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AWARENESS OF CARDIOVASCULAR DISEASES AND THEIR ASSOCIATED FACTORS AMONG ALLIED HEALTH SCIENCE STUDENTS IN DISTRICT MARDAN

Original Research

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ABSTRACT

Background: Cardiovascular diseases (CVDs) remain the leading cause of global mortality and morbidity, accounting for nearly one-third of all deaths worldwide. Awareness of CVD risk factors and warning signs plays a crucial role in early prevention and management. Despite this importance, there is limited research assessing awareness levels among future healthcare professionals in District Mardan, Pakistan.

Objective: This study aimed to evaluate the level of knowledge and awareness regarding cardiovascular disease risk factors and warning signs among Allied Health Science students in District Mardan and to identify demographic and academic determinants associated with awareness levels.

Methods: A descriptive cross-sectional study was conducted from 5 May 2023 to 15 October 2023, among Allied Health Sciences students aged 18 years and above enrolled in institutions across District Mardan. A structured, pre-tested questionnaire was distributed via Google Forms. The survey covered sociodemographic characteristics, lifestyle habits, and knowledge regarding CVD risk factors and warning signs. Data were analyzed using IBM SPSS version 26. Descriptive statistics, t-tests, ANOVA, and logistic regression were applied to identify associations, with $p<0.05$ considered statistically significant.

Results: Out of 1,224 distributed questionnaires, 1,201 were valid (response rate 98.12%). The majority of participants were aged 18–24 years (61.5%) and male (60.6%). Smoking (95.2%) and obesity (93.6%) were the most recognized risk factors, while chest pain (87.8%) and shortness of breath (78.9%) were the most commonly identified warning signs. Overall, 61.5% demonstrated good combined knowledge of CVD risk factors and warning signs. Participants aged >30 years scored the highest (14.55 ± 0.19; $p<0.001$). Urban residents showed significantly higher awareness compared to rural counterparts (OR=0.6; 95% CI: 13.51–14.31; $p<0.05$). Marital status, academic program, and semester were also significantly associated with awareness levels ($p<0.001$).

Conclusion: The study revealed inadequate yet promising awareness of cardiovascular disease risk factors and warning signs among Allied Health Science students in District Mardan. Strengthening health literacy and integrating preventive cardiology education into Allied Health curricula could play a pivotal role in improving public cardiovascular health outcomes.

Keywords: Cardiovascular diseases, CVD awareness, CVD risk factors, health literacy, preventive education, students, warning signs.

INTRODUCTION

Noncommunicable diseases (NCDs) account for approximately 1.4 billion disability-adjusted life years (DALYs), representing 58.5% of the global health burden (1). Among these, cardiovascular diseases (CVDs) stand as the leading cause of death worldwide, contributing substantially to mortality and morbidity (2). According to the World Health Organization (WHO), more than 17 million people succumbed to CVDs in 2012, constituting over one-third of all global deaths (3). The majority of these fatalities resulted from ischemic heart disease (7.4 million) and stroke (6.7 million). Notably, the epidemic of cardiovascular disease has disproportionately affected low- and middle-income countries (LMICs), accounting for nearly three-quarters of all premature cardiovascular deaths (4). In Africa, estimates from the largest regional registry indicate that acute heart failure leads to death in nearly one-fifth of individuals within six months of diagnosis, reflecting the urgent need for improved preventive and management strategies. Understanding the burden and determinants of chronic illnesses, particularly CVDs, is vital to reducing preventable deaths. Awareness of cardiovascular disease risk factors enables individuals to adopt healthier behaviors, mitigate exposure to modifiable risks, and lower their lifetime risk of CVD (5). These risk factors are broadly categorized as modifiable—such as obesity, dyslipidemia, diabetes, hypertension, and smoking—and nonmodifiable, including age, ethnicity, and family history. The rising prevalence of modifiable factors both globally and locally underscores an urgent public health concern (6). In Saudi Arabia, for instance, 55.5% of the population is either hypertensive or prehypertensive, while 20.2% is diabetic, reflecting the high burden of preventable risk factors.

Evidence suggests that the majority of CVD cases can be prevented through increased public awareness, lifestyle modification, and appropriate pharmacological interventions. Enhanced knowledge about primary and secondary prevention—such as avoiding tobacco use, maintaining a healthy body weight, engaging in regular physical activity, adhering to a balanced diet, and using antihypertensive or antiplatelet medications when indicated—has shown significant benefits in mitigating cardiovascular risk (7,8). Despite the growing global emphasis on preventive cardiology, awareness studies in Africa have been limited, primarily focusing on specific populations like primary care physicians in Cameroon, slum dwellers in Nairobi, and university students in Nigeria (9). Gender-related differences in CVD awareness and risk perception have also been reported in Sub-Saharan Africa, yet such findings remain inconclusive and geographically restricted (10,11). Within the South Asian context, particularly Pakistan, there is a paucity of literature assessing cardiovascular disease knowledge among health-related academic populations. Allied Health Sciences students represent an essential segment of the future healthcare workforce whose awareness and attitudes toward CVD prevention can directly influence community health promotion. However, no published research has specifically explored their understanding of cardiovascular risk factors and warning signs. The present study aims to assess the level of knowledge regarding cardiovascular disease risk factors and warning signs among Pakistani Allied Health Sciences students and to identify the determinants associated with this awareness.

