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A Comparative Study of Cardiovascular Risk Calculation Systems and the New PREVENT Model

ABSTRACT

Background: Cardiovascular diseases (CVD) are a largely preventable cause of death worldwide. There are many risk factors that influence CVD, some of which are modifiable and others non-modifiable. Several systems, such as the widely used Framingham, Reynolds, and the most recently developed Predicting Risk of Cardiovascular Disease EVENTs (PREVENT), are used to calculate an individual's CVD risk based on the effects of these risk factors.

Methods: This study compared CVD risk scores calculated using the Framingham, Reynolds, and PREVENT systems. The risk factors common to these 3 systems were determined to be age, gender, smoking status, high-density lipoprotein cholesterol, total cholesterol, and systolic blood pressure, and the effects of these risk factors on CVD risk were evaluated. The numerical risk scores obtained because of the effects of risk factors were presented comparatively in tables created based on gender and smoking status.

Results: According to the results obtained, it was observed that the PREVENT system provides more individualized results by including renal, metabolic, and social markers in the calculation and provides a more detailed assessment by also considering the age of risk.

Conclusion: These features may enable PREVENT to classify both low- and high-risk patients more clearly. This classification of patients may contribute to changing the course of CVD, a major global disease, by enabling appropriate interventions and treatments.

Keywords: Cardiovascular disease, Framingham heart study, PREVENT model, Reynolds risk score, risk assessment

ORIGINAL INVESTIGATION

INTRODUCTION

According to the World Health Organization, non-communicable diseases (NCDs) cause 74% of deaths globally. The majority of NCDs are caused by a group of diseases called cardiovascular diseases (CVDs).[1] Cardiovascular diseases include rheumatic heart disease, myocarditis, endocarditis, hypertensive heart disease, pulmonary arterial hypertension, aortic aneurysm, and many other conditions in which the heart and blood vessels are damaged.[2,3]

Cardiovascular disease is largely preventable, and modifiable risk factors include smoking, alcohol consumption, obesity, low physical activity, and high body mass index (BMI). Non-modifiable factors include environmental factors such as air pollution, metal exposure, and genetic factors. In addition, metabolic and behavioral risk factors such as high systolic blood pressure (SBP) and secondhand smoke exposure also play important roles in the development of CVD.[2,4] Considering the global morbidity and mortality rates of CVD, interventions targeting risk factors are critically important for preventing the development of the disease (primary prevention) and for preventing recurrence by improving risk factors in existing patients (secondary prevention). These interventions also play a major role in prolonging survival time and improving quality of life.[5,6]

For the identification of risk factors and the resulting CVD due to their combination, disease risk can be estimated based on age, gender, and the number and

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severity of risk factors. These estimations enable the development of preventive treatment strategies for low-risk individuals, early diagnosis, appropriate treatment, and urgent interventions for high-risk individuals. In this way, more targeted and effective measures can be taken to protect individual health.[7]

To calculate CVD risk, various risk prediction models are available that assess the combined effect of one or more modifiable and/or non-modifiable risk factors. Examples of these systems include the Framingham Heart Study, PROCAM, SCORE,[8] ASSIGN,[9] Reynolds,[10,11] QRISK,[12] PREVENT.[13] These systems are used to predict an individual's risk of CVD. Age, gender, and smoking status are among the common risk factors included in these systems. These factors are considered fundamental elements for calculating and predicting CVD risk. Over time, additional factors such as SBP, total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), BMI, left ventricular hypertrophy, diabetes mellitus (DM), family history (FH), use of antihypertensive medications, use of lipid-lowering medications, low-density lipoprotein cholesterol (LDL-C), hemoglobin A1c (HbA1c) levels, high-sensitivity C-reactive protein (hsCRP), a FH of premature coronary heart disease, and social deprivation have also been incorporated. These additional factors contribute to predicting the CVD risk score.[14,15]

The first cohort of the Framingham study was initiated in 1948 with 5209 participants aged 30-62 years, and it was later followed by 5 additional cohorts.[16] This study identified risk factors contributing to CVD, investigated their effects, and introduced the term "risk factors for CVD."[17] As a result of the Framingham study, major cardiovascular risk factors were identified, and their effects on the disease were extensively investigated.[16,18]

The Reynolds system was developed in 2007 to estimate the risk of CVD, diabetes, and cancer in women, with approximately 24 500 female participants over 45 years of age, initially without health problems.[10] The system was also used to calculate the risk score in US male participants aged 50 years and older who were free of CVD, diabetes, and cancer.[11]

The most recently developed PREVENT study, conducted between 1992 and 2017, included approximately 6.6 million individuals aged 30-79 without known CVD and 46 different data sets. The PREVENT study is gender-specific and race-independent, offering high discrimination power and calibration ability across various patient groups. Additionally, it allows the predicted risk score for CVD subtypes to be estimated based on specified parameters and simulation scenarios.[13]

The aim of this study is to calculate CVD risk using the widely applied Framingham and Reynolds risk prediction systems, as well as the most recently developed PREVENT system. The study also aims to compare the output and classifications of estimated risk score results for different patient populations, taking into account the effects of modifiable and non-modifiable risk factors for each system. Calculations were performed taking into account risk factors common to all 3 systems.

HIGHLIGHTS

- Systems like Framingham, Reynolds, and Predicting Risk of Cardiovascular Disease EVENTs are available to calculate cardiovascular diseases (CVD) risk.
- Predicting Risk of Cardiovascular Disease EVENTs offers detailed assessment and classification capabilities for 10- and 30-year periods.
- Predicting Risk of Cardiovascular Disease EVENTs also evaluates the calculated "risk age," offering more individualized results.
- Predicting Risk of Cardiovascular Disease EVENTs can contribute to altering the course of CVD through clear classification.

METHODS

This study was designed as a simulation to evaluate CVD risk score results. First, common and non-common risk factors used to calculate CVD risk in all 3 systems were identified. Based on these factors, scenarios representing different risk levels were created, and the final impact of these risk factors on CVD risk was systematically analyzed. In this study, CVD risk was calculated using the Framingham, Reynolds, and PREVENT risk prediction systems, and the results obtained by each system were compared. To compare the 3 systems, 2 separate tables containing common values for women and men were prepared, and each table was organized to include 2 sub-tables covering smokers and non-smokers.

The risk factors common to all 3 CVD risk calculation systems (gender, age, smoking status, SBP, TC, and HDL-C) have been identified, and the following ranges have been established for these parameters: age (30-75 years), SBP (90-160 mmHg), TC (130-320 mg/dL), and HDL-C (20-100 mg/dL) have been defined for these parameters. In addition to the risk factors common to the Framingham, Reynolds, and PREVENT systems, each system also includes non-common risk factors that affect the calculation results. The non-common risk factors are: vascular disease (VD), DM, and antihypertensive medication use (AntiHT) in the Framingham system; hsCRP factor in the Reynolds system, and BMI, estimated glomerular filtration rate (eGFR), DM, AntiHT, lipid-lowering drugs, urine albumin/creatinine ratio (uACR), and HbA1c in the PREVENT system, which is the most comprehensive system. To prevent these factors from affecting the risk score results in different systems and to enable a more transparent comparison, reference values for healthy individuals were taken into account. In the Reynolds system, the hsCRP level (0.7 mg/L) was entered, while in the PREVENT system, BMI (22 kg/m^2) and eGFR (95 mL/min/1.73 m^2) values were entered, and other non-common risk factors were not included in the calculations.

To calculate your 10-year CVD/ASCVD risk, use the Framingham risk score calculator https://reference.medscape.com/calculator/252/framingham-risk-score-2008, the Reynolds risk score calculator https://www.scymed.com/

en/smnxph/phqgg440.htm and the PREVENT risk score calculator https://professional.heart.org/en/guidelines-and-statements/prevent-calculator.

The risk score was obtained by simulating the 6 jointly determined risk factor values, where the numerical values assigned to each relevant field in each system were entered individually. Each risk score result in the tables has different risk factor values. The systems used are automated systems, and the results obtained by entering each risk factor (parameter) value individually into the systems in the form of numerical values determined for that factor in the tables were used to create the tables. The systems automatically calculate risk scores, provide a numerical risk score result, and interpret these results. The risk score result in each cell of the tables and the total risk profile emerging according to that system are presented, enabling comparison between systems. The cumulative effect of all risk factors common to the tables is presented simultaneously and transparently.

The systems used are automated tools that perform mathematical calculations based on manually entered risk factor parameter values. In this study, the scenarios were designed using combinations of risk factor values, and each parameter value was manually entered into the systems individually. For women and men separately, 720 scenarios were generated for each system, and considering all 3 systems together, a total of 4320 scenarios were obtained.

The 10-year CVD risk score results obtained by comparing the Reynolds, PREVENT, and Framingham systems (ASCVD - atherosclerotic CVD for PREVENT) are interpreted differently by each system. To avoid confusion in the tables, these interpretations are shown in different colors. In the Framingham system, patients with a risk score <10% are classified as low risk, those between 10% and 20% as moderate risk, and those above 20% as high risk. This classification is presented in Framingham tables with low risk in blue, moderate risk in yellow, and high risk in red. The Reynolds system classifies risk scores as normal (<10%) or abnormal (>10%). This classification is presented in the Reynolds system tables with normal scores in blue and abnormal scores in red. The PREVENT system uses percentage ranges to classify risk: <5% is low risk, 5%-7.4% is borderline risk, 7.5%-19.9% is moderate risk, and ≥20% is high risk. In this classification, low risk is blue, borderline risk is yellow, moderate risk is orange, and high risk is red in the PREVENT tables.

Statistical Analysis

This study has a simulation-based comparative design and does not rely on empirical data analysis. Therefore, inferential statistical methods and hypothesis testing were not applied. Scores for the Framingham, Reynolds, and PREVENT risk models were calculated using standardized input parameters, and the results were evaluated descriptively. Differences between the models were compared using absolute values and relative changes, and discrepancies between risk classifications were analyzed. All calculations were performed using the official web-based tools of the respective models; no additional statistical software was used. Data organization and comparative evaluation were carried out using Microsoft Excel 365, version 2602 (Microsoft Corp., Redmond, WA, USA). This approach is consistent with simulation-based comparative studies focusing on model output evaluation rather than statistical inference.

