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**ESTIMATING THE 10-YEAR RISK ASSESSMENT FOR CARDIOVASCULAR DISEASE AT A HOSPITAL OF TERTIARY CARE IN PUNJAB USING THE ASCVD RISK ESTIMATOR**

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Cardiovascular risk prediction algorithms contain a variety of CVD risk variables. Since the prediction models that were currently available were created using non-Asian cohorts, we made the decision to assess the ASCVD risk estimation model's performance in Punjab as well as the ten-year CVD predisposing factors that were linked with it.

**Methods**

Patients with diabetes mellitus and hypertension in a major hospital in Punjab, India, participated in a cross-sectional study that we conducted. Following their admission to the hospital ward, 176 people without ASCVD who were at forty years or more were assessed. Data on the sociodemographics and behavioural tendencies were gathered using a pre-validated questionnaire. According to established procedures, blood pressure and lipid profiles were obtained. We used ASCVD Risks Estimator Plus to determine the respondents' CVD risk. With the use of binary logistic regression and Chi-square bivariate analysis, the data were examined with IBM SPSS version 26. At a significance level of 5%, the predictors of the 10-year risk for CVD were found.

**Measurements**

We evaluated the correlations between particular risk variables and the predicted cardiovascular events in addition to the expected outcomes' categorisation. The results of this study were categorised into four groups: low group (1-4%), borderline group (6-9%), intermediate group (10-20%), and high group (21-95%).

**Result**

The majority of the 176 patients—68, or 38.6%—were in the high category, which includes 50, or 28.4%, being in the intermediate category, 34, or 19.3%, being in the low category, and 24 (or 13.6%) being in the borderline category. The ASCVD proportion that was median was 14.94%. The largest risk of having CVDs was linked to respondents who were smokers. Additionally, compared to females ( $M=16.22\%$ ), men had a considerably higher mean projected CVD outcome percentage ( $M=27.52\%$ ).

**Conclusion**

According to our prediction analysis, 108 participants (61.4%) were not at risk of developing an ASCVD in the ensuing decade. However, middle-aged men ought to be more cautious about their lifestyle choices, particularly with regard to risk factors that exacerbate their vulnerability to cardiovascular diseases.

**Keywords**

Systolic blood pressure, Cardiovascular illness, Risk prediction model, Diabetes mellitus, hypertension, Low density lipoprotein, High density lipoprotein, The ASCVD risk estimator plus

**INTRODUCTION**

In India, cardiovascular diseases (CVDs) account for the majority of deaths and disabilities. Cardiovascular diseases arise as a result of early and persistent exposure to behavioural risk factors. The combination of multiple risk factors leads to cardiovascular disease (CVD), one of the most prevalent causes of morbidity and mortality worldwide. Congestive heart failure, another name for heart failure (HF), is the incapacity of the heart to pump blood to the body. Heart failure (HF) is the incapacity of the heart to pump blood to the body. In 2017, the American Heart Association, or AHA, projected that the cost of a heart failure case is \$5,380, meaning that there were 64.34 million instances of heart failure worldwide. This means that the economic burden of heart failure is estimated to be \$346.17 billion USD. These numbers originate from computerised information gathered from the Global Health Data Exchange or GHDx registry. Every year, around 17.5 million people worldwide pass away from cardiovascular disease (CVD) [1], making it a serious public health concern. The rising rates of illness and death in emerging nations are a result of changes in the socioeconomic landscape and the way of life of the affected people [2]. In addition to being the most common vascular disease worldwide, arterial hypertension is the main cause of mortality in Brazil. Men are twice as likely as women to present with hypertension, and the frequency rises and changes with age [3,4]. Research indicates that CVD is linked to alterations in serum concentrations of entire cholesterol and its components, apart from ageing [5]. It is essential

to evaluate each person's unique traits and look for signs of CVD risk. The Framingham as well as Atherosclerotic Cardiovascular Disease Risk measures are applied to assess the risks of morbidity and mortality from coronary artery disease (CAD) and to forecast risk for the ensuing decade. Through a comparison of the ASCVD Risk measure results with the SCORE measure, the study seeks to ascertain the prevalence of risk for coronary artery disease in the general population and confirm the correlation between the factors influencing the development of cardiac disease [6]. To assess the probability of coronary artery disease in healthy, asymptomatic individuals, CVD forecasting methods based on individual risk factor profiles are utilised. Higher-risk individuals are the focus of later medicines. Current European guidelines<sup>2</sup> state that SCORE methodology ought to serve as the foundation for evaluating the risk of individuals who do not exhibit any symptoms.