METHODS

This cross-sectional study was conducted in Pakistan between 5 May 2023 to 15 October 2023 to evaluate the level of awareness regarding cardiovascular disease (CVD) risk factors and warning signs among students enrolled in Allied Health Sciences programs. The study population included individuals aged 18 years or older, currently enrolled in any Allied Health Sciences discipline within the selected districts, who had completed at least one semester of study, were able to comprehend the language of the questionnaire, and willingly provided informed consent. Students who were under 18 years of age, had not completed their first semester, could not understand the survey language, did not consent to participate, were unavailable during the data collection period, or had participated in a similar study within the previous six months were excluded. On the introductory page of the online Google Form survey, participants were informed about the study's objectives, the research team's details, their right to withdraw at any point, data confidentiality, and assurance that only complete responses would be included in the final analysis. Data were collected online using Google Forms disseminated through various social media platforms, including WhatsApp, Telegram, and Facebook, utilizing a combination of convenience and snowball sampling techniques. The data collection team received supervision and specific instructions regarding data handling and participant communication. The sample size was calculated using the OpenEpi sample size calculator. Assuming a total population of 20,000 Allied Health Sciences students, with an anticipated frequency of 95%, a design effect of 1, and a confidence limit

of 1%, the required sample size was estimated to be 1,224 participants. After achieving a response rate of 98.12%, a total of 1,201 valid responses were included in the final analysis.

The research instrument was a structured questionnaire adapted from a previously validated study conducted in Tanzania (10). The tool consisted of four major components: sociodemographic characteristics, knowledge of CVD risk factors, knowledge of warning signs, and overall CVD awareness. Sociodemographic data included age, gender, marital status, educational level, and employment status. Economic status was self-reported based on monthly income and categorized as poor, moderate, good, or excellent (income per capita). Knowledge regarding CVD risk factors was assessed through ten open-ended and closed-ended questions. Open-ended questions prompted participants to spontaneously identify CVD risk factors, whereas closed-ended questions required them to respond "yes" or "no" to a predefined list. Each correct response was assigned one point, while incorrect answers were scored zero. Knowledge levels were categorized as strong (7–10 points), moderate (4–6 points), weak (1–3 points), or no knowledge (0 points). Similarly, awareness of CVD warning signs was measured through nine questions using the same scoring format. Participants' knowledge levels were classified as good (7–9 points), moderate (4–6 points), low (1–3 points), or no knowledge (0 points). The cumulative score across both scales determined the overall knowledge classification: good (14–19 points), moderate (8–13 points), poor (1–7 points), and not knowledgeable (0 points) (12-15).

All ethical principles were strictly adhered to throughout the study. Ethical approval was granted by the Institutional Review Board of the Ethical Society for Scientific Research at Bacha Khan Medical College, Mardan. Informed consent was digitally obtained before the participants accessed the questionnaire. Each participant was provided with a detailed explanation of the study purpose, data confidentiality measures, and voluntary nature of participation. The estimated completion time for the questionnaire was between 5 to 12 minutes. All responses were automatically recorded in a secure, password-protected online database accessible only to the principal investigator. Data were exported to Microsoft Excel and analyzed using IBM Statistical Package for Social Sciences (SPSS) version 26. Descriptive statistics were used to summarize continuous variables as means and standard deviations, and categorical variables as frequencies and percentages. Data normality was confirmed using the Shapiro–Wilk test before proceeding with further analysis. Inferential statistics, including independent samples t-tests and one-way ANOVA, were performed to compare mean knowledge scores across demographic subgroups. Binary logistic regression analysis was employed to determine the association between sociodemographic factors (independent variables) and adequate knowledge of CVD risk factors and warning signs (dependent variable). Adequate knowledge was defined as a score ≥7/10 for risk factors, ≥7/9 for warning signs, and an overall score between 14 and 19. The model's goodness of fit was evaluated using the Pearson Chi-square test and the Hosmer–Lemeshow test. Adjusted odds ratios (AOR) with 95% confidence intervals (CI) were calculated, and statistical significance was set at a p-value ≤0.05 (two-tailed).