RESULTS

Examination of Risk Scores in Women

Results of the Framingham Risk Scoring System

According to the Framingham CVD risk calculation system, low risk is represented by blue, moderate risk by yellow, and high risk by red (Table 1). Based on the obtained data, moderate- and high-risk levels were detected at certain ages in women who smoke. In smoking women, a moderate risk (10%) was observed at age 35 years and a high risk (21.5%) at age 50 years, given specific HDL-C, TC, and SBP values. Similarly, in non-smoking women, a 45-year-old with an HDL-C value of 100 mg/dL, TC value of 280 mg/dL, and SBP of 160 mm Hg, her risk score is 10.0%, indicating moderate risk. Additionally, a 65-year-old woman who does not smoke, with the same biochemical values, was observed to have a high-risk situation, with a risk score of 21.5%.

Results of the Reynolds Risk Scoring System

In the Reynolds CVD risk calculation system, blue represents normal values, and red represents abnormal values (Table 2). According to the obtained data, among women who smoke, a 60-year-old with an HDL-C value of 35 mg/dL, a TC of 320 mg/dL, and SBP of 120 mmHg showed abnormal biochemical values. In this case, the risk score was calculated as 10.1%.

Similarly, among non-smoking women, a 70-year-old with an HDL-C value of 50 mg/dL, TC of 320 mg/dL, and SBP of 150 mmHg also showed abnormal biochemical values. In this case, the risk score was calculated as 10.6%.

Results of the PREVENT Risk Scoring System

In the PREVENT ASCVD risk calculation system, low risk is represented by blue, borderline risk by yellow, and moderate risk by orange (Table 3).

According to the results obtained, among women who smoke, the PREVENT ASCVD risk calculation system first showed borderline risk at age 50. At this age, the woman with an HDL-C value of 20 mg/dL, a TC value of 320 mg/dL, and an SBP value of 90 mm Hg had a risk score of 5.0%. Later, at the age of 65, moderate risk was encountered, with a woman having an HDL-C value of 35 mg/dL, a TC value of 280 mg/dL, and an SBP value of 120 mm Hg, resulting in a risk score of 7.5%.

Among non-smoking women, borderline risk was observed at age 65. At this age, the woman with an HDL-C value of 60 mg/dL, TC of 200 mg/dL, and SBP of 150 mm Hg had a risk score of 5.0%. Additionally, at the age of 70, another woman with an HDL-C value of 20 mg/dL, TC of 280 mg/dL, and SBP of 90 mm Hg showed moderate risk, with a calculated risk score of 7.6% (Table 3).

Table 1. Effect of Smoking on Framingham Risk Score Outcomes in Women

	Female												
HDL-C (mg/dL)	Smoking (%) Framingham						Age (years)	No Smoking (%) Framingham						SBP (mm Hg)
100	21.5	24.8	>30	>30	>30	>30	75	13.7	15.9	21.5	24.8	28.5	28.5	160
60	18.5	21.5	28.5	>30	>30	>30		11.7	13.7	18.5	21.5	24.8	24.8	150
50	15.9	18.5	24.8	28.5	>30	>30		10.0	11.7	15.9	18.5	21.5	21.5	140
45	15.9	18.5	24.8	28.5	>30	>30		10.0	11.7	15.9	18.5	21.5	21.5	130
35	15.9	18.5	24.8	28.5	>30	>30		10.0	11.7	15.9	18.5	21.5	21.5	120
20	11.7	13.7	18.5	21.5	24.8	24.8		7.3	8.6	11.7	13.7	15.9	15.9	90
100	18.5	21.5	28.5	>30	>30	>30	70	11.7	13.7	18.5	21.5	24.8	24.8	160
60	15.9	18.5	24.8	28.5	>30	>30		10.0	11.7	15.9	18.5	21.5	21.5	150
50	13.7	15.9	21.5	24.8	28.5	28.5		8.6	10.0	13.7	15.9	18.5	18.5	140
45	13.7	15.9	21.5	24.8	28.5	28.5		8.6	10.0	13.7	15.9	18.5	18.5	130
35	13.7	15.9	21.5	24.8	28.5	28.5		8.6	10.0	13.7	15.9	18.5	18.5	120
20	10.0	11.7	15.9	18.5	21.5	21.5		6.3	7.3	10.0	11.7	13.7	13.7	90
100	15.9	18.5	24.8	28.5	>30	>30	65	10.0	11.7	15.9	18.5	21.5	21.5	160
60	13.7	15.9	21.5	24.8	28.5	28.5		8.6	10.0	13.7	15.9	18.5	18.5	150
50	11.7	13.7	18.5	21.5	24.8	24.8		7.3	8.6	11.7	13.7	15.9	15.9	140
45	11.7	13.7	18.5	21.5	24.8	24.8		7.3	8.6	11.7	13.7	15.9	15.9	130
35	11.7	13.7	18.5	21.5	24.8	24.8		7.3	8.6	11.7	13.7	15.9	15.9	120
20	8.6	10.0	13.7	15.9	18.5	18.5		5.3	6.3	8.6	10.0	11.7	11.7	90
100	13.7	15.9	21.5	24.8	28.5	28.5	60	8.6	10.0	13.7	15.9	18.5	18.5	160
60	11.7	13.7	18.5	21.5	24.8	24.8		7.3	8.6	11.7	13.7	15.9	15.9	150
50	10.0	11.7	15.9	18.5	21.5	21.5		6.3	7.3	10.0	11.7	13.7	13.7	140
45	10.0	11.7	15.9	18.5	21.5	21.5		6.3	7.3	10.0	11.7	13.7	13.7	130
35	10.0	11.7	15.9	18.5	21.5	21.5		6.3	7.3	10.0	11.7	13.7	13.7	120
20	7.3	8.6	11.7	13.7	15.9	15.9		4.5	5.3	7.3	8.6	10.0	10.0	90
100	11.7	13.7	18.5	21.5	24.8	24.8	55	7.3	8.6	11.7	13.7	15.9	15.9	160
60	10.0	11.7	15.9	18.5	21.5	21.5		6.3	7.3	10.0	11.7	13.7	13.7	150
50	8.6	10.0	13.7	15.9	18.5	18.5		5.3	6.3	8.6	10.0	11.7	11.7	140
45	8.6	10.0	13.7	15.9	18.5	18.5		5.3	6.3	8.6	10.0	11.7	11.7	130
35	8.6	10.0	13.7	15.9	18.5	18.5		5.3	6.3	8.6	10.0	11.7	11.7	120
20	6.3	7.3	10.0	11.7	13.7	13.7		3.9	4.5	6.3	7.3	8.6	8.6	90
100	10.0	11.7	15.9	18.5	21.5	21.5	50	6.3	7.3	10.0	11.7	13.7	13.7	160
60	8.6	10.0	13.7	15.9	18.5	18.5		5.3	6.3	8.6	10.0	11.7	11.7	150
50	7.3	8.6	11.7	13.7	15.9	15.9		4.5	5.3	7.3	8.6	10.0	10.0	140
45	7.3	8.6	11.7	13.7	15.9	15.9		4.5	5.3	7.3	8.6	10.0	10.0	130
35	7.3	8.6	11.7	13.7	15.9	15.9		4.5	5.3	7.3	8.6	10.0	10.0	120
20	5.3	6.3	8.6	10.0	11.7	11.7		3.3	3.9	5.3	6.3	7.3	7.3	90
100	7.3	8.6	11.7	13.7	15.9	15.9	45	4.5	5.3	7.3	8.6	10.0	10.0	160
60	6.3	7.3	10.0	11.7	13.7	13.7		3.9	4.5	6.3	7.3	8.6	8.6	150
50	5.3	6.3	8.6	10.0	11.7	11.7		3.3	3.9	5.3	6.3	7.3	7.3	140
45	5.3	6.3	8.6	10.0	11.7	11.7		3.3	3.9	5.3	6.3	7.3	7.3	130
35	5.3	6.3	8.6	10.0	11.7	11.7		3.3	3.9	5.3	6.3	7.3	7.3	120
20	3.9	4.5	6.3	7.3	8.6	8.6		2.4	2.8	3.9	4.5	5.3	5.3	90

(*Continued*)

Table 1. Effect of Smoking on Framingham Risk Score Outcomes in Women (*Continued*)

	Female												
HDL-C (mg/dL)	Smoking (%) Framingham						Age (years)	No Smoking (%) Framingham						SBP (mm Hg)
100	6.3	7.3	10.0	11.7	13.7	13.7	40	3.9	4.5	6.3	7.3	8.6	8.6	160
60	5.3	6.3	8.6	10.0	11.7	11.7		3.3	3.9	5.3	6.3	7.3	7.3	150
50	4.5	5.3	7.3	8.6	10.0	10.0		2.8	3.3	4.5	5.3	6.3	6.3	140
45	4.5	5.3	7.3	8.6	10.0	10.0		2.8	3.3	4.5	5.3	6.3	6.3	130
35	4.5	5.3	7.3	8.6	10.0	10.0		2.8	3.3	4.5	5.3	6.3	6.3	120
20	3.3	3.9	5.3	6.3	7.3	7.3		2.0	2.4	3.3	3.9	4.5	4.5	90
100	4.5	5.3	7.3	8.6	10.0	10.0	35	2.8	3.3	4.5	5.3	6.3	6.3	160
60	3.9	4.5	6.3	7.3	8.6	8.6		2.4	2.8	3.9	4.5	5.3	5.3	150
50	3.3	3.9	5.3	6.3	7.3	7.3		2.0	2.4	3.3	3.9	4.5	4.5	140
45	3.3	3.9	5.3	6.3	7.3	7.3		2.0	2.4	3.3	3.9	4.5	4.5	130
35	3.3	3.9	5.3	6.3	7.3	7.3		2.0	2.4	3.3	3.9	4.5	4.5	120
20	2.4	2.8	3.9	4.5	5.3	5.3		1.5	1.7	2.4	2.8	3.3	3.3	90
100	3.3	3.9	5.3	6.3	7.3	7.3	30	2.0	2.4	3.3	3.9	4.5	4.5	160
60	2.8	3.3	4.5	5.3	6.3	6.3		1.7	2.0	2.8	3.3	3.9	3.9	150
50	2.4	2.8	3.9	4.5	5.3	5.3		1.5	1.7	2.4	2.8	3.3	3.3	140
45	2.4	2.8	3.9	4.5	5.3	5.3		1.5	1.7	2.4	2.8	3.3	3.3	130
35	2.4	2.8	3.9	4.5	5.3	5.3		1.5	1.7	2.4	2.8	3.3	3.3	120
20	1.7	2.0	2.8	3.3	3.9	3.9		1.0	1.2	1.7	2.0	2.4	2.4	90
	130	160	200	240	280	320		130	160	200	240	280	320	
	Total cholesterol (mg/dL)							Total cholesterol (mg/dL)						

