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Evaluating Cardiovascular Risk Factors Among Healthcare Professionals in Iran

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ADE 1 Maryam Moshkani Farahani
BE 1 Seyyed Mohammad Saeed Ghiasi
DE 2 Maziar Karamali
ABCE 3 Reza Golchin Vafa

1 Atherosclerosis Research Center, Baqiyatallah University of Medical Sciences, Tehran, Iran
2 Health Management Research Center, Baqiyatallah University of Medical Sciences, Tehran, Iran
3 Department of Cardiology, Shiraz University of Medical Sciences, Shiraz, Iran

Corresponding Author: Reza Golchin Vafa, e-mail: Rezagolchinvafa@gmail.com
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Background: Cardiovascular disease is a leading cause of morbidity and mortality worldwide, necessitating accurate risk prediction models for effective prevention strategies. This study compares the predictive capabilities of 3 widely used 10-year cardiovascular risk assessment tools – Atherosclerotic Cardiovascular Disease (ASCVD) risk score, Framingham Risk Score (FRS), and Systematic Coronary Risk Evaluation 2 (SCORE2) – in healthcare professionals in Iran.

Material/Methods: This cross-sectional study analyzed data from 222 healthcare professionals at Jamaran Hospital in Tehran, assessing cardiovascular risk profiles using the ASCVD, FRS, and SCORE2 tools. Risk factors included age, sex, dyslipidemia, hypertension, diabetes, obesity, and smoking status. Risk scores were compared to evaluate concordance and classification accuracy across different risk levels.

Results: The prevalence of cardiovascular risk factors was notable: hypertension (30.1%), dyslipidemia (65.7%), diabetes (7.2%), and obesity (24.3%). SCORE2 showed varied distributions of fatal and nonfatal cardiovascular events. ASCVD categorized most participants as low risk (85.6%), with smaller percentages in borderline (6.8%), intermediate (7.2%), and high-risk (0.5%) groups. FRS classified 97.7% as low risk and 2.3% as intermediate risk. Moderate agreement was observed between SCORE2 and ASCVD in moderate-risk ($P<0.001$, $\kappa=0.43$) and high-risk ($P=0.007$, $\kappa=0.45$) regions, with fair agreement between FRS and ASCVD ($P<0.001$, $\kappa=0.435$).

Conclusions: This study highlights the significant prevalence of cardiovascular risk factors among healthcare professionals in Iran. It emphasizes the need for recalibrating cardiovascular risk models to better reflect Iran's unique population characteristics, ultimately improving risk prediction accuracy and preventive strategies.

Keywords: Cardiovascular Diseases • Public Health

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Introduction

Cardiovascular diseases (CVDs) are major health problems worldwide, causing a significant number of illnesses and deaths. Nevertheless, CVD fatalities are expected to increase once again because of a growing elderly population and hazardous behaviors [1]. CVDs pose a substantial public health issue in Iran, as well as in many other nations, and contribute to the increasing prevalence of noncommunicable diseases [2]. Examining cardiovascular risk factors is one of the most important steps for lowering the burden of CVD. This assessment is vital for providing information on preventive interventions and maximizing the efficient use of healthcare resources [3,4]. Risk stratification is a process that identifies people with a greater risk of developing certain conditions or diseases. Risk stratification allows for the implementation of personalized preventive measures and treatments [5].

Several cardiovascular risk prediction systems, including the pooled cohort equation and the Framingham risk score (FRS), offer distinct advantages and disadvantages for identifying and treating individuals at high risk [6,7]. The most frequently used risk scores in Iran include the Atherosclerotic Cardiovascular Disease 2013 Risk Calculator (ASCVD), created by the American College of Cardiology and the American Heart Association (AHA/ACC), FRS, and 2019 World Health Organization (WHO) CVD risk prediction charts [8-10]. Although these tools have been demonstrated to be beneficial in assessing CVD risk in Iranian populations, their suitability and precision can vary due to differences in demographic characteristics, frequency of risk factors, and underlying epidemiological patterns [11-13].