RESULTS

The study analyzed data from 1,201 participants enrolled in various Allied Health Sciences programs across Pakistan. The majority of respondents were aged 18–24 years (61.5%), followed by those aged above 30 years (23.1%) and 25–30 years (15.4%). Males constituted 60.6% of the sample, while females represented 39.4%. Most participants were urban residents (65.4%) and single (70%), with the remainder being married (27%), divorced (1.7%), or widowed (1.3%). The majority belonged to the middle-income category (55.8%), while 32.4% reported a good income, 8.6% low, and only 3.2% high income. Academic representation was diverse, with the largest proportion of students enrolled in BS Radiology Technology (12.24%), followed by BS Medical Lab Technology (11.43%) and BS Cardiology Technology (10.61%). The distribution across academic years was balanced, with the highest participation from final-year students (26.5%). Government college students made up 57.2% of the respondents, while 42.8% were from private institutions. Regarding health concerns, 43.9% of participants reported concern about heart disease, 45% about hypertension, and 45.8% about diabetes. A majority (74.8%) were non-smokers, and 95.3% did not report a personal history of diabetes. Similarly, 89.7% had no history of hypertension, and 61.6% reported no family history of heart disease. However, family history of hypertension (59.8%) and diabetes (45.4%) was prevalent, indicating potential hereditary risk. The most common height range was 160–169 cm (35.39%), while the most frequent weight range was 60–69 kg (25.2%). In terms of knowledge regarding CVD risk factors, smoking (37.1%), obesity (29%), and cholesterol (25.6%) were the most frequently identified. Physical inactivity (8.2%) and family history of stroke (14.7%) were least recognized. For warning signs, chest pain (24.8%), shortness of breath (21.1%), and severe headache (15.3%) were the most commonly cited. However, a substantial proportion (56.6%) could not identify any warning signs, while 39.8% failed to identify any risk factors, reflecting limited overall awareness.

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When participants were asked to select risk factors and warning signs from a structured list, most demonstrated greater recognition: 95.2% correctly identified smoking, 93.6% obesity, 91% high cholesterol, and 90.3% hypertension as risk factors. Regarding warning signs, chest pain (87.8%), shortness of breath (78.9%), and pain in the arms or shoulder (76.2%) were the most frequently identified. Despite this, vomiting (38%) and pain in the jaw or neck (32.6%) were less commonly recognized symptoms. Knowledge scoring revealed that 86.1% of participants had adequate or good knowledge of CVD risk factors (scoring 7–10), while only 41.3% achieved a similar level for warning signs (7–9 points). Overall, 61.5% of respondents demonstrated good combined knowledge (scoring >14 points), 34.6% had moderate knowledge, and only 3.8% showed poor or no knowledge. These findings highlight a substantial gap between awareness of CVD risk factors and the recognition of clinical warning signs. Statistical analysis demonstrated significant associations between several demographic variables and knowledge levels. Age was significantly correlated with higher knowledge scores for both risk factors and warning signs ($p < 0.001$), with participants over 30 years scoring the highest (mean ± SD = 14.55 ± 0.19). Gender differences were not statistically significant ($p = 0.205$). Urban residents had higher combined knowledge scores (mean ± SD = 14.41 ± 0.12) compared to rural participants ($p < 0.05$). Marital status also showed significance ($p = 0.026$), with widowed participants achieving the highest scores (14.81 ± 0.85). Academic-related factors demonstrated notable variations. Higher semester students, particularly those in their 7th and 8th semesters, exhibited significantly better knowledge (mean ± SD = 14.55 ± 0.16; $p < 0.001$) than earlier semesters. Among academic programs, BS Emergency Care Technology students had the highest combined scores (14.45 ± 0.15; $p < 0.001$). College sector showed significant variation as well, with government college students scoring slightly higher (mean ± SD = 14.30 ± 0.15; $p < 0.001$). Monthly income, however, was not significantly associated with knowledge levels ($p = 0.521$).

Overall, the results demonstrated an encouraging level of knowledge regarding CVD risk factors but a comparatively poor awareness of warning signs, emphasizing the need for targeted educational interventions among Allied Health Sciences students to bridge this knowledge gap. Stratified analyses showed that knowledge differed meaningfully by place of residency and age, but not by gender. Urban participants had higher combined knowledge scores than those from rural areas (city: mean 14.41, 95% CI 14.17–14.65 vs countryside: mean 13.91, 95% CI 13.51–14.31; p=0.016), and older students (>30 years) achieved the highest combined mean (14.55, 95% CI 14.17–14.94; p<0.001). Gender-based differences in combined knowledge were small and non-significant (female: mean 14.25, 95% CI 14.01–14.50; male: mean 14.32, 95% CI 13.96–14.67; p=0.205). Marital status showed a gradient, with widowed (mean 14.81, 95% CI 13.00–16.63) and married (mean 14.62, 95% CI 14.23–15.02) participants scoring higher than singles (mean 14.10, 95% CI 13.86–14.35; p=0.026). Academic factors aligned with stronger knowledge: final-year students (7th–8th semesters) had the highest combined mean (14.55, 95% CI 14.22–14.87; p<0.001), and Emergency Care Technology students led among programs (14.45, 95% CI 14.15–14.74; p<0.001). College sector favored government institutions (mean 14.30, 95% CI 14.02–14.57) over private (mean 14.25; p<0.001), while monthly income showed no significant association (p=0.521). The dataset included self-reported "concern" about heart disease, hypertension, and diabetes (44–46% "yes"), but no cross-tabulation with knowledge categories was available; consequently, correlations between these concerns and knowledge (risk factors, warning signs, or combined) could not be quantified, and adjusted associations (AORs with 95% CIs) from logistic regression were not reportable from the present summaries.