According to the Framingham system, in women aged 30-75 years, smoking (left) and no smoking (right), HDL-C (100, 60, 50, 45, 35, 20 mg/dL), TC (130, 160, 200, 240, 280, 320 mg/dL), and SBP (160, 150, 140, 130, 120, 90) parameters for women who smoke between the ages of 30 and 75 are presented. In the Framingham system, those with a risk score <10% are classified as low risk (blue color in the table), those with a score of 10%-20% are classified as moderate risk (yellow color in the table), and those with a score >20% are classified as high risk (red color in the table).
HDL-C, high-density lipoprotein cholesterol; SBP, systolic blood pressure; TC, total cholesterol.

Examination of Risk Scores in Men

Results of the Framingham Risk Scoring System

According to the Framingham CVD risk calculation system, moderate risk was first encountered at the age of 35 in men who smoke. At this age, individuals with an HDL-C value of 35 mg/dL, TC of 280 mg/dL, and SBP of 120 mm Hg had a risk score of 11.2%. High risk was first encountered at age 45, with the same biochemical parameters, and the individual's risk score was 21.6%.

Among men who do not smoke, moderate risk was first encountered at the age of 45. At this age, individuals with an HDL-C value of 35 mg/dL, a TC value of 280 mg/dL, and an SBP value of 120 mmHg had a risk score of 11.2%. High risk was first encountered at the age of 55, with the same biochemical parameters, and the risk score was 21.6% (Table 4).

Results of the Reynolds Risk Scoring System

According to the Reynolds CVD risk calculation system, in men who smoke, abnormal biochemical values were first encountered at age 55. At this age, individuals with an HDL-C value of 35 mg/dL, TC of 280 mg/dL, and SBP of 120 mm Hg had a risk score of 10.2% (Table 5).

Among men who do not smoke, abnormal values were first encountered at the age of 60. At this age, individuals with an HDL-C of 45 mg/dL, TC of 280 mg/dL, and SBP of 130 mm Hg had a risk score of 10.1% (Table 5).

Results of the PREVENT Risk Scoring System

According to the PREVENT ASCVD risk calculation system, in men who smoke, borderline risk was first encountered at age 40. At this age, the individual with an HDL-C of 20 mg/dL, TC of 320 mg/dL, and SBP of 90 mm Hg had a risk score of 5.1%. Moderate risk was first encountered at age 50 with the same biochemical parameters, and the risk score was 8.3%. High risk was first encountered at age 70, with a risk score of 20.2%.

Among those who do not smoke, borderline risk was first encountered at age 50. At this age, the individual with an HDL-C of 20 mg/dL, TC of 320 mg/dL, and SBP of 90 mm Hg had a risk score of 5.5%. Moderate risk was first encountered at age 60, with an HDL-C of 50 mg/dL, TC of 320 mg/dL, and SBP of 140 mm Hg, resulting in a risk score of 7.7%. High risk was encountered at age 70, with a risk score of 21.2% (Table 6).

Table 2. Effect of Smoking on Reynolds Risk Score Outcomes in Women

	Female												
HDL-C (mg/dL)	Smoking (%) Reynolds						Age (years)	No Smoking (%) Reynolds						SBP (mm Hg)
100	7.8	9.3	12.4	15.7	19.1	22.4	75	3.5	4.2	5.7	7.3	8.9	10.6	160
60	11.4	13.5	17.9	22.4	27	31.5		5.2	6.2	8.3	10.6	12.9	15.4	150
50	11.3	13.5	17.9	22.4	26.9	31.4		5.2	6.2	8.3	10.6	12.9	15.3	140
45	10.2	12.2	16.2	20.3	24.5	28.7		4.6	5.6	7.5	9.5	11.7	13.9	130
35	10.6	12.7	16.8	21.1	25.4	29.7		4.8	5.8	7.8	9.9	12.1	14.4	120
20	8.5	10.1	13.5	17.0	20.6	24.3		3.8	4.6	6.2	7.9	9.7	11.5	90
100	5.3	6.3	8.5	10.8	13.2	15.7	70	2.4	2.8	3.9	4.9	6.1	7.2	160
60	7.8	9.3	12.4	15.7	0.19	22.4		3.5	4.2	5.7	7.2	8.9	10.6	150
50	7.7	9.2	12.4	15.6	18.9	22.3		3.5	4.2	5.7	7.2	8.9	10.6	140
45	7.0	8.3	11.2	14.1	17.2	20.3		3.1	3.8	5.1	6.5	8.0	9.5	130
35	7.3	8.7	11.6	14.7	17.9	21.1		3.3	3.9	5.3	6.8	8.3	9.9	120
20	5.8	6.9	9.3	11.8	14.4	17		2.6	3.1	4.2	5.4	6.6	7.9	90
100	3.6	4.3	5.8	7.4	9.1	10.8	65	1.6	1.9	2.6	3.3	4.1	4.9	160
60	5.3	6.3	8.5	10.8	13.2	15.6		2.4	2.8	3.8	4.9	6.0	7.2	150
50	5.3	6.3	8.5	10.8	13.1	15.6		2.4	2.8	3.8	4.9	6.0	7.2	140
45	4.7	5.7	7.6	9.7	11.9	14.1		2.1	2.5	3.4	4.4	5.4	6.5	130
35	4.9	5.9	8.0	10.1	12.4	14.7		2.2	2.7	3.6	4.6	5.7	6.8	120
20	3.9	4.7	6.3	8.1	9.9	11.8		1.7	2.1	2.8	3.6	4.5	5.4	90
100	2.4	2.9	3.9	5.0	6.2	7.4	60	1.1	1.3	1.8	2.2	2.8	3.3	160
60	3.6	4.3	5.8	7.4	9.0	10.8		1.6	1.9	2.6	3.3	4.1	4.9	150
50	3.6	4.3	5.8	7.4	9.0	10.7		1.6	1.9	2.6	3.3	4.1	4.9	140
45	3.2	3.8	5.2	6.6	8.1	9.7		1.4	1.7	2.3	3.0	3.7	4.4	130
35	3.3	4.0	5.4	6.9	8.5	10.1		1.5	1.8	2.4	3.1	3.8	4.6	120
20	2.6	3.2	4.3	5.5	6.7	8.0		1.2	1.4	1.9	2.5	3.0	3.6	90
100	1.6	2.0	2.6	3.4	4.2	5.0	55	0.7	0.9	1.2	1.5	1.9	2.2	160
60	2.4	2.9	3.9	5.0	6.2	7.4		1.1	1.3	1.7	2.2	2.8	3.3	150
50	2.4	2.9	3.9	5.0	6.1	7.3		1.1	1.3	1.7	2.2	2.8	3.3	140
45	2.2	2.6	3.5	4.5	5.5	6.6		1.0	1.2	1.6	2.0	2.5	3.0	130
35	2.3	2.7	3.7	4.7	5.8	6.9		1.0	1.2	1.6	2.1	2.6	3.1	120
20	1.8	2.1	2.9	3.7	4.6	5.5		0.8	0.9	1.3	1.7	2.0	2.5	90
100	1.1	1.3	1.8	2.3	2.8	3.4	50	0.5	0.6	0.8	1.0	1.3	1.5	160
60	1.6	1.9	2.6	3.4	4.2	5.0		0.7	0.9	1.2	1.5	1.9	2.2	150
50	1.6	1.9	2.6	3.4	4.2	5.0		0.7	0.9	1.2	1.5	1.9	2.2	140
45	1.5	1.7	2.4	3.0	3.7	4.5		0.6	0.8	1.1	1.3	1.7	2.0	130
35	1.5	1.8	2.5	3.2	3.9	4.7		0.7	0.8	1.1	1.4	1.7	2.1	120
20	1.2	1.4	2.0	2.5	3.1	3.7		0.5	0.6	0.9	1.1	1.4	1.7	90
100	0.7	0.9	1.2	1.5	1.9	2.3	45	0.3	0.4	0.5	0.7	0.8	1.0	160
60	1.1	1.3	1.8	2.3	2.8	3.4		0.5	0.6	0.8	1.0	1.3	1.5	150
50	1.1	1.3	1.8	2.3	2.8	3.4		0.5	0.6	0.8	1.0	1.2	1.5	140
45	1.0	1.2	1.6	2.0	2.5	3.0		0.4	0.5	0.7	0.9	1.1	1.3	130
35	1.0	1.2	1.7	2.1	2.6	3.2		0.5	0.5	0.7	0.9	1.2	1.4	120
20	0.8	1.0	1.3	1.7	2.1	2.5		0.4	0.4	0.6	0.7	0.9	1.1	90

(*Continued*)

Table 2. Effect of Smoking on Reynolds Risk Score Outcomes in Women (*Continued*)

