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Evaluating Risk Factors for Coronary Heart Disease Among Adults Aged 26-45: A Study from Punjab, Pakistan

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Abstract

In the prevention of heart disease, the identification of risk factors plays a pivotal role. For this purpose, the present study aims to identify the lifestyle and health factors that contribute to heart disease in individuals aged 26 to 45. The goal of this study is to identify the risk factors like personal, clinical, and lifestyle that significantly increase the prevalence of coronary heart disease in adult males and females aged 26 to 45 years. Data is collected from the Preventive Department of the Punjab Institute of Cardiology (PIC) in Lahore, Pakistan. In 2021, from August 9 to September 22, we collected data from 300 participants through surveys and medical records, half of whom had cardiac disease, and the other half were healthy. Factors such as high blood pressure, smoking, stress, exercise habits, cholesterol levels, weight, age, family history, and gender were also taken into consideration. Using the binary logistic regression model, it was revealed that the OR (P-value) of smoking 3.898 (0.000), high blood pressure 2.598 (0.001), a family history of heart disease 2.433 (0.001) and being 41–45 years old 4.162 (0.007) were all significant risk factors for developing coronary heart disease. To decrease heart disease in Pakistan, smoking prevention, high blood pressure treatment, cholesterol maintenance, and family history awareness should be significantly focused.

Keywords

Coronary Heart Disease, Smoking, Cholesterol, Hypertension, Risk factors.

1. Introduction

In many developed nations, the primary cause of death is heart disease. Globally, 80% of these losses are disproportionately impacted by underdeveloped countries. Every year, 17.9 million people die from CHD alone (Hanif et al., 2022). From 1990 to 2010, the global number of cardiovascular and circulatory illnesses-related deaths increased by one-third over two decades (Mahmood et al., 2014). The World Health Organization (WHO) emphasizes the crucial need for heart disease prevention and early detection to save lives.

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Noncommunicable diseases, particularly coronary heart disease (CHD) significantly contributes to global mortality, with underdeveloped countries accounting for 80% of these deaths (Huang et al., 2022).

This quantitative assessment of the literature offers up-to-date information on the epidemiological link between smoking and CHD. Smoking significantly increases the risk of CHD, causing numerous annual fatalities and accounting for 29% of all coronary heart disease deaths. Quitting smoking can significantly reduce the risk of CHD, although it increases the danger as the more cigarettes smoked, the more the danger is (Jackson et al., 2017; Huang et al., 2022). Smoking and passive smoking are found to be modifiable risk factors for both CHD and acute myocardial infarction (AMI) (Basnet et al., 2019). Gender significantly influences smoking prevalence, as heavy smokers need longer periods to decrease their risk of CHD compared to current smokers (Anagnosti et al., 2024).

Lifestyle choices significantly impact CHD risk factors, including cholesterol levels, smoking habits, high blood pressure, obesity, poor diets, stress, and diabetes (Mazhar et al., 2023; Cao et al., 2022). Family history significantly influences the risk of CHD, as genes can increase the likelihood of the condition. Genetics family eating habits and cholesterol levels can contribute to early heart problems (Osadnik et al., 2019). International studies suggest a family history of CHD in first-degree relatives as an independent risk factor for CHD development in individuals that is influenced by age, genetic, environmental exposures, and potential confounding factors (Volpe and Gello, 2023).

Dyslipidemia, characterized by low HDLc, elevated LDLc particles, and high triglycerides, significantly contributes to the onset of CHD (Găman et al., 2020). Dyslipidemia prevalence in young adults usually ranges from 12.0% to 13.0%. Studies suggest that cholesterol in young adults is associated with cardiovascular events, coronary calcium risk, and future coronary heart disease (Jeong et al., 2018). Depression, affecting one in 10 people, can be a deadly companion for CHD, especially for women (Vaccarino et al., 2020). Low socio-economic status, lack of social support, stress, animosity, type-D personality, depression, and anxiety are psychological risk factors for CHD (Pogosova et al., 2017). Advancements in medicine still hinder the recognition and treatment of CHD, especially in women, who often experience symptoms later than men (Smith et al., 2011). Age and gender significantly influence the risk of developing CHD in women who are more likely to battle diabetes and high blood pressure and less likely to smoke due to cardiac issues (Gheisari et al., 2020). Women with cardiovascular disease (CHD) have a higher mortality risk due to diabetes and smoking and they require further efforts to improve lifestyle and treatment strategies (Manfrini et al., 2020).