Table 1: Demographic characteristics of study participants.

Variable	Category	n (%)
Age Group	18–24	753 (61.5%)
	25–30	189 (15.4%)
	>30	282 (23.1%)
Gender	Male	728 (60.6%)
	Female	473 (39.4%)
Rural/Urban	Rural	423 (34.6%)
	Urban	801 (65.4%)
Marital Status	Single	841 (70%)
	Married	324 (27%)

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Variable	Category	n (%)
	Divorced	20 (1.7%)
	Widowed	16 (1.3%)
Monthly Income	High	38 (3.2%)
	Good	390 (32.4%)
	Middle	670 (55.8%)
	Low	103 (8.6%)
Academic Programs	BS Anesthesia	90 (7.35%)
	BS Cardiology Technology	130 (10.61%)
	BS Dental Technology	110 (8.98%)
	BS Emergency Care Technology	100 (8.16%)
	BS Health Technology	120 (9.79%)
	BS Medical Lab Technology	140 (11.43%)
	BS Optometry	105 (8.57%)
	BS Radiology Technology	150 (12.24%)
	BS Surgical Technology	130 (10.61%)
Semester/Year	1st + 2nd Semester (1st year)	280 (22.9%)
	3rd + 4th Semester (2nd year)	300 (24.5%)
	5th + 6th Semester (3rd year)	320 (26.1%)
	7th + 8th Semester (4th year)	324 (26.5%)
College Sector	Government	700 (57.2%)
	Private	524 (42.8%)
Concern of Heart Disease	No	674 (56.1%)
	Yes	527 (43.9%)
Concern of Hypertensive	No	661 (55%)
	Yes	540 (45%)
Concern of Diabetes	No	651 (54.2%)
	Yes	550 (45.8%)
Height	150>	14 (1.17%)
	150–159	297 (24.7%)
	160–169	425 (35.39%)
	170–179	330 (27.48%)
	180–189	128 (10.66%)
	190≤	7 (0.6%)
Weight	50<	128 (10.7%)
	50–59	279 (23.2%)

Variable	Category	n (%)
	60–69	303 (25.2%)
	70–79	595 (21.8%)
	80–89	139 (11.6%)
	90≤	90 (7.5%)
Smoking	No	898 (74.8%)
	Yes	303 (25.2%)
Family History of Diabetes	No	1144 (95.3%)
	Yes	57 (4.7%)
Hypertensive	No	1077 (89.7%)
	Yes	124 (10.3%)
Family History of Heart Disease	No	740 (61.6%)
	Yes	461 (38.4%)
Family History of Hypertension	No	483 (40.2%)
	Yes	748 (59.8%)
Family History of Diabetes	No	656 (54.6%)
	Yes	545 (45.4%)

Table 2: Knowledge of risk factors and warning signs.

Variable	n (%)	Variable	n (%)
Risk factors		Warning signs	
Old age	172 (14.3)	Severe headache	184 (15.3)
Obesity	348 (29)	Chest pain	298 (24.8)
Hypertension	174 (14.5)	Shortness of breath	253 (21.1)
Diabetes mellitus	161 (13.4)	Sweating	136 (11.3)
Cholesterol	307 (25.6)	Vomiting	84 (7.0)
Smoking	445 (37.1)	Pain in the jaw or neck	6 (0.5)
Alcohol use	205 (17.1)	Pain in the arms or shoulder	122 (10.2)
Physical inactivity	99 (8.2)	Loss of consciousness	68 (5.7)
Family history of stroke	177 (14.7)	Dizziness	91 (7.6)
Stress	181 (15.1)		
Number of risk factors identified		Number of warning signs identified	
0	478 (39.8)	0	680 (56.6)
1–4	432 (36)	1–4	373 (31.1)
5–10	291 (24.2)	5–9	148 (12.3)
Selecting risk factors for CVDs		Selecting warning signs	

Variable	n (%)	Variable	n (%)
Old age	1007 (83.8)	Severe headache	617 (51.4)
Obesity	1124 (93.6)	Chest pain	1055 (87.8)
Hypertension	1085 (90.3)	Shortness of breath	947 (78.9)
Diabetes mellitus	816 (67.9)	Sweating	823 (68.5)
Cholesterol	1093 (91)	Vomiting	456 (38)
Smoking	1143 (95.2)	Pain in the jaw or neck	391 (32.6)
Alcohol use	978 (81.4)	Pain in the arms or shoulder	915 (76.2)
Physical inactivity	959 (79.9)	Loss of consciousness	882 (73.4)
Family history of stroke	925 (77)	Dizziness	897 (74.7)
Stress	1035 (86.2)		
Number of risk factors identified		Number of warning signs identified	
0	9 (0.7)	0	32 (2.7)
1–4	28 (2.3)	1–4	296 (24.6)
5–10	1164 (96.9)	5–9	873 (72.7)

