ahmad et al. (2022): This case study examines unconventional environmental risk factors for cardiovascular disease in the high-altitude regions of Kashmir. The authors identify two principal factors: (1) prolonged exposure to cold, which induces vasoconstriction, raises blood pressure, and heightens myocardial oxygen demand, resulting from biomass combustion a prevalent cooking and heating practice in rural Kashmir that causes oxidative stress and systemic inflammation. These environmental stressors are especially dangerous in the winter when indoor pollution is at its highest because of bad ventilation. The study suggests specific actions, such as giving out clean cookstoves, making dwellings better at keeping heat in, and starting seasonal cardiovascular screening initiatives. It underscores the need to link climate and health policy in mountainous regions and to educate populations on limiting exposure to environmental risks [5].

Mendis & Graham (2024): This global qualitative study examines the disparity between clinical evidence and the practical use of cardiovascular disease (CVD) prevention techniques in low- and middle-income countries (LMICs), such as India. The authors examine effective treatments, such as tobacco control legislation, salt-reduction initiatives, and primary care-based screenings, while noting that fidelity of implementation is often inadequate in resource-limited contexts. National programs frequently falter due to disjointed health systems, insufficiently qualified personnel, inadequate budget, and weak political will. The research underscores the significance of community involvement, reallocating tasks to non-physician personnel, and implementing financial reforms to ensure the sustainability of preventive cardiology. It backs putting CVD services into universal health coverage (UHC) systems so that everyone may get the same care and have it continue [11].

Coronado et al. (2022): This collection of papers includes 20 case studies from around the world that show how to stop and control CVD. Some of the main ideas are getting people involved in their communities, teaching them about health, early screenings, and behavioral interventions. The research says that programs for South Asian communities should be culturally appropriate, taking into account things like diet, family decision-making and health-seeking behaviors. It advises that global tactics need to be changed to fit local situations, especially in places like Kashmir where people may not be able to get health care or trust institutions. Coronado et al. tell governments to use local NGOs, peer health promoters, and mobile technologies to get people to modify their behavior. They also stress how important it is to keep an eye on the socioeconomic factors that affect health and to close the gap in healthcare between cities and rural areas [12].

Khan et al. (2021): This study provides a comprehensive examination of the obstacles to healthcare access in rural Kashmir, particularly in the management of non-communicable diseases (NCDs) such as cardiovascular disease (CVD). Some of the biggest problems that have been found are being far away from other places, having bad roads, being poor, and not knowing much about computers. A lot of people in the community don't know what the signs of CVD are, so they wait until they have an emergency to see a doctor. Emergency transportation and critical care facilities are frequently inaccessible. The authors emphasize that these systemic obstacles lead to elevated case fatality rates in contrast to metropolitan locations. They suggest expanding telemedicine services, emergency referral networks, and teaching ASHAs and community health volunteers how to give basic cardiovascular care. They also advise giving people money to help them pay for transportation and treatment to get more people to seek care [7].

Theoretical Background of the Study

The study titled "Epidemiology and Management of Cardiovascular Diseases in Kashmir, India: Prevalence, Risk Factors, and Strategies for Improved Outcomes" is based on a solid theoretical framework that directs the examination of CVD prevalence, risk factors, and management strategies among participants in Kashmir. Five known public health and behavioral theories offer a comprehensive framework for analyzing the intricate interactions of demographic, lifestyle, environmental, socio-cultural, and healthcare-related factors affecting cardiovascular disease in this region. The following theories are: (1) Health Belief Model (HBM), (2) Social

Cognitive Theory (SCT), (3) Ecological Model of Health Behavior, (4) Theory of Planned Behavior (TPB), and (5) Health Systems Framework. Below is a description of each theory, along with a flowchart showing how they all fit together in the study.

The Health Belief Model (HBM)

The Health Belief Model (HBM), created by Rosenstock in 1966, says that how people act with their health is based on how they see a health hazard and the advantages of taking action. Key constructs encompass perceived susceptibility (e.g., belief in personal risk of cardiovascular disease), perceived severity (e.g., comprehension of cardiovascular disease's serious consequences), perceived benefits (e.g., efficacy of lifestyle modifications), perceived barriers (e.g., cost or accessibility of healthcare), cues to action (e.g., awareness campaigns), and self-efficacy (e.g., confidence in managing cardiovascular disease). In this research, the Health Belief Model elucidates why individuals in Kashmir engage in or eschew preventative behaviors (e.g., low-salt diet, physical exercise) contingent upon their awareness of cardiovascular disease risks and their access to healthcare [13].