Hypertension, a major cause of mortality, affects the heart health of 1.15 billion people globally. Controlling blood pressure is crucial for combating cardiovascular diseases (Malik et al., 2021). In low- and middle-income countries, 75% of cases are diagnosed. Lowering systolic blood pressure can reduce coronary heart disease risk by 50% (Arshed et al., 2023).

In the modern era, obesity and overweight crucially contribute to the progression of coronary heart disease, with waist circumference, waist-to-hip, and waist-to-height ratios indicating a 40% higher risk of developing the disease (Manoharan et al., 2022). Obesity as defined by a BMI of 25-30 kg/m2, affects over 600 million people globally and

contributes significantly to cardiovascular disease related to mortality that emphasizing the need for immediate action (Mahmood et al., 2014).

This article particularly focused on understanding the risk factors of coronary heart disease (CHD) among individuals aged 26 to 45 in Pakistan. However, existing literature has extensively studied various risk factors associated with CHD, such as smoking, hypertension, and high cholesterol levels. This study aims to explore how these factors manifest specifically within the stated age group in Pakistan.

2. Methodology

The methodology of this study involves the following subsections.

2.1 Data source

This is a case-control study. The target population is patients suffering from CHD aged 26-45 years admitted to the Punjab Institute of Cardiology in Lahore. The sample size of n=300 is selected from simple random sampling. The study collected data from these patients using detailed questionnaires and medical records to better understand the risk factors for CHD in this population. Data was collected over six weeks, from August 9 to September 22, 2021. Only the persons aged 26-45 years were included in the study, the rest of the age groups were excluded. No other criteria were specified for inclusion/exclusion. Among them, 150 individuals served as the case group who had already developed CHD or 'outcome' of interest, whereas the remaining 150 individuals aged 26-45, who were interviewed had no heart disease, worked as a comparison group and served as our control. The interviews that were taken with patients focused around lifestyle facets, clinical indicators, and socio-demographic factors.

2.2 Statistical methods

In this study, we explored the response variable 'occurrence of CHD' in individuals categorized as "Yes" or "No". A binary logistic regression model was used to model the relationship between the occurrence of CHD and risk factors including gender, age, family medical history, smoking habits, body mass index (BMI), cholesterol levels, stress levels, walking, and hypertension. These factors were studied to determine their impact on the likelihood of getting CHD and revealed important details about the complex link between lifestyle, genetics, and cardiovascular health. The model computes the odds of the event versus no event. In general, the binary logistic regression model is given as follows (Annas et al., 2022):

$$p(x_i) = \frac{\exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_i x_i)}{1 + \exp(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_i x_i)} \tag{1}$$

Where $p(x_i)$ is the probability of a binary outcome with the category "Yes". The logit function is a linear transformation of equation (1) as given below:

$$g(x) = \ln(\frac{p(x_i)}{1 - p(x_i)}) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_i x_i \beta_9 , \tag{2}$$

where, $g(x)$ is the logit known as the log odds of the response variable. β_0 is the intercept that represents the log odds or logit estimate of the outcome variable when model covariates are evaluated at zero. These $\beta_1, \beta_2, \ldots \beta_i$are the logistic regression coefficients. $Exp(\beta)$ is the "odds ratio" for the independent variable. The odds ratio of an explanatory variable is the factor by which the explanatory variable increases (if positive) or decreases (if negative) the log odds of the dependent variable (Annas et al., 2022).

3. Results

Descriptive statistics of the study variables are contained in Table 1. It is shown that out of 300 participants, 139 were smokers, 98 had heart disease in their family history, 175 were hypertensive, 57 had walking routines, and 165 were stress-prone, contrasting with 161 who refrained from smoking, 202 and 125 had no heart disease and hypertension respectively. Moreover, among 300 participants, 98 were females and 202 participants were males, 130 participants had normal cholesterol levels, 133 had borderline levels, and 37 had elevated levels.

Furthermore, in Table 1, the data reveals some notable patterns when comparing individuals with and without heart disease. Those with heart disease tend to have a slightly higher average body mass index (29.06 ± 4.87) as compared to those without the disease (28.19 ± 5.91). It suggests a possible link between higher BMI and heart disease. In terms

Table 1: Participant's demographic and clinical characteristics of cases and controls.