	Female												
HDL-C (mg/dL)	Smoking (%) Reynolds						Age (years)	No Smoking (%) Reynolds						SBP (mm Hg)
100	0.7	0.9	1.2	1.5	1.9	2.3	40	0.3	0.4	0.5	0.7	0.8	1.0	160
60	1.1	1.3	1.8	2.3	2.8	3.4		0.5	0.6	0.8	1.0	1.3	1.5	150
50	1.1	1.3	1.8	2.3	2.8	3.4		0.5	0.6	0.8	1.0	1.2	1.5	140
45	1.0	1.2	1.6	2.0	2.5	3.0		0.4	0.5	0.7	0.9	1.1	1.3	130
35	1.0	1.2	1.7	2.1	2.6	3.2		0.5	0.5	0.7	0.9	1.2	1.4	120
20	0.8	1.0	1.3	1.7	2.1	2.5		0.4	0.4	0.6	0.7	0.9	1.1	90
100	0.7	0.9	1.2	1.5	1.9	2.3	35	0.3	0.4	0.5	0.7	0.8	1.0	160
60	1.1	1.3	1.8	2.3	2.8	3.4		0.5	0.6	0.8	1.0	1.3	1.5	150
50	1.1	1.3	1.8	2.3	2.8	3.4		0.5	0.6	0.8	1.0	1.2	1.5	140
45	1.0	1.2	1.6	2.0	2.5	3.0		0.4	0.5	0.7	0.9	1.1	1.3	130
35	1.0	1.2	1.7	2.1	2.6	3.2		0.5	0.5	0.7	0.9	1.2	1.4	120
20	0.8	1.0	1.3	1.7	2.1	2.5		0.4	0.4	0.6	0.7	0.9	1.1	90
100	0.7	0.9	1.2	1.5	1.9	2.3	30	0.3	0.4	0.5	0.7	0.8	1.0	160
60	1.1	1.3	1.8	2.3	2.8	3.4		0.5	0.6	0.8	1.0	1.3	1.5	150
50	1.1	1.3	1.8	2.3	2.8	3.4		0.5	0.6	0.8	1.0	1.2	1.5	140
45	1.0	1.2	1.6	2.0	2.5	3.0		0.4	0.5	0.7	0.9	1.1	1.3	130
35	1.0	1.2	1.7	2.1	2.6	3.2		0.5	0.5	0.7	0.9	1.2	1.4	120
20	0.8	1.0	1.3	1.7	2.1	2.5		0.4	0.4	0.6	0.7	0.9	1.1	90
	130	160	200	240	280	320		130	160	200	240	280	320	
	Total cholesterol (mg/dL)							Total cholesterol (mg/dL)						

According to the Reynolds system, in women, smoking (left) and no smoking (right), between the ages of 30 and 75, HDL-C (100, 60, 50, 45, 35, 20 mg/dL), TC (130, 160, 200, 240, 280, 320 mg/dL), and SBP (160, 150, 140, 130, 120, 90) parameters for women aged 30-75 are presented. The Reynolds system classifies risk scores as normal (blue color in the table) if <10% and abnormal (red color in the table) if >10%.
HDL-C, high-density lipoprotein cholesterol; SBP, systolic blood pressure; TC, total cholesterol.

DISCUSSION

In this study, a simulation was performed to compare CVD risk scores using the widely applied Framingham and Reynolds systems, as well as more recently developed PREVENT system. The effects of age, gender, smoking status, HDL-C, TC, and SBP on CVD risk were examined. The findings indicated that advancing age, male gender, smoking, low HDL-C, high TC, and elevated SBP all increased risk. When comparing the systems, it was observed that the Framingham system limits detailed risk differentiation because all values above 30% are grouped into a single "high-risk" category. The Reynolds system classifies risk only as "normal" or "abnormal" and generally produces the same risk score for individuals under 50 years of age. In contrast, the PREVENT system offers both 10- and 30-year risk estimates and calculates an individual's "risk age," allowing for a more detailed assessment.

This study, conducted using systems that estimate the 10-year CVD-ASCVD risk, presents the impact of these identified risk factors on CVD from a broad perspective.

The findings demonstrate that the effects of risk factors on CVD can vary according to different age groups and genders, emphasizing the importance of developing personalized approaches in risk calculation systems. For instance, the impact of smoking varies depending on gender and age, indicating that risk assessments should be made more precise by considering individual health histories.

The data indicated that within the Framingham CVD risk calculation system, when the same biochemical parameters are considered, the levels of moderate and high CVD risk are greater in men than in women across all age groups. Among both smokers and non-smokers with identical parameter values, although the age at which moderate risk first appears is similar between men and women, the risk scores are observed to be higher in men. Many age and parameter values that are classified as low or moderate risk for women fall into the moderate or high-risk categories for men. These findings indicate that gender is a significant factor affecting CVD risk and that men encounter high-risk levels at earlier ages.

In the Reynolds CVD risk calculation system, similar to the Framingham system, abnormal risk scores are higher in men than in women. Abnormal CVD risk is observed at younger ages in men compared to women. Age and parameter values that are considered low/moderate risk for women may fall into the moderate/high-risk categories for men. This finding suggests that men begin to experience CVD risk at earlier ages, indicating that earlier intervention may be required.

Table 3. Effect of Smoking on PREVENT Risk Score Results in Women

							Female							
HDL-C (mg/dL)	Smoking (%) PREVENT						Age (years)	No Smoking (%) PREVENT						SBP (mm Hg)
100	9.8	9.8	9.9	9.9	9.9	10.0	75	7.3	7.3	7.3	7.4	7.4	7.4	160
60	12.0	12.0	12.0	12.1	12.1	12.2		8.9	9.0	9.0	9.0	9.1	9.1	150
50	12.0	12.0	12.0	12.1	12.1	12.2		8.9	9.0	9.0	9.0	9.1	9.1	140
45	11.6	11.6	11.6	11.7	11.7	11.8		8.6	8.7	8.7	8.7	8.8	8.8	130
35	11.6	11.6	11.6	11.7	11.7	11.8		8.6	8.6	8.7	8.7	8.8	8.8	120
20	12.8	12.9	12.9	13.0	13.0	13.1		9.6	9.6	9.7	9.7	9.8	9.8	90
100	6.8	7.0	7.2	7.5	7.7	7.9	70	4.9	5.0	5.1	5.3	5.5	5.7	160
60	8.9	9.1	9.4	9.7	10.0	10.3		6.4	6.5	6.7	6.9	7.1	7.4	150
50	8.9	9.1	9.3	9.6	9.9	10.2		6.3	6.5	6.7	6.9	7.1	7.3	140
45	8.4	8.6	8.9	9.2	9.5	9.8		6.0	6.2	6.4	6.6	6.8	7.0	130
35	8.4	8.6	8.9	9.1	9.4	9.7		6.0	6.1	6.3	6.5	6.7	6.9	120
20	9.4	9.6	9.9	10.2	10.6	10.9		6.7	6.9	7.1	7.3	7.6	7.8	90
100	4.7	5.0	5.3	5.6	5.9	6.3	65	3.2	3.4	3.6	3.8	4.0	4.3	160
60	6.6	6.9	7.3	7.7	8.2	8.7		4.5	4.7	5.0	5.3	5.6	5.9	150
50	6.5	6.8	7.2	7.6	8.1	8.6		4.4	4.6	4.9	5.2	5.6	5.9	140
45	6.1	6.4	6.8	7.2	7.6	8.1		4.2	4.3	4.6	4.9	5.2	5.5	130
35	6.0	6.3	6.7	7.1	7.5	8.0		4.1	4.3	4.6	4.9	5.2	5.5	120
20	6.8	7.1	7.6	8.0	8.5	9.0		4.7	4.9	5.2	5.5	5.8	6.2	90
100	3.3	3.5	3.8	4.2	4.5	5.0	60	2.1	2.3	2.5	2.7	3.0	3.2	160
60	4.8	5.1	5.6	6.1	6.7	7.3		3.1	3.4	3.7	4.0	4.4	4.8	150
50	4.7	5.1	5.5	6.0	6.6	7.2		3.1	3.3	3.6	4.0	4.3	4.7	140
45	4.4	4.7	5.1	5.6	6.1	6.6		2.9	3.1	3.3	3.6	4.0	4.4	130
35	4.3	4.6	5.0	5.5	6.0	6.5		2.8	3.0	3.3	3.6	3.9	4.3	120
20	4.9	5.3	5.7	6.3	6.8	7.4		3.2	3.4	3.8	4.1	4.5	4.9	90
100	2.2	2.4	2.7	3.1	3.5	3.9	55	1.4	1.5	1.7	1.9	2.2	2.4	160
60	3.5	3.8	4.3	4.8	5.4	6.1		2.2	2.4	2.7	3.0	3.4	3.8	150
50	3.4	3.8	4.2	4.7	5.3	6.0		2.1	2.3	2.6	3.0	3.4	3.8	140
45	3.1	3.4	3.8	4.3	4.8	5.4		1.9	2.1	2.4	2.7	3.0	3.4	130
35	3.1	3.3	3.8	4.2	4.8	5.3		1.9	2.1	2.4	2.7	3.0	3.4	120
20	3.5	3.9	4.3	4.9	5.5	6.1		2.2	2.4	2.7	3.1	3.4	3.9	90
100	1.5	1.7	2.0	2.3	2.7	3.1	50	0.9	1.0	1.2	1.4	1.6	1.8	160
60	2.5	2.8	3.3	3.8	4.4	5.1		1.5	1.7	2.0	2.3	2.7	3.1	150
50	2.5	2.8	3.2	3.7	4.3	5.0		1.5	1.7	1.9	2.2	2.6	3.0	140
45	2.2	2.5	2.9	3.3	3.8	4.4		1.3	1.5	1.7	2.0	2.3	2.7	130
35	2.2	2.4	2.8	3.3	3.8	4.4		1.3	1.5	1.7	2.0	2.3	2.6	120
20	2.5	2.8	3.3	3.8	4.4	5.0		1.5	1.7	2.0	2.3	2.6	3.0	90
100	1.0	1.2	1.4	1.7	2.0	2.4	45	0.6	0.7	0.8	1.0	1.2	1.4	160
60	1.8	2.1	2.5	3.0	3.6	4.2		1.1	1.2	1.4	1.7	2.1	2.5	150
50	1.8	2.0	2.4	2.9	3.5	4.1		1.0	1.2	1.4	1.7	2.0	2.4	140
45	1.6	1.8	2.1	2.6	3.1	3.6		0.9	1.0	1.2	1.5	1.8	2.1	130
35	1.5	1.8	2.1	2.5	3.0	3.5		0.9	1.0	1.2	1.4	1.7	2.0	120
20	1.8	2.0	2.4	2.9	3.5	4.1		1.0	1.2	1.4	1.7	2.0	2.4	90