The SCORE method uses the following risk factors—sex, age, cigarette usage, and the total cholesterol—to calculate the 10-year total risk of CVD death.

However, there is growing interest in improving risk prediction by adding new risk indicators, especially those related to imaging, as the SCORE occasionally overestimates and occasionally underestimates hazard. To advise risk stratification utilising costly imaging modalities, some of which may be radiation-related, an assessment of easily accessible risk indicators connected to CVD should be conducted first.

Before now, this has never been done. This study set out to methodically assess whether readily available risk markers may enhance risk classification in a way that went beyond what the SCORE algorithm could [7]. Although prevalent across India, the prevalence of heart disease differs significantly between states. Mizoram has the lowest disease load, nine times lower than Punjab, with 17.5 percent of the population affected. Punjab has the highest disease burden [8].

## METHODS

**Study site**—Following clearance by the ISF College of Pharmacy, Moga's institutional ethics committee (IEC), the study was carried out at Guru Gobind Singh Medical Hospital in Faridkot and Anil Baghi Hospital in Ferozepur.

## STUDY DESIGN AND POPULATION

Only individuals of Indian heritage were enrolled in the prospective observational study, which was carried out from October 2023 to March 2024. All hospitalised patients with diabetes and hypertension at the time of the study comprised the study population. Patients who were 40 years of age or older and did not have a history of proven atherosclerotic cardiovascular disease (ASCVD) at the time of enrollment met the study's inclusion criteria. The following factors were used as exclusion criteria: missing laboratory results, Pregnant and lactating women and who were not willing to participate are will excluded. After providing their informed consent form, the individuals were included to the group. In all, 176 volunteers from the Indian state of Punjab signed up for our research. STROBE criteria were adhered to when gathering the data.

## SAMPLE SIZE AND SAMPLING TECHNIQUE

The sample size was determined using the literature's suggested 95% confidence interval, 5% significance criterion, and margin of error. The CDC-developed "epi info" tool from the US Department of Human and Medical Services was utilised to determine the sample size. It was determined that the expected frequency of the sickness was 50%.

## Study variables

Numerous factors are included by the ASCVD Risk Estimator Plus, including age, race, gender, antihypertensive medication, smoking, history of diabetes, total cholesterol value (mg/dL), high-density cholesterol levels (HDL), and low-density lipoprotein (LDL).

## Outcome(S)

ASCVD Risks Estimator Plus, which predicts a ten-year ASCVD risk, classifies it into four groups: risk group (less than five percent), borderline risks (between 5.7 percent and 7.4%), intermediate risk group (between 7.5 percent and 19.9%), and the highest risk (more than 20%). Since these patients are classified as high-risk and are expected to be diagnosed with CVD within the following ten years, they were our primary focus for interest.

## MODELS FOR PREDICTING CARDIOVASCULAR RISK

In this investigation, we used the ASCVD, the possibility Calculator as well as risk estimation model to predict cardiac events over a ten-year timeframe. In order to reduce ASCVD overprediction in specific individual groups identified in the PCE model, the ASCVD Risk Estimation Plus model was created. Despite the observation that it tends to overestimate ASCVD results in Asians, it has demonstrated substantial clinical use.

The comparison of different race groups' coronary arteries calcium (CAC) and ASCVD scores was the goal of Rifai et al. [11]. The study found that individuals who identified as South Asian and had low to moderate ASCVD scores were also likely to have zero CAC scores. The association between ASCVD score and ethnicity was examined using logistic regression models. The authors concluded that although ASCVCD can be used for clinical decision-making, the total number of southern Asians who have been assigned a low or intermediate risk classification is probably going to be inflated. The comparison of different racial groups' coronary artery calcium (CAC) and ASCVD scores was the goal of Rifai et al. [9]. The study found that individuals who identified as South Asian and had low to moderate ASCVD scores were also likely to have zero CAC scores. The association between ASCVD score and ethnicity was examined using logistic regression models. The authors concluded that although ASCVCD can be used for clinical decision-making, the total number of southern Asians who have been assigned a low or intermediate risk classification is probably going to be inflated [9].