Variables		**BMI**	**With Heart Disease (Cases) n=150 (Mean±S.D) 29.06±4.87**	**Without Heart Disease (Control) n=150 (Mean±S.D) 28.19±5.91**	**Total n=300**	**Chi-Square (P-value)**
Age	26-30		8	25	33	0.016
	31-35		29	24	53	-
	36-40		53	52	105	-
	41-45		60	49	109	-
Sex	Male		107	95	202	0.140
	Female		43	55	98	-
Hypertension	Yes		90	52	142	0.000
	No		60	98	158	-
Smoking	Yes		92	47	139	0.000
	No		58	103	161	-
Family History	Yes		86	56	142	0.001
	No		64	94	158	-
Walk	Yes		27	30	57	0.659
	No		123	120	243	-
Stress	Yes		78	87	165	0.296
	No		72	63	135	-
Cholesterol	<=159		72	58	130	0.000
	160-199		50	83	133	-
	Above 200		28	9	37	-

of gender, there are more men than women in both groups. Additionally, risk factors like hypertension, smoking, family history, stress, and high cholesterol levels are more common in the heart disease group and an indication of their potential role in increasing the risk of developing heart problems. Overall physical activity levels measured by walking are generally low for both groups, the difference between those with and without heart disease is small. These findings emphasize the importance of managing modifiable risk factors to maintain heart health.

In this study for the variables under consideration, Equations (1) and (2) result in the following changes to the logistic model, respectively.

$$p(x_i) = \frac{\begin{matrix}\text{and}\, exp(\beta_0 + \beta_1 age + \beta_2 stress + \beta_3 smoking + \beta_4 walk + \beta_5 BMI + \\ \text{and}\beta_6 hypertension + \beta_7 cholestrol + \beta_8 gender + \beta_9 familyhistory)\end{matrix}}{\begin{matrix}\text{and}1 + exp(\beta_0 + \beta_1 age + \beta_2 stress + \beta_3 smoking + \beta_4 walk + \beta_5 BMI + \\ \text{and}\beta_6 hypertension + \beta_7 cholestrol + \beta_8 gender + \beta_9 familyhistory)\end{matrix}} \quad (3)$$

$$\begin{aligned} g(x) &= ln(\frac{p(\text{CHD})}{1 - p(\text{CHD})}) \\ &= \beta_0 + \beta_1 age + \beta_2 stress + \beta_3 smoking + \beta_4 walk + \beta_5 BMI + \\ &\quad \beta_6 hypertension + \beta_7 cholestrol + \beta_8 gender + \beta_9 familyhistory \end{aligned} \quad (4)$$

The results of the binary logistic model presented in Table 2, reveal several significant associations. The parameter estimates of each risk factor indicate that age, smoking, BMI, hypertension, cholesterol (>200), and family history increase the risk of developing coronary heart disease (CHD), whereas stress, walking, cholesterol (160-199), and male gender decrease it.

Smoking is identified as a significant risk factor, with an odds ratio of 3.898 (0.000), indicating a threefold increase in risk for smokers when compared with nonsmokers. The age groups 31-35, and 41-45, show significant correlations with CHD, with odds ratios of 3.721 (0.02) and 4.162 (0.007), respectively. The age group 26-30 serves as the reference category.

The variables such as walking, BMI, stress, cholesterol (over 200), and males have odds ratios < 1, indicating that perhaps they have not a substantial impact on the chance of getting coronary heart disease in this study. The risk factor stress occurs in cases (n=78) almost as frequently as in controls (n=87). Similarly, almost the same number of participants responded that they were not undergoing stress in cases (n=72) and controls (n=63). As there is no significant difference observed in the stress level of cases and controls; the variable stress showed insignificant impact on CHD. At the same time, hypertension emerged as a notable factor with an odds ratio of 2.598 (0.001). Furthermore, specific cholesterol levels between 160-199 mg/dL and family history also significantly increased the risk of CHD with an odds ratio of 0.458 (0.008) and 2.433 (0.001) respectively. However, gender alone did not significantly affect CHD risk. Notably, interactions between certain risk factors, such as smoking and family history, showed significant odds ratios, indicating enhanced risk in specific populations.