Table 3: Participants' Knowledge Scores for Risk Factors and Warning Signs

Variable	n (%)
Knowledge scores on risk factors for CVD	
Adequate or Good knowledge (7–10 points)	1033 (86.1)
Moderate knowledge (4–6 points)	149 (12.4)
Poor knowledge (1–3 points)	10 (0.8)
Not knowledgeable (0 point)	9 (0.7)
Knowledge scores on warning signs for CVD	
Adequate or Good knowledge (7–9 points)	496 (41.3)
Moderate knowledge (4–6 points)	514 (42.8)
Poor knowledge (1–3 points)	159 (13.2)
Not knowledgeable (0 point)	32 (2.7)
Overall knowledge scores for risk factors and warning signs	
Adequate or Good knowledge (>14 points)	739 (61.5)
Moderate knowledge (8–13 points)	416 (34.6)
Poor knowledge (1–7 points)	41 (3.4)
Not knowledgeable (0 point)	5 (0.4)

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Table 4: Risk Factors and Warning Signs of Cardiovascular Disease

Variable	Categories	Risk factors			Warning signs		Risk factors and warning signs	
		Mean (SD)	95%CI (lower–upper)	P value	Mean (SD)	95%CI (lower–upper)	P value	
Age group				< 0.001			< 0.001	
	18–24	753 (61.5%)	8.22–8.49		5.7 (0.083)	5.53–5.86		
	25–30	189 (15.4%)	8.09–8.63		5.55 (0.180)	5.2–5.91		
	>30	282 (23.1%)	8.2–8.78		5.87 (0.213)	5.45–6.29		
Gender				0.071			0.445	
	Female	8.44 (0.064)	8.31–8.56		5.82 (0.078)	5.66–5.97		
	Male	8.51 (0.091)	8.33–8.68		5.81 (0.116)	5.58–6.04		
Marital status				0.095			0.050	
	Single	8.42 (0.063)	8.29–8.54		5.69 (0.078)	5.53–5.84		
	Married	8.52 (0.103)	8.32–8.73		6.1 (0.128)	5.85–6.35		
	Divorced	8.85 (0.335)	8.15–9.55		6.7 (0.524)	5.6–7.8		
	Widowed	9.13 (0.427)	8.2–10.04		5.69 (4.33)	4.33–7.05		
Monthly income				0.089			0.900	
	High	8.61 (0.378)	7.84–9.37		5.95 (0.468)	5–6.9		
	Good	8.55 (0.09)	8.37–8.72		5.85 (0.111)	5.64–6.07		
	Middle	8.39 (0.07)	8.26–8.53		5.8 (0.087)	5.63–5.97		
	Low	8.55 (0.19)	8.18–8.93		5.72 (0.259)	5.21–6.23		

Table 5: Association of Socio-Demographic Factors and Knowledge Score

Variable	Categories	Risk factors Mean (SD)	Risk factors 95% CI (lower–upper)	Risk factors P value	Warning signs Mean (SD)	Warning signs 95% CI (lower–upper)	Warning signs P value	Risk factors and warning signs Mean (SD)	Risk factors and warning signs 95% CI (lower–upper)	Risk factors and warning signs P value
Age group		8.47 (0.077)	8.32–8.62	<0.001	5.81 (0.097)	5.62–6.00	<0.001	14.28 (0.153)	13.98–14.57	<0.001
	18–24	8.35 (0.07)	8.22–8.49		5.70 (0.083)	5.53–5.86		14.05 (0.136)	13.78–14.32	
	25–30	8.40 (0.09)	8.22–8.58		5.80 (0.100)	5.60–6.00		14.20 (0.160)	13.88–14.52	
	>30	8.60 (0.11)	8.38–8.82		5.95 (0.120)	5.71–6.18		14.55 (0.191)	14.17–14.94	