### Statistical evaluation

Using the Statistical Program for the Social Sciences, or SPSS software, we carried out our inquiry using four different statistical test types: the Kruskal Wallis analysis, the test of Mann-Whitney U, linear regression, and the chi-square test. For comparing the overviews of the continuous variables, which generated using the quartiles, mean, and median, the Wilcoxon test was employed. Additionally, a summary based on frequencies and percentages was created, and McNemar's chi-square test was used to compare the results for categorical variables. Less than 0.05 was the threshold for a meaningful p-value. The ASCVD Risk Estimator Plus was used to calculate each participant's expected chance of experiencing a cardiovascular disease events over the course of the following ten years.

### RESULT

The research population's baseline characteristics are shown in Table 1. According to the 2017 ACC/AHA Hypertension Guidelines Revised Definition of Hypertension, the majority of research participants had stage 1 hypertension, denoted by a systolic range of 130–139. For most of the study group, HDL was low and total and LDL cholesterol were high.

**Table 1: Incidence and prognostic variables for CVD**

Factors	Rate	The percentage (%)
Smoker		
No	156	88.6
Yes	20	11.4
Systolic blood pressure (SBP)		
Normal level	17	9.7
Elevated levels	159	90.3
Total cholesterol (TC)		
Normal	28	15.9
High	148	84.1
Plasma HDL		
Optimum	76	43.2
Low	100	56.8
LDL		
Optimum	16	9.1
High	160	90.9
DM		
Yes	126	71.6
No	50	28.4

### Participant sociodemographic characteristics

The respondents' average age was 55.89 years. This study's lowest age was 40 years old, while its highest range was 79 years old. 38 (21.6%) people, or those in the age range of 46 to 50, made up the bulk of the participants. Every participant was of Indian heritage, with 57.4% of them being women and the remaining participants being men.

Table 1 below shows the prevalence of diabetes, hyperlipidemia, systolic hypertension, low HDLc and high LDLc present, which were 126 (71.6%), 148 (84.1%), 159 (90.3%), 100 (56.8%) and 160 (90.9%) respectively.

CVD risk stratification among hospitalised patients

68(38.6%) of the 176 participants fell into the high group, 50(28.4%) into the middle category, 34(19.3%) into the low category, and 24(13.6%) into the borderline category. The average ASCVD proportion, as shown in Fig. 1 below, was 40.02%.

Relationship between respondents' 10-year risk for cardiovascular diseases and sociodemographic factors

In comparison to females (M=16.22%), men had a considerably higher mean projected CVD outcome percentage (M=27.52%). In the non-smoker group, the proportion of females was substantially greater. Age was shown to be positively connected with the expected CVD % in a linear regression test of connection between Age and ASCVD outcomes. The p-value of 0.001 indicated that the results were significant. Table 2 below gives an explanation of the statistical techniques applied in this study.

Relationship between respondents' 10-year risk for CVDs and risk factors

The subject's SBP group and the TC category had a strong association (p=0.001), according to the chi-square test findings. Furthermore, gender did not substantially affect the patients' behaviours (p=0.050). According to Mann Whitney's u test, gender had no bearing on TC or SBP (p=0.012 and p=0.216, respectively). According to linear regression analysis, TC levels were associated with the anticipated ASCVD outcomes (p=0.001), and age had an influence on ASCVD outcomes (p=0.001). However, the patient's TC levels were unaffected by their age. The following associations were discovered using Kruskal Wallis tests: DM history is substantially correlated with ASCVD outcomes (p=0.001), age effects DM history (p=0.001), and SBP category had no discernible impact on the SBP result.