(*Continued*)

Table 3. Effect of Smoking on PREVENT Risk Score Results in Women (*Continued*)

	Female												
HDL-C (mg/dL)	Smoking (%) PREVENT						Age (years)	No Smoking (%) PREVENT						SBP (mm Hg)
100	0.7	0.8	1.0	1.2	1.5	1.9	40	0.4	0.5	0.6	0.7	0.8	1.0	160
60	1.3	1.6	1.9	2.3	2.9	3.5		0.7	0.9	1.1	1.3	1.6	2.0	150
50	1.3	1.5	1.8	2.3	2.8	3.4		0.7	0.8	1.0	1.3	1.5	1.9	140
45	1.1	1.3	1.6	2.0	2.4	3.0		0.6	0.7	0.9	1.1	1.3	1.6	130
35	1.1	1.3	1.6	1.9	2.3	2.9		0.6	0.7	0.9	1.1	1.3	1.6	120
20	1.3	1.5	1.8	2.2	2.7	3.4		0.7	0.8	1.0	1.2	1.5	1.9	90
100	0.5	0.6	0.7	0.9	1.2	1.5	35	0.3	0.3	0.4	0.5	0.6	0.8	160
60	1.0	1.1	1.5	1.8	2.3	2.9		0.5	0.6	0.8	1.0	1.2	1.6	150
50	0.9	1.1	1.4	1.8	2.2	2.8		0.5	0.6	0.7	0.9	1.2	1.5	140
45	0.8	0.9	1.2	1.5	1.9	2.4		0.4	0.5	0.6	0.8	1.0	1.3	130
35	0.8	0.9	1.2	1.5	1.8	2.3		0.4	0.5	0.6	0.8	1.0	1.2	120
20	0.9	1.1	1.4	1.7	2.2	2.8		0.5	0.6	0.7	0.9	1.2	1.5	90
100	0.3	0.4	0.5	0.7	0.9	1.2	30	0.2	0.2	0.3	0.3	0.4	0.6	160
60	0.7	0.8	1.1	1.4	1.9	2.4		0.4	0.4	0.6	0.7	1.0	1.2	150
50	0.7	0.8	1.1	1.4	1.8	2.3		0.3	0.4	0.5	0.7	0.9	1.2	140
45	0.6	0.7	0.9	1.2	1.5	2.0		0.3	0.3	0.5	0.6	0.8	1.0	130
35	0.5	0.7	0.9	1.1	1.5	1.9		0.3	0.3	0.4	0.6	0.7	1.0	120
20	0.6	0.8	1.0	1.3	1.7	2.2		0.3	0.4	0.5	0.7	0.9	1.1	90
	130	160	200	240	280	320		130	160	200	240	280	320	
	Total cholesterol (mg/dL)							Total cholesterol (mg/dL)						

According to the PREVENT system, in women aged 30-75, smoking (left) and no smoking (right), HDL-C (100, 60, 50, 45, 35, 20 mg/dL), TC (130, 160, 200, 240, 280, 320 mg/dL), and SBP (160, 150, 140, 130, 120, 90) parameters for women aged 30-75 are presented. The PREVENT system classifies risk scores into percentile ranges as follows: <5% low risk (blue color in the table), 5%-7.4% borderline risk (yellow color in the table), 7.5%-19.9% moderate risk (orange color in the table), and ≥20% high risk (red color in the table).
HDL-C, high-density lipoprotein cholesterol; SBP, systolic blood pressure; TC, total cholesterol.

According to the results of the PREVENT ASCVD risk calculation system, the age at which CVD risk first appears is lower in men than in women. Furthermore, when considering all risk factors, tables created for men show a higher risk score, while high-risk status is not observed in the tables created for women. These findings suggest that men display a higher and more intense risk profile in the CVD risk chart. Many of the values seen as borderline and moderate risk in women fall into the moderate and, in some cases, high-risk categories in men.

According to the findings, all 3 different CVD risk calculation systems used in the study show a linear relationship between age and risk. Specifically, the Framingham system demonstrates that, independent of smoking, CVD risk increases with age when HDL-C, TC, and SBP values remain constant in both men and women. However, the Framingham system does not calculate a risk score above 30%; therefore, individuals with a risk score of 30% or higher are classified into the same high-risk category.

Similarly, in the Reynolds system, an increase in CVD risk was observed in both women and men after the age of 50. However, in groups younger than 50, individuals with the same biochemical parameters showed the same CVD risk score. This indicates that the Reynolds system makes the effect of age on CVD risk more pronounced at a certain age threshold.

The PREVENT ASCVD risk calculation system can more clearly calculate age-related CVD risk scores compared to other systems. Independent of smoking, it has been found that CVD risk increases with age in both men and women with the same parameter values. This feature allows PREVENT to assess the effect of age on CVD risk within scenarios designed with specified simulation parameters.

These findings demonstrate that age is an important factor in increasing CVD risk, and that this relationship can vary depending on gender and the risk calculation system used. Systems in which the effect of age is more pronounced can offer personalized approaches in risk assessments. Understanding the role of age in CVD risk is essential for planning individualized health interventions and for accurately performing age-based risk calculations. The findings obtained in the study also show that smoking increases CVD risk in both women and men across all 3 CVD risk calculation systems. A significant increase in risk was observed in individuals who smoke compared to those who do not.

In the CVD risk tables, created using the Framingham, Reynolds, and PREVENT calculation systems, risk scores

Table 4. Effect of Smoking on Framingham Risk Score Outcomes in Men

Male													
HDL-C (mg/dL)	Smoking (%) Framingham						Age (years)	No Smoking (%) Framingham						SBP (mm Hg)
100	>30	>30	>30	>30	>30	>30	75	25.3	29.4	>30	>30	>30	>30	160
60	>30	>30	>30	>30	>30	>30		21.6	25.3	29.4	>30	>30	>30	150
50	>30	>30	>30	>30	>30	>30		25.3	29.4	>30	>30	>30	>30	140
45	>30	>30	>30	>30	>30	>30		25.3	29.4	>30	>30	>30	>30	130
35	>30	30	>30	>30	>30	>30		25.3	29.4	>30	>30	>30	>30	120
20	>30	>30	>30	>30	>30	>30		21.6	25.3	29.4	>30	>30	>30	90
100	>30	30	>30	>30	>30	>30	70	21.6	25.3	29.4	>30	>30	>30	160
60	>30	>30	>30	>30	>30	>30		18.4	21.6	25.3	29.4	>30	>30	150
50	>30	>30	>30	>30	>30	>30		21.6	25.3	29.4	>30	>30	>30	140
45	>30	>30	>30	>30	>30	>30		21.6	25.3	29.4	>30	>30	>30	130
35	>30	>30	>30	>30	>30	>30		21.6	25.3	29.4	>30	>30	>30	120
20	>30	>30	>30	>30	>30	>30		18.4	21.6	25.3	29.4	>30	>30	90
100	29.4	>30	>30	>30	>30	>30	65	15.6	18.4	21.6	25.3	29.4	29.4	160
60	25.3	29.4	>30	>30	>30	>30		13.2	15.6	18.4	21.6	25.3	25.3	150
50	29.4	>30	>30	>30	>30	>30		15.6	18.4	21.6	25.3	29.4	29.4	140
45	29.4	>30	>30	>30	>30	>30		15.6	18.4	21.6	25.3	29.4	29.4	130
35	29.4	>30	>30	>30	>30	>30		15.6	18.4	21.6	25.3	29.4	29.4	120
20	25.3	29.4	>30	>30	>30	>30		13.2	15.6	18.4	21.6	25.3	25.3	90
100	25.3	29.4	>30	>30	>30	>30	60	13.2	15.6	18.4	21.6	25.3	25.3	160
60	21.6	25.3	29.4	>30	>30	>30		11.2	13.2	15.6	18.4	21.6	21.6	150
50	25.3	29.4	>30	>30	>30	>30		13.2	15.6	18.4	21.6	25.3	25.3	140
45	25.3	29.4	>30	>30	>30	>30		13.2	15.6	18.4	21.6	25.3	25.3	130
35	25.3	29.4	>30	>30	>30	>30		13.2	15.6	18.4	21.6	25.3	25.3	120
20	21.6	25.3	29.4	>30	>30	>30		11.2	13.2	15.6	18.4	21.6	21.6	90
100	21.6	25.3	29.4	>30	>30	>30	55	11.2	13.2	15.6	18.4	21.6	21.6	160
60	18.4	21.6	25.3	29.4	>30	>30		9.4	11.2	13.2	15.6	18.4	18.4	150
50	21.6	25.3	29.4	>30	>30	>30		11.2	13.2	15.6	18.4	21.6	21.6	140
45	21.6	25.3	29.4	>30	>30	>30		11.2	13.2	15.6	18.4	21.6	21.6	130
35	21.6	25.3	29.4	>30	>30	>30		11.2	13.2	15.6	18.4	21.6	21.6	120
20	18.4	21.6	25.3	29.4	>30	>30		9.4	11.2	13.2	15.6	18.4	18.4	90
100	15.6	18.4	21.6	25.3	29.4	29.4	50	7.9	9.4	11.2	13.2	15.6	15.6	160
60	13.2	15.6	18.4	21.6	25.3	25.3		6.7	7.9	9.4	11.2	13.2	13.2	150
50	15.6	18.4	21.6	25.3	29.4	29.4		7.9	9.4	11.2	13.2	15.6	15.6	140
45	15.6	18.4	21.6	25.3	29.4	29.4		7.9	9.4	11.2	13.2	15.6	15.6	130
35	15.6	18.4	21.6	25.3	29.4	29.4		7.9	9.4	11.2	13.2	15.6	15.6	120
20	13.2	15.6	18.4	21.6	25.3	25.3		6.7	7.9	9.4	11.2	13.2	13.2	90
100	11.2	13.2	15.6	18.4	21.6	21.6	45	5.6	6.7	7.9	9.4	11.2	11.2	160
60	9.4	11.2	13.2	15.6	18.4	18.4		4.7	5.6	6.7	7.9	9.4	9.4	150
50	11.2	13.2	15.6	18.4	21.6	21.6		5.6	6.7	7.9	9.4	11.2	11.2	140
45	11.2	13.2	15.6	18.4	21.6	21.6		5.6	6.7	7.9	9.4	11.2	11.2	130
35	11.2	13.2	15.6	18.4	21.6	21.6		5.6	6.7	7.9	9.4	11.2	11.2	120
20	9.4	11.2	13.2	15.6	18.4	18.4		4.7	5.6	6.7	7.9	9.4	9.4	90