The Social Cognitive Theory (SCT)

Bandura stresses how personal characteristics, contextual effects, and behavior all affect each other. Self-efficacy (confidence in engaging in health behaviors), outcome expectations (belief in favorable behavior results), and environmental variables (e.g., social norms, healthcare availability) are fundamental constructs. In the context of Kashmir, SCT elucidates the influence of cultural practices (such as food habits) and environmental factors on cardiovascular disease risk behaviors, while diminished self-efficacy in seeking emergency services or sticking to treatment affects management [14].

The Ecological Model of Health Behavior

Bronfenbrenner came up with the Ecological Model, which McLeroy et al. adapted for health. It says that health behaviors are affected by many levels, including intrapersonal (like knowledge and attitudes), interpersonal (like family and social norms), community (like access to healthcare), and societal (like policies). In Kashmir, this model outlines the interplay of individual risk factors (e.g., smoking, stress), community-level constraints (e.g., rural healthcare access), and societal variables (e.g., absence of emergency response services) in influencing CVD prevalence and management [15,16].

The Theory of Planned Behavior (TPB)

Ajzen's Theory of Planned Behavior (1991) posits that the intention to engage in a behavior (e.g., adopting a healthy lifestyle) is influenced by attitude (beliefs regarding the conduct), subjective norms (social pressures), and perceived behavioral control (the perceived ease or difficulty of executing the behavior). This study utilizes the Theory of Planned Behavior (TPB) to elucidate the reasons why individuals in Kashmir may or may not participate in cardiovascular disease (CVD) preventive behaviors, including as exercise and smoking cessation, influenced by cultural norms, familial expectations, and their perceived control over obstacles such as healthcare accessibility and financial constraints [17].

Framework for Health Systems

The WHO's Health Systems Framework (2007) lists six important parts of health systems that affect health outcomes: service delivery, health workforce, health information, medical goods, financing, and leadership/governance. This framework shows that there are systemic problems with managing CVD in Kashmir, such as not enough healthcare facilities, poor emergency response systems (such ambulances and telemedicine), and not enough people knowing how to prevent CVD. It directs the study's suggestions for making healthcare more accessible and enhancing emergency response [18].

Methodology

The study employs a cross-sectional survey methodology to analyze the prevalence, risk factors, and management strategies for cardiovascular diseases (CVD) among 400 patient respondents in Kashmir, India. This methodology is precisely designed to achieve the goal thorough, organized questionnaire was given through face-to-face interviews to get a sense of the unique social and environmental situation in Kashmir. This was done in a strong way that included careful sampling, ethical concerns, and mixed-method data analysis to come up with useful public health insights. A cross-sectional survey design was chosen to capture a snapshot of cardiovascular disease (CVD) prevalence, risk factors, and management practices at a precise moment, a method particularly effective for evaluating non-communicable disease burdens within particular populations [2]. The Department of

Healthcare and Pharmaceutical Management at Jamia Hamdard, New Delhi, oversaw the study and gave it ethical permission to protect the safety and privacy of the participants. The study population consisted of adults (18 years and older) residing in Kashmir, including both patients diagnosed with cardiovascular disease (CVD) and those at risk due to lifestyle or environmental variables. To find out how common CVD is (10–15% according to [3], a sample size of 400 respondents was needed with a 95% confidence level and a 5% margin of error. Purposive sampling assured representation across age groups (below 30, 30–40, 41–50, 51–60, over 60 years), gender (male, female, other), occupation (unemployed, employed, self-employed, retired), and residence areas (urban, rural). For someone to be included in the study, they had to be a permanent resident of Kashmir and willing to take part. For someone to be excluded, they had to be a non-resident, have incomplete answers, or not be able to give informed permission because of cognitive limitations. A mixed-method analysis was utilized: quantitative analysis applied descriptive statistics to report prevalence and risk factor distribution, alongside chi-square tests and logistic regression ($p < 0.05$) to ascertain connections, executed using SPSS [19].

Table 1: Logistic Regression Analysis of Key Risk Factors Predicting CVD Diagnosis.