Table 2: Parameter estimates of binary logistic model for different variables with CHD.

Variables		β_i (Adjusted)	P-value (Adjusted)	Odd Ratio (OR) (Adjusted)	Odd Ratio (OR) (Unadjusted)
Constant		-0.684	0.197	0.139	0.505
Age	31-353	1.314	0.020	3.721	3.776
	36-40	0.990	0.057	2.692	3.185
	41-45	1.426	0.007	4.162	3.827
Stress	Yes	-0.36	0.200	0.699	0.784
Smoking	Yes	1.360	0.000	3.898	0.938
Walk	Yes	-0.11	0.754	0.895	0.878
BMI	Yes	0.018	0.511	1.018	1.373
Hypertension	Yes	0.955	0.001	2.598	1.147
Cholesterol	160-199	-0.78	0.008	0.458	0.485
	Above 200	0.758	0.119	2.134	2.506
Gender	Male	-0.12	0.704	0.884	1.441
Family-History	Yes	0.889	0.001	2.433	0.653
Interaction Terms					
Family History * Smoking		1.712	0.000	5.539	-
Age (36-40) * Hypertension		1.150	0.001	3.158	-
Age (41-45) * Hypertension		1.256	0.000	3.512	-

The unadjusted odd ratio shows age groups 31-35, and 41-45 show significant correlations with CHD, with odds ratios of 3.776, and 3.827 respectively. However, hypertension emerges as a highly remarkable factor with an odds ratio of 1.147. Furthermore, cholesterol level (above 200) is significantly associated with CHD with an odd ratio of 2.506. Further, family history, stress, and walking are not associated with CHD specifically for this age group.

These findings highlight the multifaceted nature of CHD risk and the significance of focused interventions and improved preventative methods to reduce the disease's prevalence among Pakistani adults aged 26 to 45 years.

4. Discussion and conclusion

The results of this study reveal the several critical risk factors associated with the prevalence of CHD. We have highlighted the significant impact of age, family history, smoking, high blood pressure, and high cholesterol leading to the development of CHD. The findings are consistent with previous research on cardiovascular disease, which has shown that male gender and age over 65 are important risk factors for CHD. Recognizing these factors as main determinants emphasize the importance of focused interventions and preventive measures (Smith et al., 2011; Wang et al., 2018; Agrawal et al., 2023; Farzana Gul Balouch et al., 2022). After menopause, women are more likely to develop CHD.

Moreover, family history is a significant risk factor for CHD and a consistent risk factor independent of age, gender, region, and socio-economic status. A family history of CHD is associated with premature CHD. If families with a positive history of CHD are diagnosed well in time, the disease may be averted (Raza et al., 2023). Interestingly, our study found that certain characteristics, such as stress, BMI, and physical activity, mainly walking, do not show a high correlation with CHD in people aged 26 to 40, irrespective of gender. This is consistent with preceding research, that these factors have varying effects among age groups. The modest impact of these variables emphasizes the importance of management measures and, age-specific risk assessment (Jackson et al., 2017; Powell et al., 2021).

The results of the study have important implications for public health measures that focus on reducing CHD rates, particularly in Pakistan. Ranking the flexible risk factors such as smoking, hypertension, and high cholesterol levels are critical. Comprehensive programs promoting quitting smoking, healthy eating habits, and regular monitoring of blood pressure could provoke substantial reductions in CHD patients (Yusuf et al., 2016; Wagan and Surahyo, 2024).

Moreover, the significance of family history about the risk of CHD emphasizes the necessity for improved genetic screening and risk evaluation. Incorporating congenital heart disease (CHD) into clinical tests can help with early identification and individualized treatment plans for those with the family history of the condition (Tada et al., 2016). Subsequently, the findings provided insights into the complex web of CHD risk factors among Pakistanis between the ages of 26 and 45.

Health care professionals and policymakers can more excellently tailor their approaches to mitigate the burden of CHD by acknowledging the limited impact of certain other risk factors within this age group and the importance of age, family history, smoking, hypertension, and high cholesterol. This study is interesting as it focuses on the risk factors for CHD in people between the ages of 26 and 45. The study sheds important information on the gap between existing medical knowledge and the early development of heart problems in youngsters.

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