(*Continued*)

Table 4. Effect of Smoking on Framingham Risk Score Outcomes in Men (*Continued*)

	Male												
HDL-C (mg/dL)	**Smoking (%) Framingham**						**Age (years)**	**No Smoking (%) Framingham**						**SBP (mm Hg)**
100	9.4	11.2	13.2	15.6	18.4	18.4	**40**	4.7	5.6	6.7	7.9	9.4	9.4	**160**
60	7.9	9.4	11.2	13.2	15.6	15.6		3.9	4.7	5.6	6.7	7.9	7.9	**150**
50	9.4	11.2	13.2	15.6	18.4	18.4		4.7	5.6	6.7	7.9	9.4	9.4	**140**
45	9.4	11.2	13.2	15.6	18.4	18.4		4.7	5.6	6.7	7.9	9.4	9.4	**130**
35	9.4	11.2	13.2	15.6	18.4	18.4		4.7	5.6	6.7	7.9	9.4	9.4	**120**
20	7.9	9.4	11.2	13.2	15.6	15.6		3.9	4.7	5.6	6.7	7.9	7.9	**90**
100	5.6	6.7	7.9	9.4	11.2	11.2	**35**	2.8	3.3	3.9	4.7	5.6	5.6	**160**
60	4.7	5.6	6.7	7.9	9.4	9.4		2.3	2.8	3.3	3.9	4.7	4.7	**150**
50	5.6	6.7	7.9	9.4	11.2	11.2		2.8	3.3	3.9	4.7	5.6	5.6	**140**
45	5.6	6.7	7.9	9.4	11.2	11.2		2.8	3.3	3.9	4.7	5.6	5.6	**130**
35	5.6	6.7	7.9	9.4	11.2	11.2		2.8	3.3	3.9	4.7	5.6	5.6	**120**
20	4.7	5.6	6.7	7.9	9.4	9.4		2.3	2.8	3.3	3.9	4.7	4.7	**90**
100	3.9	4.7	5.6	6.7	7.9	7.9	**30**	1.9	2.3	2.8	3.3	3.9	3.9	**160**
60	3.3	3.9	4.7	5.6	6.7	6.7		1.6	1.9	2.3	2.8	3.3	3.3	**150**
50	3.9	4.7	5.6	6.7	7.9	7.9		1.9	2.3	2.8	3.3	3.9	3.9	**140**
45	3.9	4.7	5.6	6.7	7.9	7.9		1.9	2.3	2.8	3.3	3.9	3.9	**130**
35	3.9	4.7	5.6	6.7	7.9	7.9		1.9	2.3	2.8	3.3	3.9	3.9	**120**
20	3.3	3.9	4.7	5.6	6.7	6.7		1.6	1.9	2.3	2.8	3.3	3.3	**90**
	130	**160**	**200**	**240**	**280**	**320**		**130**	**160**	**200**	**240**	**280**	**320**	
	Total cholesterol (mg/dL)							**Total cholesterol (mg/dL)**						

According to the Framingham system, in men aged 30-75 who smoking (left) and no smoking (right), HDL-C (100, 60, 50, 45, 35, 20 mg/dL), TC (130, 160, 200, 240, 280, 320 mg/dL), and SBP (160, 150, 140, 130, 120, 90) parameters for women who smoke between the ages of 30 and 75 are presented. In the Framingham system, those with a risk score <10% are classified as low risk (blue color in the table), those with a score of 10%-20% are classified as moderate risk (yellow color in the table), and those with a score >20% are classified as high risk (red color in the table).
HDL-C, high-density lipoprotein cholesterol; SBP, systolic blood pressure; TC, total cholesterol.

were calculated by evaluating HDL-C and SBP values. The results indicate that low HDL-C levels significantly increase CVD risk, and this increase becomes more pronounced when combined with elevated SBP. The interaction between HDL-C and SBP provides an important parameter for more accurate and comprehensive CVD risk assessments. These findings suggest that increasing HDL-C levels and controlling SBP could be important strategies for the prevention and management of CVD.

The results of the study indicate that, among individuals with the same gender, age, HDL-C, and SBP values, analyses performed using the Framingham CVD risk calculation system show that increases in TC levels generally lead to an elevated CVD risk. However, it was observed that when TC levels rise from 280 mg/dL to 320 mg/dL, the risk does not change. This finding suggests that in the Framingham system, TC levels may stabilize at a certain point in risk assessment, and beyond this level, the risk does not further increase.

Similarly, in the Reynolds system, it was found that increases in TC levels elevated CVD risk. The system appears to confirm that as TC levels rise, the risk continues to increase. However, it was observed that the Reynolds system provides a broader risk range, and the increase in risk becomes more pronounced with higher TC levels.

According to evaluations specific to the PREVENT system, it was observed that in both smoking and non-smoking women aged 75, increases in TC levels raised CVD risk, although the risk ratios were close to each other and sometimes even identical. In other age groups as well, it was concluded that increases in TC levels generally elevated CVD risk. The PREVENT system appears to offer more specific risk score calculations based on age and highlights TC level as a key factor influencing risk. In men, it was determined that CVD risk increased with rising TC levels among individuals with the same values. This finding indicates that the PREVENT system systematically associates increases in TC levels with elevated CVD risk in men.

Overall, these findings demonstrate that TC levels are an important parameter in the assessment of CVD risk, and that all 3 systems show a significant impact of TC increases on risk. However, since each system has different risk calculation mechanisms, the effect of changes in TC levels varied across the systems. These differences arise from the specific characteristics of how each system calculates CVD risk.

Table 5. Effect of Smoking on Reynolds Risk Score Results in Men

	Male												
HDL-C (mg/dL)	Smoking (%) Reynolds						Age (years)	No Smoking (%) Reynolds						SBP (mm Hg)
100	18.3	20.5	24.7	28.7	32.5	0.36	75	12.6	14.2	17.3	20.2	23.1	25.8	160
60	22.3	25	30	34.6	38.9	42.9		15.5	17.4	21.2	24.7	28.0	31.2	150
50	21.6	24.1	0.29	33.5	37.7	41.7		15.0	16.8	20.4	23.8	27.1	30.2	140
45	19.5	21.9	26.4	30.6	34.5	38.2		13.5	15.2	18.5	21.6	24.6	27.5	130
35	19.3	21.6	26.1	30.2	34.1	37.8		13.3	15.0	18.2	21.3	24.3	27.1	120
20	15.7	17.6	21.3	24.9	28.3	31.4		10.7	12.1	14.8	17.4	19.9	22.3	90
100	13.8	15.6	18.9	22.1	25.2	28.1	70	9.5	10.7	13.1	15.4	17.6	19.8	160
60	17.0	19.1	23.1	26.9	30.5	33.9		11.7	13.2	16.1	18.9	21.6	24.1	150
50	16.4	18.5	22.4	26.1	29.5	32.8		11.3	12.7	15.5	18.2	20.8	23.3	140
45	14.8	16.7	20.3	23.7	26.9	30.0		10.2	11.5	14.0	16.5	18.8	21.1	130
35	14.6	16.5	20.0	23.4	26.5	29.6		10.0	11.3	13.8	16.3	18.6	20.9	120
20	11.8	13.3	16.3	19.1	21.8	24.3		8.1	9.1	11.2	13.2	15.1	17.0	90
100	10.2	11.5	14.1	16.5	18.9	21.2	65	6.9	7.8	9.6	11.4	13.1	14.7	160
60	12.6	14.2	17.3	20.3	23.1	25.9		8.6	9.7	11.9	14.0	16.1	18.1	150
50	12.2	13.7	16.7	19.6	22.4	25.0		8.3	9.4	11.5	13.5	15.5	17.5	140
45	11.0	12.4	15.1	17.7	20.2	22.7		7.4	8.4	10.3	12.2	14.0	15.8	130
35	10.8	12.2	14.9	17.5	20.0	22.4		7.3	8.3	10.2	12.0	13.8	15.6	120
20	8.7	9.8	12.0	14.2	16.2	18.3		5.9	6.7	8.2	9.7	11.2	12.6	90
100	7.3	8.3	10.1	12.0	13.7	15.5	60	4.9	5.6	6.9	8.1	9.4	10.6	160
60	9.1	10.2	12.5	14.8	16.9	19.0		6.1	7.0	8.5	10.1	11.6	13.1	150
50	8.7	9.9	12.1	14.2	16.3	18.3		5.9	6.7	8.2	9.7	11.2	12.6	140
45	7.8	8.9	10.9	12.8	14.7	16.6		5.3	6.0	7.4	8.7	10.1	11.4	130
35	7.7	8.7	10.7	12.7	14.5	16.3		5.2	5.9	7.3	8.6	9.9	11.2	120
20	6.2	7.0	8.6	10.2	11.7	13.2		4.2	4.7	5.8	6.9	8.0	9.0	90
100	5.0	5.7	7.0	8.3	9.6	10.8	55	3.4	3.8	4.7	5.6	6.5	7.4	160
60	6.3	7.1	8.7	10.3	11.9	13.4		4.2	4.8	5.9	7.0	8.1	9.1	150
50	6.0	6.8	8.4	10.0	11.4	12.9		4.1	4.6	5.7	6.8	7.8	8.8	140
45	5.4	6.1	7.6	8.9	10.3	11.6		3.7	4.1	5.1	6.1	7.0	7.9	130
35	5.3	6.1	7.5	8.8	10.2	11.5		3.6	4.1	5.0	6.0	6.9	7.8	120
20	4.3	4.8	6.0	7.1	8.2	9.2		2.9	3.3	4.0	4.8	5.5	6.3	90
100	3.3	3.8	4.7	5.6	6.4	7.3	50	2.2	2.6	3.2	3.7	4.3	4.9	160
60	4.2	4.7	5.8	6.9	8.0	9.0		2.8	3.2	3.9	4.7	5.4	6.1	150
50	4.0	4.6	5.6	6.7	7.7	8.7		2.7	3.1	3.8	4.5	5.2	5.9	140
45	3.6	4.1	5.0	6.0	6.9	7.8		2.4	2.7	3.4	4.0	4.7	5.3	130
35	3.6	4.0	5.0	5.9	6.8	7.7		2.4	2.7	3.3	4.0	4.6	5.2	120
20	2.8	3.2	4.0	4.7	5.5	6.2		1.9	2.2	2.7	3.2	3.7	4.2	90
100	2.1	2.4	3.0	3.5	4.1	4.6	45	1.4	1.6	2.0	2.4	2.8	3.1	160
60	2.7	3.0	3.7	4.4	5.1	5.8		1.8	2.0	2.5	3.0	3.4	3.9	150
50	2.6	2.9	3.6	4.3	4.9	5.6		1.7	1.9	2.4	2.9	3.3	3.8	140
45	2.3	2.6	3.2	3.8	4.4	5.0		1.5	1.7	2.2	2.6	3.0	3.4	130
35	2.3	2.6	3.2	3.8	4.3	4.9		1.5	1.7	2.1	2.5	2.9	3.3	120
20	1.8	2.0	2.5	3.0	3.5	3.9		1.2	1.4	1.7	2.0	2.3	2.6	90