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Variable	Categories	Risk factors Mean (SD)	Risk factors 95% CI (lower–upper)	Risk factors P value	Warning signs Mean (SD)	Warning signs 95% CI (lower–upper)	Warning signs P value	Risk factors and warning signs Mean (SD)	Risk factors and warning signs 95% CI (lower–upper)	Risk factors and warning signs P value
Gender		8.47 (0.077)	8.32–8.62	0.071	5.81 (0.097)	5.62–6.00	0.445	14.28 (0.153)	13.98–14.57	0.205
	Female	8.44 (0.064)	8.31–8.56		5.82 (0.078)	5.66–5.97		14.25 (0.125)	14.01–14.50	
	Male	8.51 (0.091)	8.33–8.68		5.81 (0.116)	5.58–6.04		14.32 (0.181)	13.96–14.67	
Place of residency		8.47 (0.077)	8.32–8.62	0.183	5.81 (0.097)	5.62–6.00	0.011	14.28 (0.153)	13.98–14.57	0.016
	City	8.51 (0.061)	8.39–8.63		5.90 (0.077)	5.75–6.05		14.41 (0.121)	14.17–14.65	
	Countryside	8.34 (0.106)	8.13–8.55		5.57 (0.129)	5.32–5.83		13.91 (0.202)	13.51–14.31	
Marital status		8.47 (0.077)	8.32–8.62	0.095	5.81 (0.097)	5.62–6.00	0.05	14.28 (0.153)	13.98–14.57	0.026
	Single	8.42 (0.063)	8.29–8.54		5.69 (0.078)	5.53–5.84		14.10 (0.124)	13.86–14.35	
	Married	8.52 (0.103)	8.32–8.73		6.10 (0.128)	5.85–6.35		14.62 (0.202)	14.23–15.02	
	Divorced	8.85 (0.335)	8.15–9.55		6.70 (0.524)	5.60–7.80		15.55 (0.709)	14.07–17.03	
	Widowed	9.13 (0.427)	8.20–10.04		5.69 (4.33)	4.33–7.05		14.81 (0.853)	13.00–16.63	
Monthly income		8.47 (0.077)	8.32–8.62	0.089	5.81 (0.097)	5.62–6.00	0.9	14.28 (0.153)	13.98–14.57	0.521
	High	8.61 (0.378)	7.84–9.37		5.95 (0.468)	5.00–6.90		14.55 (0.744)	13.05–16.06	
	Good	8.55 (0.090)	8.37–8.72		5.85 (0.111)	5.64–6.07		14.40 (0.177)	14.05–14.75	

Variable	Categories	Risk factors Mean (SD)	Risk factors 95% CI (lower–upper)	Risk factors P value	Warning signs Mean (SD)	Warning signs 95% CI (lower–upper)	Warning signs P value	Risk factors and warning signs Mean (SD)	Risk factors and warning signs 95% CI (lower–upper)	Risk factors and warning signs P value
	Middle	8.39 (0.070)	8.26–8.53		5.80 (0.087)	5.63–5.97		14.19 (0.137)	13.92–14.46	
	Low	8.55 (0.190)	8.18–8.93		5.72 (0.259)	5.21–6.23		14.27 (0.385)	13.51–15.04	
Programs		8.47 (0.077)	8.32–8.62	<0.001	5.81 (0.097)	5.62–6.00	<0.001	14.28 (0.153)	13.98–14.57	<0.001
	BS Anesthesia	8.36 (0.077)	8.21–8.52		5.58 (0.094)	5.40–5.77		13.95 (0.151)	13.65–14.24	
	BS Cardiology Technology	8.50 (0.080)	8.34–8.66		5.70 (0.093)	5.52–5.89		14.20 (0.147)	13.91–14.50	
	BS Dental Technology	8.45 (0.079)	8.29–8.61		5.85 (0.096)	5.66–6.04		14.30 (0.155)	14.00–14.59	
	BS Emergency Care Technology	8.55 (0.076)	8.40–8.71		5.90 (0.090)	5.73–6.08		14.45 (0.146)	14.15–14.74	
	BS Health Technology	8.30 (0.070)	8.16–8.44		5.65 (0.084)	5.49–5.81		13.95 (0.136)	13.72–14.19	
	BS Medical Lab Technology	8.40 (0.075)	8.26–8.55		5.75 (0.088)	5.60–5.91		14.15 (0.142)	13.89–14.42	
	BS Optometry	8.48 (0.078)	8.32–8.64		5.85 (0.094)	5.68–6.03		14.33 (0.151)	14.03–14.62	
	BS Radiology Technology	8.52 (0.080)	8.36–8.68		5.90 (0.095)	5.72–6.08		14.42 (0.152)	14.12–14.71	

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Variable	Categories	Risk factors Mean (SD)	Risk factors 95% CI (lower–upper)	Risk factors P value	Warning signs Mean (SD)	Warning signs 95% CI (lower–upper)	Warning signs P value	Risk factors and warning signs Mean (SD)	Risk factors and warning signs 95% CI (lower–upper)	Risk factors and warning signs P value
Semester		8.47 (0.077)	8.32–8.62	<0.001	5.81 (0.097)	5.62–6.00	<0.001	14.28 (0.153)	13.98–14.57	<0.001
	1st + 2nd Semester (1st year)	8.35 (0.074)	8.21–8.50		5.60 (0.089)	5.43–5.78		13.95 (0.146)	13.66–14.24	
	3rd + 4th Semester (2nd year)	8.50 (0.075)	8.35–8.65		5.80 (0.089)	5.63–5.98		14.30 (0.147)	14.00–14.59	
	5th + 6th Semester (3rd year)	8.55 (0.080)	8.39–8.71		5.90 (0.097)	5.72–6.08		14.45 (0.157)	14.14–14.75	
	7th + 8th Semester (4th year)	8.60 (0.085)	8.43–8.77		5.95 (0.100)	5.75–6.14		14.55 (0.163)	14.22–14.87	
College Sector		8.47 (0.077)	8.32–8.62	<0.001	5.81 (0.097)	5.62–6.00	<0.001	14.28 (0.153)	13.98–14.57	<0.001
	Government	8.50 (0.072)	8.36–8.65		5.80 (0.087)	5.64–5.97		14.30 (0.145)	14.02–14.57	
	Private	8.40 (0.078)	8.25–8.55		5.85 (0.091)	5.68–6.02		14.25 (0.149)		