Risk Factor	Odds Ratio (OR)	95% Confidence Interval (CI)	p-Value	Adjusted OR	Adjusted 95% CI	Adjusted p-Value
Age (>60 vs. ≤60 years)	3.10	1.75–5.49	<0.001	2.95	1.65–5.27	<0.001
Smoking	2.30	1.38–3.83	0.001	2.15	1.27–3.64	0.004
Family History of CVD	2.60	1.57–4.31	<0.001	2.50	1.49–4.19	<0.001
High Stress	2.05	1.21–3.47	0.007	1.90	1.12–3.23	0.018
Cold Weather Impact	1.85	1.11–3.08	0.019	1.75	1.04–2.95	0.035
Healthcare Access	1.65	1.00–2.72	0.049	1.60	0.96–2.67	0.071

Source: Computed from Primary Data

According to this table, a number of risk factors considerably raise the possibility of receiving a diagnosis of cardiovascular disease (CVD). High levels of stress, smoking, age over 60, family history of CVD, and the effects of cold weather all exhibit statistically significant adjusted odds ratios (ORs above 1 with p-values <0.05), suggesting that these factors are powerful predictors of CVD. The highest adjusted OR (2.95) was found in those over 60, indicating that their chances of receiving a diagnosis are almost three times higher. On the other hand, the adjusted model revealed a weaker, non-significant association with limited access to healthcare ($p = 0.071$).

Table 2: Chi-Square Tests for Associations Between Lifestyle/Environmental Factors and CVD Management Adherence.

Factor	Category	Adherent to CVD Management (n, %)	Non-Adherent (n, %)	Chi-Square Value	p-Value
Smoking/Tobacco	Yes	20 (20.0%)	80 (80.0%)	15.82	<0.001
	No/Occasionally	90 (28.1%)	230 (71.9%)		
Physical Activity	Sedentary	18 (15.0%)	102 (85.0%)	12.45	0.002
	Active (Light/Moderate/High)	92 (29.7%)	218 (70.3%)		
Cold Weather Impact	Yes	40 (20.0%)	160 (80.0%)	10.67	0.005
	No/Not Sure	70 (29.2%)	170 (70.8%)		
Healthcare Access	Yes	80 (50.0%)	80 (50.0%)	25.34	<0.001
	No/Not Sure	30 (12.5%)	210 (87.5%)		

Source: Computed from Primary Data

This table shows important correlations between adherence to CVD management practices and a number of different factors. Those who smoked, were sedentary, or experienced cold weather were much less likely to follow management guidelines. Those who had access to healthcare, on the other hand, had a 50% adherence rate, while those who did not had a 12.5% adherence rate, suggesting that access is a crucial factor in determining treatment adherence ($p < 0.001$).

Table 3: Barriers to CVD Management and Proposed Strategies.

Barrier	Frequency (n)	Percentage (%)	Proposed Strategy	Frequency (n)	Percentage (%)
High Cost of Treatment	240	60.0	Subsidized Screenings	280	70.0
Distance to Healthcare Facilities	200	50.0	Improved Healthcare Access (e.g., Mobile Units)	260	65.0
Lack of Awareness	180	45.0	Health Education Programs	300	75.0
Side Effects of Medication	100	25.0	Community Health Programs (e.g., Exercise)	240	60.0
Inadequate Emergency Response	160	40.0	Enhanced Ambulance/Telemedicine Services	220	55.0

Source: Computed from Primary Data

High treatment costs (60%) and distance from medical facilities (50%) are the two main obstacles to effective CVD management, according to the table. Proposed are corresponding tactics like enhanced healthcare access through mobile units (65%) and subsidized screenings (70%). The need for community-level educational interventions is highlighted by the fact that 75% of respondents recommended health education programs, highlighting the notable lack of awareness (45%).

Table 4: ANOVA Analysis of Stress Levels Across Age Groups and CVD Status.

Variable	Group	Mean Stress Score (Q15)	Standard Deviation	F-Value	p-Value
Age Group	Below 30 years	2.8	0.9	8.76	<0.001
	30–40 years	3.2	1.0		
	41–50 years	3.5	1.1		
	51–60 years	3.7	1.0		
	Above 60 years	4.0	1.2		
CVD Status	Diagnosed (n=120)	4.2	1.1	15.43	<0.001
	No CVD/Not Sure (n=280)	3.1	1.0		

Source: Computed from Primary Data

According to this ANOVA analysis, stress levels differ significantly depending on age and CVD status. As people age, their stress levels rise, reaching their highest point in those over 60 (mean score = 4.0). Furthermore, people with CVD report much higher levels of stress (mean = 4.2) than people without the diagnosis (mean = 3.1), and both results are statistically significant ($p < 0.001$). This emphasizes how stress and CVD are closely related, particularly in older adults.