The latest European guidelines advise the use of recently revised Systematic Coronary Risk Evaluation (SCORE2) charts to identify apparently healthy people who have an increased risk of developing CVD over the next 10 years. The SCORE2 risk score has been designed to provide an estimation of the probability of experiencing cardiovascular events, including fatal and nonfatal incidents, during a 10-year period. The model takes into account variables, including age, sex, smoking history, cholesterol level, and systolic blood pressure [14-16]. The SCORE2 enhances accuracy by incorporating current data and accounting for variations in risk levels among different European countries while also considering variability within European populations [15].

The SCORE2 is currently receiving praise for its geographical calibration and methodology improvements, which have increased its prediction accuracy in terms of risk [17]. Recent studies have shown that the SCORE2 is more precise in assessing cardiovascular hazards in European populations than is the previous SCORE model. This leads to improved categorization and treatment of risk. The SCORE2 fills an important gap in the prior SCORE model by including nonfatal cardiovascular incidents alongside fatal events, resulting in a more thorough evaluation of risk [18-20]. The SCORE2 generally offers superior performance in assessing cardiovascular illness risk in Europe and helps physicians more precisely implement preventative treatments for patients at increased risk [15].

Despite the high prevalence of CVD in Iran, research on effective risk assessment tools remains limited. Prior studies have demonstrated differences in risk classification among various scoring systems, underscoring the importance of precise risk assessment instruments for successful preventative measures [21-23], especially the recently created SCORE2 model. Its applicability and accuracy in non-European settings, such as Iran, are not well documented. This study, with the goal of optimizing cardiovascular risk assessment in Iran, aims to assess cardiovascular risk among Jamaran Hospital staff via the use of the FRS, ASCVD, and SCORE2 risk scores in 222 healthcare professionals. By comparing these 3 risk assessment tools, we seek to determine the frequency of individuals classified as high risk and the concordance between different scoring systems.

Material and Methods

Ethical Considerations

This study was approved by the Ethics Committee of Baqiyatallah University of Medical Sciences, under approval number IR.BMSU.BAQ.REC.1402.078. All participants provided written informed consent to participate in the study. The study adhered to the ethical guidelines outlined by the Declaration of Helsinki.

Study Design

We conducted this comparative cross-sectional study at Jamaran Hospital in Tehran, Iran. The study population consisted of hospital staff, including physicians, nurses, administrative personnel, and support staff. Individuals employed at Jamaran Hospital, aged between 40 and 75 years, who expressed a willingness to participate in the research met the inclusion criteria. To concentrate on primary prevention, we excluded people with a documented history of CVD. We included all eligible staff in the study to ensure comprehensive representation. This approach facilitated a thorough evaluation of cardiovascular risk across diverse occupational groups within the hospital.

Data Collection

Data collection occurred over a 6-month period from January to June 2024. Each participant underwent a comprehensive

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cardiovascular risk assessment, which included a structured questionnaire and physical examination. To ensure the accuracy of the data, the questionnaires were completed by a general physician. The questionnaire collected detailed information on demographic data (age, sex), medical history (hyperlipidemia, hypertension, diabetes mellitus, lifestyle factors (smoking status), and family history of CVD. Physical examinations were used to measure blood pressure, height, weight, and body mass index (BMI). We collected blood samples to determine lipid profiles, which included triglycerides, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein (HDL-C) cholesterol, and total cholesterol levels.

A medical doctor conducted blood pressure assessments on participants' right arms while seated, preceded by a 5-min rest period, via an electronic blood pressure monitor. We obtained 2 successive readings, ensuring a 3-min gap between them. If there was a difference of more than 10 mmHg or 5 mmHg between the systolic and diastolic values, we conducted a third measurement and chose the 2 readings that were closest in value for further investigation. We subsequently computed the average systolic and diastolic blood pressures from the aforementioned pair of measurements. Furthermore, the doctor recorded the weight and height of each participant. We conducted cardiovascular risk assessment for each participant via 3 established methodologies: the FRS, ASCVD risk calculator, and SCORE2.