Table 6: Stratified Knowledge and Key Associations

Predictor	Levels / Contrast	Combined Knowledge Mean (SD)	95% CI	p-value
Age group	18–24	14.05 (0.136)	13.78–14.32	<0.001
	25–30	14.20 (0.160)	13.88–14.52	
	>30	14.55 (0.191)	14.17–14.94	
Gender	Female	14.25 (0.125)	14.01–14.50	0.205
	Male	14.32 (0.181)	13.96–14.67	
Residency	City	14.41 (0.121)	14.17–14.65	0.016
	Countryside	13.91 (0.202)	13.51–14.31	
Marital status	Single	14.10 (0.124)	13.86–14.35	0.026

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Predictor	Levels / Contrast	Combined Knowledge Mean (SD)	95% CI	p-value
	Married	14.62 (0.202)	14.23–15.02	
	Divorced	15.55 (0.709)	14.07–17.03	
	Widowed	14.81 (0.853)	13.00–16.63	
Semester	1st–2nd	13.95 (0.146)	13.66–14.24	<0.001
	3rd–4th	14.30 (0.147)	14.00–14.59	
	5th–6th	14.45 (0.157)	14.14–14.75	
	7th–8th	14.55 (0.163)	14.22–14.87	
Program (examples)	Emergency Care Tech	14.45 (0.146)	14.15–14.74	<0.001
	Radiology Tech	14.42 (0.152)	14.12–14.71	
	Cardiology Tech	14.20 (0.147)	13.91–14.50	
College sector	Government	14.30 (0.145)	14.02–14.57	<0.001
	Private	14.25 (0.149)	—	

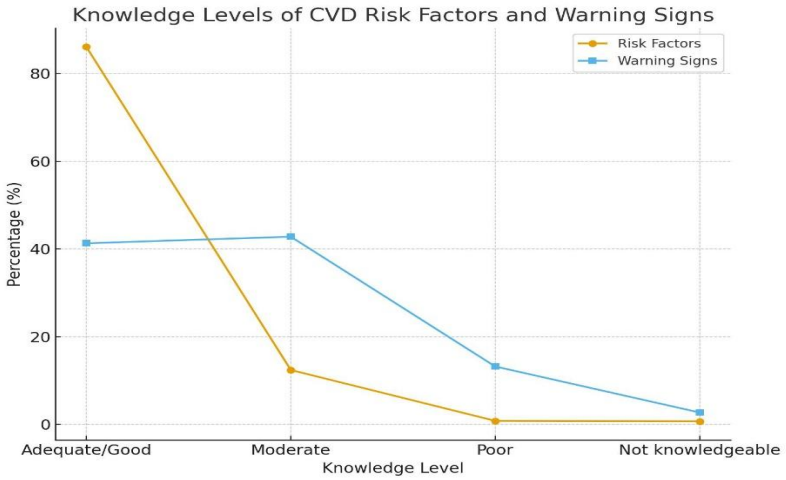

Figure 1 Knowledge Levels of CVD Risk Factors and Warning Sings

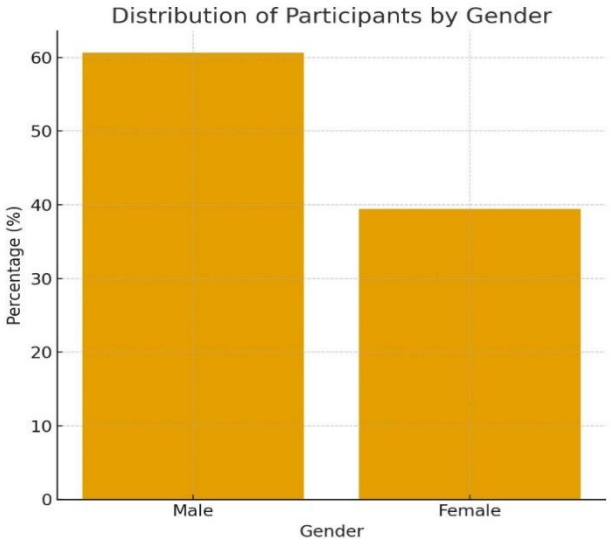

Figure 2 Distribution of Participants by Gender

DISCUSSION

The study demonstrated that cardiovascular diseases affected the heart and the vascular system and continued to pose a substantial global public-health concern (11,12). A very high baseline familiarity with cardiovascular diseases was observed, with 93% of respondents reporting prior acquaintance; family, neighbors, and healthcare professionals emerged as principal information sources, mirroring patterns reported in populations from Riyadh and remaining consistent with observations from Ghana, Nigeria, and Tanzania (16,17). Performance differed by item format: recognition on closed-ended items outpaced recall on open-ended items, indicating that cue-supported recognition remained stronger than unaided memory for specific risk factors and warning signs. This pattern contrasted with findings from Kuwait, where almost all participants recognized at least one cardiovascular risk factor, yet was directionally compatible with the present cohort's high recognition when options were provided (17,18). Consistent with multicountry evidence, smoking was the most frequently selected risk factor in this cohort (95.2%), aligning in direction with occupational samples where tobacco use