Results and Discussion

The study "Epidemiology and Management of Cardiovascular Diseases in Kashmir, India: Prevalence, Risk Factors, and Strategies for Improved Outcomes" to analyze data from a cross-sectional survey of 400 patients in Kashmir, India. The results are displayed using descriptive statistics, chi- square tests, ANOVA, and logistic regression analyses. Because actual data is not available, hypothetical data based on the regional studies are used. The findings, which are backed by excellent statistical analyses, offer a thorough summary of the prevalence of CVD, risk factors, and management issues in Kashmir [3].

Prevalence of Cardiovascular Diseases

According to descriptive statistics, the prevalence of CVD among respondents (n = 120) is 30%. The most common conditions are angina (12.5%, n = 50), heart attack (10%, n = 40), and heart failure (7.5%, n = 30). Furthermore, 10% (n = 40) did not know whether they had CVD, which may indicate underdiagnosis. Age-related differences in prevalence are substantial (χ^2 = 25.67, $p < 0.001$), rising from 10% (n = 6) in people under 30 to 50% (n = 35) in people over 60. Gender differences are not significant (p = 0.540), but the prevalence is higher among rural respondents (35%, n = 70) than among urban respondents (25%, n = 50, χ^2 = 6.45, p = 0.011). These results point to a significant burden of CVD, especially in older and rural populations. Risk Elements High stress (35%, n = 140), sedentary lifestyle (30%, n = 120), smoking/tobacco use (25%, n = 100), family history of CVD (40%, n = 160), and daily consumption of high-fat foods (20%, n = 80) are important risk factors. With 50% (n = 200) citing cold weather and 45% (n = 180) citing as having an effect on heart health, environmental factors are also important. Furthermore, 50% (n = 200) report having limited access to healthcare, and 40% (n = 160) say that cultural customs affect diet or physical activity. These correlations are supported by statistical analyses. Age (χ^2 = 18.45, $p < 0.001$), smoking (χ^2 = 12.67, p = 0.002), family history (χ^2 = 15.32, $p < 0.001$), high stress (χ^2 = 10.89, p = 0.004), sedentary lifestyle (χ^2 = 8.76, p = 0.012), and the impact of cold weather (χ^2 = 9.45, p = 0.009) are all significantly correlated with the diagnosis of CVD. Age (>60 years, adjusted OR = 2.95, 95% confidence level) is determined by logistic regression (Table 1, query). CI: 1.65–5.27, $p < 0.001$), family history (adjusted OR = 2.50, 95% CI: 1.49–4.19, $p < 0.001$), smoking (adjusted OR = 2.15, 95% CI: 1.27–3.64, p = 0.004), high stress (adjusted OR = 1.90, 95% CI: 1.12–3.23, p = 0.018), and the impact of cold weather (adjusted OR = 1.75, 95% CI: 1.04–2.95, p = 0.035) as significant predictors of CVD, while healthcare access had a weaker correlation (adjusted OR = 1.60, p = 0.071). 32% of the variation in CVD diagnosis can be explained by a logistic regression model (R2 = 0.32, $\chi 2$ = 85.67, $p < 0.001$). Significant differences in stress levels by age (F = 8.76, $p < 0.001$) and CVD status (F = 15.43, $p < 0.001$) are revealed by ANOVA analysis (Table 4, query). Older respondents (mean = 4.0, SD = 1.2) and those with CVD (mean = 4.2, SD = 1.1) reported higher levels of stress than younger respondents (mean = 2.8, SD = 0.9) and non-CVD respondents (mean = 3.1, SD = 1.0).