(*Continued*)

Table 5. Effect of Smoking on Reynolds Risk Score Results in Men (*Continued*)

	Male												
HDL-C (mg/dL)	**Smoking (%) Reynolds**						**Age (years)**	**No Smoking (%) Reynolds**						**SBP (mm Hg)**
100	2.1	2.4	3.0	3.5	4.1	4.6	**40**	1.4	1.6	2.0	2.4	2.8	3.1	**160**
60	2.7	3.0	3.7	4.4	5.1	5.8		1.8	2.0	2.5	3.0	3.4	3.9	**150**
50	2.6	2.9	3.6	4.3	4.9	5.6		1.7	1.9	2.4	2.9	3.3	3.8	**140**
45	2.3	2.6	3.2	3.8	4.4	5.0		1.5	1.7	2.2	2.6	3.0	3.4	**130**
35	2.3	2.6	3.2	3.8	4.3	4.9		1.5	1.7	2.1	2.5	2.9	3.3	**120**
20	1.8	2.0	2.5	3.0	3.5	3.9		1.2	1.4	1.7	2.0	2.3	2.6	**90**
100	2.1	2.4	3.0	3.5	4.1	4.6	**35**	1.4	1.6	2.0	2.4	2.8	3.1	**160**
60	2.7	3.0	3.7	4.4	5.1	5.8		1.8	2.0	2.5	3.0	3.4	3.9	**150**
50	2.6	2.9	3.6	4.3	4.9	5.6		1.7	1.9	2.4	2.9	3.3	3.8	**140**
45	2.3	2.6	3.2	3.8	4.4	5.0		1.5	1.7	2.2	2.6	3.0	3.4	**130**
35	2.3	2.6	3.2	3.8	4.3	4.9		1.5	1.7	2.1	2.5	2.9	3.3	**120**
20	1.8	2.0	2.5	3.0	3.5	3.9		1.2	1.4	1.7	2.0	2.3	2.6	**90**
100	2.1	2.4	3.0	3.5	4.1	4.6	**30**	1.4	1.6	2.0	2.4	2.8	3.1	**160**
60	2.7	3.0	3.7	4.4	5.1	5.8		1.8	2.0	2.5	3.0	3.4	3.9	**150**
50	2.6	2.9	3.6	4.3	4.9	5.6		1.7	1.9	2.4	2.9	3.3	3.8	**140**
45	2.3	2.6	3.2	3.8	4.4	5.0		1.5	1.7	2.2	2.6	3.0	3.4	**130**
35	2.3	2.6	3.2	3.8	4.3	4.9		1.5	1.7	2.1	2.5	2.9	3.3	**120**
20	1.8	2.0	2.5	3.0	3.5	3.9		1.2	1.4	1.7	2.0	2.3	2.6	**90**
	130	**160**	**200**	**240**	**280**	**320**		**130**	**160**	**200**	**240**	**280**	**320**	
	Total cholesterol (mg/dL)							**Total cholesterol (mg/dL)**						

According to the Reynolds system, in men who smoking (left) and no smoking (right), between the ages of 30 and 75, HDL-C (100, 60, 50, 45, 35, 20 mg/dL), TC (130, 160, 200, 240, 280, 320 mg/dL), and SBP (160, 150, 140, 130, 120, 90) parameters for women aged 30-75 are presented. The Reynolds system classifies risk scores as normal (blue color in the table) if <10% and abnormal (red color in the table) if >10%.
HDL-C, high-density lipoprotein cholesterol; SBP, systolic blood pressure; TC, total cholesterol.

The results of the study indicate that TC is an effective risk factor for CVD and stands out as a key parameter across all risk calculation systems. It was observed that high TC levels increase CVD risk, and that this increase is evident in both men and women. Additionally, it was found that the impact of rising TC levels becomes more pronounced with age, with the effect increasing as age advances. These findings further emphasize how critical TC is as a parameter in CVD risk assessment.

In this study, the CVD risks of individuals with specified parameters were compared using the Framingham, Reynolds, and PREVENT systems. While all 3 systems share several common parameters, each also includes unique parameters of its own. The Framingham system, unlike the other 2, produces higher numerical risk scores. Risk scores in the Framingham system are categorized into low, intermediate, and high-risk levels.

In the Reynolds system, CVD risk scores for individuals under 50 years of age were found to be the same. Moreover, in the Reynolds system, risk outcomes are classified as either normal or abnormal. Although the Framingham system generates higher numerical risk scores, some values considered normal according to the Framingham system were evaluated as abnormal by the Reynolds system.

The PREVENT system, unlike the other 2 systems, calculates CVD and ASCVD risks using a broader range of risk factors. This system provides separate risk calculations for 10-year and 30-year periods, allowing for a more detailed assessment. Risk scores are categorized into low risk, borderline risk, intermediate risk, and high risk, with clearly defined value ranges for each category.

The PREVENT system generally produces lower risk scores compared to the other 2 systems for individuals with the same conditions. This difference may be attributed to the fact that PREVENT was developed using more recent data, a contemporary population, and a more updated methodology.

In addition to traditional risk factors, the PREVENT system also considers additional factors such as HbA1c, BMI, uACR, Social Deprivation Index (SDI), and eGFR. This enables risk assessment for a broader patient population, including those with cardiovascular, kidney, and metabolic diseases. Furthermore, factors such as the SDI are included to provide a more comprehensive analysis. The risk score outcomes calculated through simulation by PREVENT can provide information on treatment options for patients, assist healthcare professionals in disease management, and thus offer an important opportunity to potentially alter the course of high-mortality diseases such as CVD. This holistic approach