Table 2: Incidence and prognostic variables for CVD

Test	p-value
Chi Square	
Habits vs. Gender	0.050
SBP versus TC	0.001
Linear-regression	0.001
AgeversusASCVD	0.001
TCversus ASCVD	0.361
Age vs. Total Cholestrol	
Kruskal Wallis	
SBP vs DM History	0.622
ASCVD vs. SBP	0.001
ASCVD vs. DM history	0.001
DM history vs. Age	0.001
Mann Whitney's U-test	
CS versus ASCVD	0.002
SBP vs. Gender	0.216
TC versus Gender	0.012

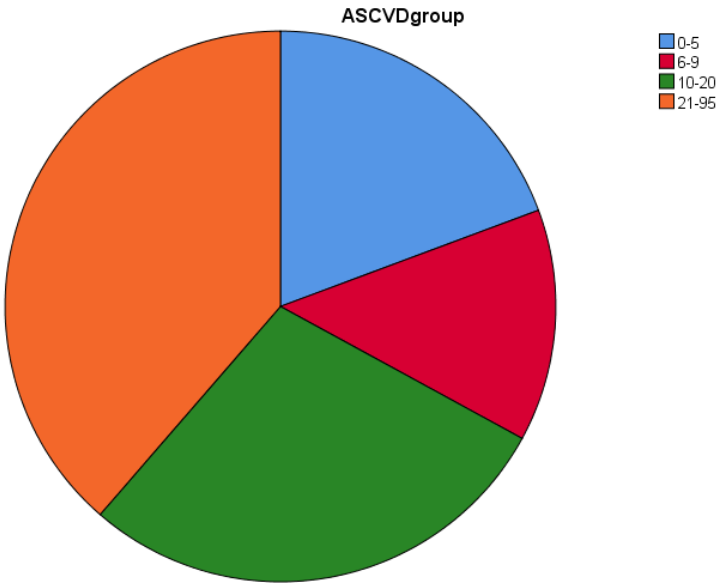


Fig 1: Predicted ASCVD outcomes

## DISCUSSION

The highest proportion of participants in our prediction research are 38 (21.6%) in the 46–50 age range and 31 (17.6%) in the 51–55 age group. It was established that the average age of 55.89 years included a lower age limit of 40 years and a higher age 79 years. According to these findings, middle-aged people had a higher risk of CVDs than previously thought. Similar findings were revealed by scholars Garshick et al. (2019), who found that lifestyle and traditional factors increased the risk of cardiovascular disease (CVD) problems in young to middle-aged individuals ( $50 \pm 6$  years). According to their research, the chance of developing CVDs later in life was raised by variables including financial difficulty, elevated psychological stress, and behaviours like skipping fruits and vegetables as a child [10]. Comparing the social habits of the patients with those of their age group has yielded some noteworthy findings. The average age of the participants in our study was contrasted with values obtained at forty-five years of age by Jones et al. (2006).

Furthermore, the results of our study indicate that female participants are more likely to encounter CVD events than their male peers. Statistically significant differences were seen in the total mean ASCVD score between female patients ( $M=16.22\%$ ) and male patients ( $M=27.52\%$ ). According to our study's findings, there was no discernible difference in the mean TC levels among male and female participants ( $M=252.19$  mg/dL as well as  $M=238.50$  mg/dL), indicating that the sexes' TC ranges were the same.

According to our research, women made up 57.4% of hospitalised patients with cardiovascular disease. This finding is consistent with a 2019 analysis by Gao et al. that found that although women had a higher prevalence of CVDs than males, they also had worse outcomes and a higher death rate.

In our research, 50 subjects, or 28.4% of the total, had SBPs between 131 and 140 mmHg, whereas 40 patients, or 22.7% of the total, have SBPs between 121 and 130 mmHg. The average Systolic blood pressure was 141.64 mmHg, which is more than the 122 mmHg mean SBP that was reported with earlier measurements (Bundy et al 2017). The majority of patients on pharmaceutical wards have SBPs that are within normal ranges, according to this. Our SBP value was compared to that of Rahimi et al.'s 2021 study, which was 146 mmHg.

In this investigation, it was discovered that the bulk of subjects fell into the TC range between 251–300 mg/dL, comprising 72 (40.9%) patients, while 69 (39.2%) patients were observed in the TC range 201–250 mg/dL. In the median level of total cholesterol (TC) level of 247.00 mg/dL, there was a low of 95 mg/dL and a maximum of 392 mg/dL. Our TC result and the measured level of 243 mg/dL in a study by Yi et al. in 2019 were compared.