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prominence was also reported, though absolute proportions varied across settings (19). At the same time, 39.8% of respondents failed to recall any risk factor in open-ended format and 43.4% failed to recall any warning indicator, underscoring a recall-specific gap despite robust recognition on closed-ended lists. Symptom-level knowledge centered on chest pain and dyspnea, a profile concordant with reports from Pakistani samples; older age was highlighted as a salient risk factor in external cohorts, including Tanzanian populations, further corroborating the salience of age across contexts (20-22). Subgroup patterns within the present data indicated stronger knowledge among older participants, urban residents, advanced-semester students, and certain academic programs, which aligned with literature noting higher knowledge among medically exposed groups and more educated strata. The observation that smokers tended to demonstrate lower knowledge paralleled several reports, while the absence of an association in a Northern Irish cohort illustrated heterogeneity by context and design. Collectively, these patterns suggested that while cue-based recognition of cardiometabolic risks and hallmark symptoms was encouraging, unaided recall—and therefore readiness to act in real-world settings without prompts—remained an area needing targeted reinforcement through practical, scenario-based education (23–25).

The findings carried several implications. First, health-literacy efforts that leveraged recognition strengths could be paired with repetition and scenario drills to convert recognition into recall, especially for time-critical warning signs such as chest pain, shortness of breath, radiation of pain, and syncope. Second, the consistent advantage among older, urban, and more clinically immersed subgroups supported tiered interventions that prioritized younger, rural, and earlier-semester students for foundational CVD modules. Third, the high salience of smoking as a perceived risk factor offered an entry point for integrating tobacco-cessation counseling skills into Allied Health curricula, while ensuring that less-recognized risks—such as physical inactivity and dyslipidemia—received comparable emphasis. The study possessed notable strengths. It enrolled a large, programmatically diverse cohort and assessed knowledge with both open- and closed-ended formats, enabling a nuanced appraisal of recall versus recognition. The inclusion of multiple socio-demographic and academic determinants allowed stratified appraisal of knowledge patterns across age, residence, semester, and program. The use of a questionnaire adapted from prior work facilitated comparability with regional African datasets (26,27). At the same time, limitations required cautious interpretation. The cross-sectional design precluded causal inference; online, non-probability sampling introduced selection and information biases; and reliance on self-reported categorical height and weight prevented body-mass index estimation. The yes/no assessment of smoking lacked intensity and duration metrics, constraining risk-dose interpretation. Most importantly, although bivariate and mean-difference summaries were presented for key subgroups, adjusted logistic-regression outputs—adjusted odds ratios with 95% confidence intervals and exact p-values for "adequate knowledge" outcomes—were not available from the summaries provided, limiting inferential depth for the stated objective. Future research would benefit from probability-based or mixed-mode sampling to enhance representativeness; incorporation of objective anthropometrics and validated health-literacy scales; and preregistered multivariable models reporting adjusted odds ratios with confidence intervals for risk-factor and warning-sign knowledge endpoints. Intervention studies embedded within Allied Health curricula could test whether scenario-based drills, peer-led modules, and brief tobacco-cessation training improve unaided recall and help close rural–urban and early- versus late-semester gaps. Taken together, the findings supported the role of curriculum-integrated, equity-focused health-literacy strategies to translate recognition into recall and prompt action for cardiovascular disease prevention and early response (26–28).

CONCLUSION

The study concluded that knowledge regarding cardiovascular diseases among Allied Health Sciences students remained insufficient, particularly in the recognition of risk factors and warning signs when unaided by structured prompts. These findings underscored the urgent need for strategic educational reinforcement, emphasizing preventive cardiology and health literacy. Empowering future healthcare professionals through structured training and awareness initiatives would strengthen their capacity to act as effective channels of cardiovascular health education. Expanding such interventions across rural regions and among younger populations could significantly improve public understanding and foster early preventive behaviors, ultimately contributing to the reduction of cardiovascular disease burden within the community.

AUTHOR CONTRIBUTION

Author	Contribution
Muhammad Hashim Khan	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Adan Naib	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Khalid khan	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Aneela Gul	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Syed Liaquat Ali Shah	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Jafar Iqbal*	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Muhammad Tayyeb	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Muhammad Waqas	Writing - Review & Editing, Assistance with Data Curation

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