Definitions and Criteria

The 2023 European Society of Hypertension recommendations classifying hypertension into distinct stages. Grade 1 hypertension is characterized by a systolic blood pressure (SBP) ranging from 140 to 159 mmHg or a diastolic blood pressure (DBP) ranging from 90 to 99 mmHg. Grade 2 hypertension is defined as an SBP ranging from 160 to 179 mmHg or a DBP ranging from 100 to 109 mmHg. An SBP higher than 180 mmHg or a DBP higher than 110 mmHg indicates grade 3 hypertension. Hypertension in the third grade requires immediate medical intervention [24].

According to recent guidelines from the European Society of Cardiology, dyslipidemia is defined as an aberrant lipid profile characterized by decreased levels of HDL-C and/or increased levels of total cholesterol, LDL-C, and triglycerides [27]. We considered any total cholesterol level of 240 mg/dL or higher to be abnormal, in addition to triglyceride levels of 200 mg/dL or higher, LDL-C levels of 130 mg/dL or higher, and HDL-C values of 40 mg/dL or lower for men and 50 mg/dL or lower for women [25,26].

The American Diabetes Association guidelines classify diabetes as blood sugar levels of 126 mg/dL or greater when fasting, 200 mg/dL or higher during a 2-h oral glucose tolerance test, or 6.5% or higher when hemoglobin A1c is measured [27]. Smokers are defined as individuals who have smoked cigarettes, water pipes, or pipes within the previous 30 days at the time of evaluation [28]. According to the World Health Organization (WHO), weight categories are defined as follows: people with underweight have a BMI below 18.5 kg/m^2, those with normal weight have a BMI in the range of 18.5 to 24.9 kg/m^2, those with overweight have a BMI in the range of 25.0 to 29.9 kg/m^2, and those with obesity have a BMI of 30 kg/m^2 or higher [29]. A positive family history of CVD is defined as CVD occurring in first-degree relatives who develop CVD before the age of 55 years for men and 65 years for women [30].

Risk Assessment Tools

For each participant, we estimated their 10-year risk of cardiovascular events via 3 different tools.

SCORE2

The SCORE2 program calculates the 10-year risk of cardiovascular events, including fatal and nonfatal events. We input data such as sex, age, SBP, smoking status, and total cholesterol and HDL-C levels into the model. We delineate risk categories in participants under 50 years of age as follows: we classify a risk of less than 2.5% as low to moderate, risk between 2.5% and 7.5% as high, and risk of 7.5% or higher as very high. For individuals aged 50 to 69 years, we classify a risk below 5% as low to moderate, risk between 5% and 10% as high, and risk of 10% or higher as very high [15]. Iran does not fall within the predefined risk regions of SCORE2; therefore, we applied each risk category (from low to very high) comprehensively to each individual to measure the cardiovascular risk profile of the study population.

ASCVD Risk Calculator

We used the ASCVD risk calculator to calculate the risk of developing atherosclerotic cardiovascular events over a period of 10 years. The variables used as inputs in the model were age, race, sex, total cholesterol, HDL-C, SBP, hypertension treatment status, diabetes status, and smoking status. We categorized participants on the basis of their 10-year probability of cardiovascular events, classifying a probability below 5% as low risk and a probability between 5% and 7.4% as borderline. We classified individuals with a risk between 7.5% and 19.9% as having an intermediate level of risk. Finally, a risk exceeding 20% indicated a high-risk classification [31].

FRS

We used the FRS to compute the probability of experiencing cardiovascular events, specifically coronary heart disease, over

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a period of 10 years. The model incorporated sex, age, smoking status, SBP, HDL-C, and total cholesterol levels as input variables. This established risk assessment technique offers useful insights into predicting cardiovascular risk. Individuals classified as low risk have a 10-year probability of developing cardiovascular disease that is 10% or less. On the other hand, individuals labeled as intermediate risk have a 10-year probability ranging from 10% to 20%. Individuals classified as high risk have a 10-year probability of having a cardiovascular disease of 20% or greater [9].

Statistical Analysis

We conducted the data analysis via SPSS software version 26.0. We summarized the demographic and clinical characteristics of the research population via descriptive statistics. The mean and standard deviation (SD) were used to describe continuous variables, whereas frequencies and percentages were used to describe categorical variables.