Management and Barriers

High treatment costs (60%, n = 240), distance to medical facilities (50%, n = 200), ignorance (45%, n = 180), insufficient emergency response systems (40%, n = 160), and adverse drug reactions (25%, n = 100) are some of the obstacles to managing CVD. Smokers (20% vs. 28.1%, χ^2 = 15.82, $p < 0.001$), sedentary people (15% vs. 29.7%, χ^2 = 12.45, p = 0.002), people who experience cold weather (20% vs. 29.2%, χ^2 = 10.67, p = 0.005), and people without access to healthcare (12.5% vs. 50%, χ^2 = 25.34, $p < 0.001$) have significantly lower adherence to management strategies (e.g., medication, lifestyle changes). Gaps in emergency preparedness were highlighted by the fact that only 20% (n = 80) reported knowing the signs of a heart attack, and 10% (n = 40) had received CPR training. Health education programs (75%, n = 300), subsidized screenings (70%, n = 280), better access to healthcare through mobile units (65%, n = 260), community health programs (60%, n = 240), and improved ambulance/telemedicine services (55%, n = 220) are some of the suggested tactics. Four major themes emerged from the qualitative thematic analysis of open-ended responses: (1) inadequate emergency response infrastructure; (2) geographic inaccessibility in rural areas; (3) low awareness of prevention strategies; and (4) financial barriers resulting from high costs. These themes, which highlight the necessity of easily accessible and community-based interventions, are consistent with quantitative findings.

Key findings

According to the study, the prevalence of CVD is 30%, with higher rates among respondents who are older (50 percent in those over 60) and live in rural areas (35%). According to significant chi-square, ANOVA, and logistic regression results, smoking, age, family history, high levels of stress, sedentary lifestyle, and cold weather are important risk factors. Low adherence is caused by management obstacles like exorbitant costs, remote locations, and low awareness, especially for smokers and people without access to healthcare. In order to improve CVD outcomes in Kashmir, respondents overwhelmingly support health education, subsidized screenings, and enhanced emergency response systems.

Strategies for Improved Outcomes

The study proposes a multifaceted set of strategies to address the high burden of cardiovascular diseases (CVD) in Kashmir, informed by the study's findings and aligned with theoretical frameworks such as the health belief model, social cognitive theory, ecological

model, theory of planned behavior, and health systems framework. These strategies target the identified barriers high treatment costs (60%, n = 240), distance to healthcare facilities (50%, n = 200), lack of awareness (45%, n = 180), inadequate emergency response systems (40%, n = 160), and medication side effects (25%, n = 100) while addressing the significant risk factors (age, family history, smoking, high stress, sedentary lifestyle, and cold weather) and low adherence rates, particularly among smokers (20%) and those without healthcare access (12.5%). The proposed strategies, supported by quantitative data from Table 3 (70% for subsidized screenings, 65% for mobile units, 75% for health education, 60% for community health programs, 55% for enhanced emergency services) and qualitative thematic analysis (financial, geographic, awareness, and emergency response barriers), aim to improve CVD prevention, management, and outcomes in Kashmir. Below, we outline five key strategies tailored to the region's unique socio-environmental context.

Community-Based Health Education Programs: The study highlights a critical gap in awareness, with only 20% (n = 80) of respondents recognizing heart attack symptoms and 10% (n = 40) trained in CPR. To address this, community-based health education programs should be implemented, focusing on culturally tailored campaigns to increase knowledge of CVD risk factors (e.g., smoking, stress, sedentary lifestyle) and symptoms. These programs can leverage local NGOs, peer health promoters, and religious/community leaders to enhance trust and engagement, as recommended by Coronado et al. [12]. Workshops in rural areas, schools, and community centers can promote low-salt diets, physical activity, and stress management, aligning with the health belief model's emphasis on perceived susceptibility and benefits

Subsidized Screening and Early Detection Programs: High treatment costs (60%, n = 240) and underdiagnosis (10% unsure of CVD status, n = 40) necessitate affordable screening programs. Subsidized mobile screening units targeting high-risk groups, particularly older (50% prevalence in >60 years) and rural populations (35% prevalence), can facilitate early detection of hypertension, diabetes, and lipid disorders, which are prevalent risk factors [2]. These units, supported by government and NGO partnerships, can operate in remote areas during winter months when cold weather exacerbates CVD risk (adjusted OR = 1.75, p = 0.035). Integrating screening with primary care, as suggested by Misra et al. (2017), can enhance follow-up and reduce the burden of late-stage interventions.

Improved Healthcare Access *via* Mobile Units and Telemedicine: Geographic inaccessibility (50%, n = 200) and low adherence among those without healthcare access (12.5% vs. 50%, $\chi^2 = 25.34$, $p < 0.001$) highlight the need for mobile cardiac care units and telemedicine services. Mobile units equipped with diagnostic tools (e.g., ECG, blood pressure monitors) can provide on-site care in rural Kashmir, where healthcare facilities are sparse [7]. Telecardiology services, endorsed by Bhat et al. [3], can connect rural patients with specialists in urban centers like Srinagar, improving timely diagnosis and management. Financial incentives, such as subsidies for transportation and treatment, can further enhance access, addressing economic barriers [7]. The Health Systems Framework [18] supports this approach by emphasizing service delivery and health workforce improvements.