Study findings show that 26 patients, or 14.8% of the total, are in the 25–28 mg/dL HDL group, whereas the bulk of patients (76, or 43.2%) fall into the 41–45 mg/dL segment. The findings indicated a median HDL levels of 34.00 mg/dL, a minimal level of 17 mg/dL of HDL cholesterol levels, and a maximum of 45 mg/dL of TC. Rohra consulted a website that had an article classifying HDL values below 40 mg/dL as low. The findings of this study therefore indicated that the majority of patients admitted to the medical area had decreased levels of HDL than usual. When compared to our HDL readings, the observed value of 54 mg/dL was discovered in a research conducted by Cho et al. (2022).

According to our study's findings, 67 patients, or 38.1%, fell into the LDL range between 171 and 200 mg/dL, while 2 patients, or 1.1% of the total, were determined to be in the lowest LDL group, which was 231–250 mg/dL. At 167.00 mg/dL, the median LDL was discovered. Our findings show that most patients brought to the medicine ward had much greater LDL levels than advised, with the ideal range for LDL being less than 100 mg/dL. The mean LDL level in the study by Ueda et al. (2018) was 110 mg/dL, and we compared it to ours.

Our study also evaluated the patients' condition regarding treatment of hypertension and history of diabetes. The majority of the subjects had just diabetes (71.6%), followed by management of hypertension (70.5%) (124). In a research by Jayaraj et al. (2020), it was observed that among patients chosen at random from medical wards, the overall prevalence of having diabetes was 71.6%, while the prevalence of hypertension was 70.5%. Our research indicates that both diabetes mellitus (DM) and hypertension are quite prevalent in India; thus, while treating patients, preventative strategies should be appropriately considered [11].

Furthermore, our study evaluated the participants' behaviours and found that most of them did not smoke. The remaining patients, however, was smokers. According to a survey conducted in 2020 by Sivapuram et al., 11.4% of Indians smoke [12]. Thus, our research indicates that an individual's social behaviours in India are not greatly influenced by their age.

According to our study's findings, the bulk of the patients—68, or 38.6%—were in the high group, or 21–95%. These were followed by 50, or 28.4%, of patients in the intermediate category, or 10–20%. Our median ASCVD rate was 14.95%.

## **CONCLUSION**

Middle-aged people should be more aware of the risks they face, such as unhealthy lifestyle choices that might hasten the development of CVD, according to the results of the present prediction research. We also beg responsible organisations, including the government, to pay greater attention to this age group, who is becoming increasingly susceptible to CVD. Moreover, healthcare providers must do a complete assessment of hospitalised patients' blood pressure characteristics and educate them appropriately on how to maintain their pressure levels inside recommended limits. Crucially, patients must consciously keep an eye on their bp, eating, smoking, and exercise routines, among other things.

The Indian government is proactively tackling this issue with the launch of the National Programme for the Prevention and Control of Diabetes, Cardiovascular Disease, and Stroke (NPCDCS). Based on its cohorts, India should soon endeavour to enhance its CVD prediction model.

## **ABBREVIATION**

SBP- Systolic blood pressure

DM -Diabetes Mellitus

CVD- Cardiovascular diseases

LDL- Low density lipoprotein

HDL – High density lipoprotein

## **ACKNOWLEDGEMENTS**

The authors appreciate both the administrations of Guru Gobind Singh Medical College and Hospital, Faridkot as well as the ISF College of Pharmacy, Moga

## **Funding**

No financial support was received for this research.

## **Availability of data and materials**

Upon request, external researchers can be offered access to the data analyzed at the Department of Pharmacy Practice, ISF College of Pharmacy, Moga, Punjab. To do so, kindly contact Dr.Ranjeet Kumar

## **DECLARATIONS**

### **Ethics approval and consent to participate**

Approval for the study was obtained from the Ethical Review Committee, ISF College of Pharmacy, Moga (Ref No: ECR/296/PB/2023/ISFCP/04).

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