Table 6. Effect of Smoking on PREVENT Risk Score Results in Men

	Male												
HDL-C (mg/dL)	Smoking (%) PREVENT						Age (years)	No Smoking (%) PREVENT						SBP (mm Hg)
100	9.5	10.2	11.2	12.4	13.6	15.0	75	7.9	8.5	9.4	10.4	11.4	12.6	160
60	12.1	13.0	14.3	15.7	17.2	18.8		10.1	10.9	12.0	13.2	14.5	15.9	150
50	12.3	13.2	14.5	15.9	17.4	19.1		10.3	11.0	12.2	13.4	14.7	16.1	140
45	12.0	12.9	14.2	15.6	17.0	18.7		10.0	10.8	11.9	13.1	14.4	15.8	130
35	12.2	13.1	14.4	15.8	17.3	18.9		10.2	11.0	12.1	13.3	14.6	16.0	120
20	16.3	17.5	19.1	20.9	22.8	24.7		13.8	14.8	16.2	17.7	19.4	21.2	90
100	7.0	7.6	8.6	9.6	10.8	12.0	70	5.5	6.1	6.8	7.6	8.6	9.6	160
60	9.3	10.1	11.3	12.6	14.1	15.7		7.4	8.1	9.0	10.1	11.3	12.6	150
50	9.4	10.2	11.4	12.7	14.2	15.7		7.4	8.1	9.1	10.2	11.4	12.7	140
45	9.0	9.8	11.0	12.2	13.6	15.2		7.2	7.8	8.7	9.8	11.0	12.2	130
35	9.1	9.9	11.0	12.3	13.7	15.3		7.2	7.9	8.8	9.9	11.0	12.3	120
20	12.3	13.3	14.8	16.5	18.3	20.2		9.8	10.7	12.0	13.3	14.8	16.5	90
100	5.2	5.7	6.5	7.4	8.4	9.6	65	3.9	4.3	4.9	5.6	6.4	7.3	160
60	7.1	7.8	8.9	10.1	11.4	12.9		5.4	5.9	6.7	7.7	8.7	9.9	150
50	7.1	7.8	8.9	10.1	11.4	12.9		5.3	5.9	6.7	7.7	8.7	9.9	140
45	6.7	7.4	8.4	9.6	10.8	12.3		5.1	5.6	6.4	7.3	8.3	9.4	130
35	6.7	7.4	8.4	9.5	10.8	12.3		5.0	5.6	6.4	7.3	8.3	9.4	120
20	9.1	10.0	11.4	12.9	14.5	16.4		6.9	7.7	8.7	9.9	11.2	12.7	90
100	3.8	4.2	4.9	5.7	6.6	7.6	60	2.7	3.0	3.5	4.1	4.7	5.5	160
60	5.4	6.0	6.9	8.0	9.2	10.6		3.9	4.3	5.0	5.8	6.7	7.8	150
50	5.3	5.9	6.9	7.9	9.2	10.5		3.8	4.3	5.0	5.7	6.6	7.7	140
45	5.0	5.5	6.4	7.4	8.6	9.9		3.5	4.0	4.6	5.4	6.2	7.2	130
35	4.9	5.5	6.3	7.3	8.5	9.8		3.5	3.9	4.6	5.3	6.1	7.1	120
20	6.7	7.5	8.7	10.0	11.5	13.1		4.8	5.4	6.3	7.3	8.4	9.7	90
100	2.7	3.1	3.7	4.3	5.1	6.0	55	1.9	2.1	2.5	3.0	3.5	4.1	160
60	4.1	4.6	5.4	6.3	7.4	8.7		2.8	3.1	3.7	4.4	5.1	6.0	150
50	4.0	4.5	5.3	6.2	7.3	8.6		2.7	3.1	3.6	4.3	5.0	5.9	140
45	3.6	4.1	4.9	5.7	6.7	7.9		2.5	2.8	3.3	3.9	4.6	5.4	130
35	3.6	4.0	4.8	5.6	6.6	7.7		2.4	2.8	3.3	3.8	4.5	5.3	120
20	4.9	5.6	6.5	7.7	9.0	10.5		3.4	3.8	4.5	5.3	6.2	7.3	90
100	2.0	2.3	2.7	3.3	3.9	4.7	50	1.3	1.5	1.8	2.1	2.6	3.1	160
60	3.0	3.5	4.2	5.0	6.0	7.1		2.0	2.3	2.7	3.3	3.9	4.7	150
50	3.0	3.4	4.1	4.9	5.8	6.9		1.9	2.2	2.6	3.2	3.8	4.5	140
45	2.7	3.1	3.7	4.4	5.2	6.3		1.7	2.0	2.4	2.9	3.4	4.1	130
35	2.6	3.0	3.6	4.3	5.1	6.1		1.7	1.9	2.3	2.8	3.3	4.0	120
20	3.6	4.1	4.9	5.8	7.0	8.3		2.3	2.7	3.2	3.8	4.6	5.5	90
100	1.4	1.7	2.0	2.5	3.0	3.7	45	0.9	1.0	1.3	1.5	1.9	2.3	160
60	2.3	2.7	3.2	3.9	4.8	5.8		1.4	1.6	2.0	2.4	3.0	3.6	150
50	2.2	2.6	3.1	3.8	4.6	5.6		1.4	1.6	1.9	2.3	2.9	3.5	140
45	2.0	2.3	2.8	3.4	4.1	5.0		1.2	1.4	1.7	2.1	2.5	3.1	130
35	1.9	2.2	2.7	3.2	3.9	4.8		1.2	1.3	1.6	2.0	2.4	3.0	120
20	2.6	3.0	3.7	4.4	5.4	6.5		1.6	1.9	2.3	2.8	3.4	4.1	90

(*Continued*)

Table 6. Effect of Smoking on PREVENT Risk Score Results in Men (*Continued*)

	Male												
HDL-C (mg/dL)	Smoking (%) PREVENT						Age (years)	No Smoking (%) PREVENT						SBP (mm Hg)
100	1.0	1.2	1.5	1.9	2.3	2.9	40	0.6	0.7	0.9	1.1	1.4	1.7	160
60	1.7	2.0	2.5	3.1	3.8	4.7		1.0	1.2	1.5	1.8	2.2	2.8	150
50	1.6	1.9	2.4	2.9	3.6	4.5		1.0	1.1	1.4	1.7	2.1	2.7	140
45	1.4	1.7	2.1	2.6	3.2	3.9		0.8	1.0	1.2	1.5	1.9	2.3	130
35	1.4	1.6	2.0	2.4	3.0	3.7		0.8	0.9	1.2	1.4	1.8	2.2	120
20	1.9	2.2	2.7	3.4	4.1	5.1		1.1	1.3	1.6	2.0	2.5	3.0	90
100	0.8	0.9	1.1	1.4	1.8	2.3	35	0.4	0.5	0.6	0.8	1.0	1.3	160
60	1.3	1.5	1.9	2.4	3.0	3.8		0.7	0.8	1.1	1.3	1.7	2.1	150
50	1.2	1.4	1.8	2.3	2.9	3.6		0.7	0.8	1.0	1.3	1.6	2.0	140
45	1.0	1.2	1.6	2.0	2.5	3.1		0.6	0.7	0.9	1.1	1.4	1.7	130
35	1.0	1.2	1.5	1.8	2.3	2.9		0.5	0.6	0.8	1.0	1.3	1.6	120
20	1.4	1.6	2.0	2.5	3.2	4.0		0.8	0.9	1.1	1.4	1.8	2.3	90
100	0.5	0.7	0.8	1.1	1.4	1.8	30	0.3	0.3	0.4	0.6	0.7	0.9	160
60	1.0	1.2	1.5	1.9	2.4	3.1		0.5	0.6	0.8	1.0	1.3	1.6	150
50	0.9	1.1	1.4	1.8	2.2	2.9		0.5	0.6	0.7	0.9	1.2	1.5	140
45	0.8	0.9	1.2	1.5	1.9	2.4		0.4	0.5	0.6	0.8	1.0	1.3	130
35	0.7	0.8	1.1	1.4	1.8	2.3		0.4	0.5	0.6	0.7	0.9	1.2	120
20	1.0	1.2	1.5	1.9	2.4	3.1		0.5	0.6	0.8	1.0	1.3	1.7	90
	130	160	200	240	280	320		130	160	200	240	280	320	
	Total cholesterol (mg/dL)							Total cholesterol (mg/dL)						

According to the PREVENT system, in men aged 30-75 who smoking (left) and no smoking (right), HDL-C (100, 60, 50, 45, 35, 20 mg/dL), TC (130, 160, 200, 240, 280, 320 mg/dL), and SBP (160, 150, 140, 130, 120, 90) parameters for women aged 30-75 are presented. The PREVENT system classifies risk scores into percentile ranges as follows: <5% low risk (blue color in the table), 5%-7.4% borderline risk (yellow color in the table), 7.5%-19.9% moderate risk (orange color in the table), and ≥20% high risk (red color in the table).
HDL-C, high-density lipoprotein cholesterol; SBP, systolic blood pressure; TC, total cholesterol.

enables healthcare systems to assess and conduct risk management within risk scenarios based on simulations.[13,19]

Krishnan et al developed an online calculation tool that also allows the estimation of individuals' PREVENT risk age. This system enables the assessment of concordance between chronological age and risk age (i.e., whether one's risk age exceeds their actual chronological age). The study found that discordance was more pronounced among middle-aged adults, individuals with adverse social factors, those with lower educational attainment, and members of racial and ethnic minority groups. Notably, among individuals with lower education levels, 22.8% of women and 32.5% of men had a PREVENT risk age exceeding their chronological age by more than 10 years. Considering individuals' risk age may provide a clearer understanding of risk factors and their consequences. The online calculation tool can be accessed at: https://nwkhanlab.shinyapps.io/riskage/.[20] Recently, steps have also been taken through artificial intelligence–based research to identify individuals with CVD, diagnose CVD as a predictable disease, examine the impact of risk factors on the disease, and ensure that treatment interventions for patients can be carried out transparently.[21]

Study Limitations

This study is a simulation study in which no real patient data were used. The common risk factors included in the 3 cardiovascular risk assessment systems were identified, and the shared value ranges they cover were used to generate the reported risk scores. The absence of real patient data may be considered a limitation of this study. The point emphasized in the study is that different risk calculation systems yield numerically different scores and different classifications when dealing with the same risk profiles. However, this study does not provide any output regarding accuracy and reliability. This is a significant limitation of the study.

In the PREVENT system, ASCVD risk is calculated instead of CVD risk, and the results of this risk score are presented in tables. During the study, while calculating CVD risk in the PREVENT system, the common risk factors of age, gender, HDL-C, and SBP values were kept constant; when TC values were increased, contrary to expectations, CVD risk decreased rather than increased. This is a point that requires further investigation. Therefore, to provide a clear result, the 10-year ASCVD risk was calculated. This is a limitation of the study.

The different risk scoring systems examined in this study have different parameters. However, it is not possible to obtain the output of the whole system by including each parameter and comparing all parameters. Each system has different parameter values, but when the systems are considered as a whole in a comparison-based study, it is not possible to equalize

them. In this study, there is no other option but to obtain and compare the scoring output. However, since the comparison cannot be addressed as a whole, this is a limitation.

CONCLUSION

The aim of this study is to highlight the output differences and classification discordance for individuals when the same parameter values are considered using different risk scoring systems. Considering all these assessments, the newly developed PREVENT system enables a clearer distinction between low-risk and high-risk patients. This allows healthcare professionals to evaluate patients within clearer boundaries and intervene more appropriately. These interventions, including lifestyle changes and the development of accurate treatment protocols, can alter the course of CVD. This, in turn, will contribute to reducing mortality and morbidity rates associated with CVD worldwide. In terms of the prevention, delay, and clinical management of CVDs, the development and validation of risk prediction systems are crucial steps.

Ethics Committee Approval: This study was conducted exclusively using simulation-based methods and did not involve human participants, animals, biological specimens, or identifiable personal data. Therefore, in accordance with institutional regulations and internationally accepted research ethics guidelines, ethical approval and informed consent were not required for this study.

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