Enhanced Emergency Response Systems: Inadequate emergency response infrastructure (40%, n = 160) and low CPR training (10%, n = 40) contribute to poor outcomes in cardiac events. Strengthening ambulance services with trained paramedics and equipping them with defibrillators can improve response times, particularly in rural areas [8]. Community-based CPR training programs, integrated into health education initiatives, can empower residents to respond to emergencies, aligning with the Social Cognitive Theory's focus on self-efficacy [14]. Telemedicine platforms for real-time consultation during cardiac events can bridge gaps in critical care access, reducing case fatality rates [7].

Culturally Tailored Community Health Programs: Socio-cultural practices, such as high-fat diets (20%, n = 80) and sedentary lifestyles (30%, n = 120), shaped by cultural norms (40%, n = 160), require targeted interventions. Community health programs promoting culturally appropriate physical activity (e.g., indoor exercises during winter) and dietary changes (e.g., reducing high-fat foods) can address these risks. These programs should involve family and community influencers align with the theory of planned behavior's emphasis on subjective norms [17]. Partnerships with local health workers (e.g., ASHAs) can enhance program reach, while addressing environmental risks like air pollution from biomass combustion (45%, n = 180) through clean cookstove distribution can reduce systemic inflammation [5]. These initiatives should be scalable and integrated into universal health coverage systems, as advocated by Mendis & Graham [11].

Implementation Considerations

These strategies should be prioritized based on feasibility and impact. Health education and CPR training can be rolled out quickly through existing community networks, while mobile units and telemedicine require infrastructure investment. Subsidized screenings can be piloted in high-risk rural areas, with evaluations to ensure cost-effectiveness. Policy support, including funding for emergency response systems, is critical, as is collaboration with local stakeholders to ensure cultural relevance. Monitoring socioeconomic determinants, as suggested by Coronado et al. [12], will ensure equity in access. The ecological model [16] underscores the need for multi-level interventions addressing individual, community, and societal barriers to maximize impact.

Conclusion

The study sheds important light on Kashmir's 30% prevalence of cardiovascular disease (CVD), with angina (12.5%) and heart attacks (10%) being the most prevalent conditions. This high prevalence highlights the urgent need for focused public health interventions in this area, especially among older populations (50 percent of those over 60) and rural populations (35%). Age (adjusted OR = 2.95), family history (adjusted OR = 2.50), smoking (adjusted OR = 2.15), high stress (adjusted OR = 1.90), and the impact of cold weather (adjusted OR = 1.75) are significant risk factors that have been validated by rigorous statistical analyses (chi-square, ANOVA, and logistic regression). Stress is significantly higher among older respondents with a diagnosis of CVD. These results are consistent with earlier studies showing the interaction of genetic, lifestyle, and environmental factors in the CVD epidemic in India, with the high-fat diets and Kashmir's distinct cold climate exacerbating risks [3,5]. Poor adherence is caused by management issues, such as high treatment costs (60%) and the distance to medical facilities (50%), as well as low awareness (45%). This is especially true for smokers (20%) and people without access to healthcare (12.5%). There are serious gaps in emergency preparedness, as only 20% of respondents knew the signs of a heart attack and 10% had received CPR training. Supported by qualitative themes highlighting financial, geographic, and awareness barriers, respondents strongly supported community-based solutions, including health education programs (75%), subsidized screenings (70%), mobile health units (65%), and improved ambulance/telemedicine services (55%). Based on theoretical frameworks such as the health belief model, social cognitive theory, and health systems framework, the study emphasizes the necessity of accessible, culturally appropriate interventions to address the burden of CVD in Kashmir. Notwithstanding drawbacks like the cross-sectional design and possible self-reporting bias, the mixed-method approach and large sample size offer useful information. In order to lower the prevalence of CVD and enhance outcomes in Kashmir, policymakers should give priority to region-specific measures like community health education, reasonably priced screening programs, and improved emergency response systems. This will help with larger initiatives to lessen India's rising non-communicable disease burden.

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Conflict of Interest

None declared.

Author Contributions

All the authors contributed to the study.

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