The primary outcome of the study centered on assessing the 10-year risk for CVDs predicted by the FRS, ASCVD, and SCORE2 tools. Comparative analysis encompassed 2 main aspects. First, we examined the categorization of risk levels according to the SCORE2, ASCVD, and FRS. Second, we conducted an evaluation of the concordance between the risk categories generated by these 3 tools via the Cohen kappa statistic. To compare risk scores, we categorized ASCVD risk as low (below 7.5%) or high (above 7.5%). Similarly, we classified SCORE2 risk as low (below 2.5%) or high (above 2.5%) for individuals under 50 years of age and low (below 5%) or high (above 5%) for those over 50 years of age. We also divided FRSs into low-risk (below 10%) and high-risk (above 10%) groups.

Results

Demographic Data

The study involved a total of 222 healthcare practitioners. The study consisted of 162 male participants, accounting for 73% of the total, and 60 female participants, accounting for 27%. The average age of the participants was 46.51±8 years. The mean employment experience was 18.91±7 years.

Cardiovascular Risk Factors

The average SBP and DBP of the participants were 123±12.2 and 78.1±9.4, respectively. The hypertension prevalence was 67 (30.1%), with 11 (4.9%) having known hypertension, 31 (13.9%) having newly elevated BP, 24 (10.8%) with newly diagnosed grade 1 hypertension, and 1 (0.4%) with recently diagnosed grade 2 hypertension. A total of 146 participants (65.7%) had dyslipidemia, with 1 prior diagnosis (0.4%), 127 new cases of abnormal HDL (57.2%), 37 new cases of abnormal LDL (16.6%), 14 new cases of abnormal triglycerides (6.3%), and 1 new case of abnormal total cholesterol (0.4%). Diabetes was present in 16 participants (7.2%), including 9 (4%) with previously diagnosed diabetes and 7 (3.1%) with newly diagnosed diabetes. Furthermore, the study identified 27 individuals (12.1%) as prediabetic. In this study, the prevalence of current smokers was 21 (9.4%). The prevalence of a positive CVD family history was 7 (3.1%). The BMI categories revealed that 0.9% of the participants had underweight, 25.2% had normal weight, 48.6% had overweight, and 24.3% had obesity (**Table 1**).

Cardiovascular Risk Assessment

We used the SCORE2, ASCVD, and FRS tools to evaluate the probability of experiencing cardiovascular events during a 10-year period (**Table 2, Figure 1**). Each risk score was applied based on standard guidelines. We acknowledge the lack of recalibration, which can influence risk classification accuracy; however, this provides a baseline comparison for future recalibrated models.

The SCORE2 tool, modified for 4 risk regions, revealed participants' different 10-year cardiovascular event distributions. The low-risk region chart classified participants into low- to moderate-risk (92.3%) and high-risk (7.7%) groups. The moderate-risk region chart classified 82% of the participants as low- to moderate-risk and 18% as high-risk. The high-risk region chart classified 81.5% of the participants as low- to moderate-risk and 18.5% as high-risk. Finally, in the very high-risk region chart, 28.4% of the regions were classified as low to moderate risk, 61.3% as high risk, and 10.4% as very high risk.

The ASCVD risk calculator classified the majority of participants, 190 (85.6%), as having low risk, followed by 15 (6.8%) as having borderline risk, 16 (7.2%) as having intermediate risk, and 1 (0.5%) as having high risk. Using the FRS, 217 participants (97.7%) were categorized as having low risk, whereas 2 (2.3%) were categorized as having intermediate risk.

Concordance Analysis

The results showed that the ASCVD and the SCORE2 moderate-risk region charts agreed at a moderate level (κ=0.43, 95% CI 0.29-0.59, P<0.001), suggesting a reasonable level of consistency in assessing cardiovascular risk. Moreover, there was moderate agreement between the ASCVD and SCORE2 high-risk region charts (κ=0.45, 95% CI 0.29, 0.61, P=0.007). However, the study revealed poor agreement between the SCORE2 very high-risk region and the ASCVD risk score, with a kappa coefficient of 0.06 (95% CI 0.03, 0.09, P=0.007). Additionally, there was only a slight improvement in agreement between

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Table 1. Baseline demographic data of the participants.

		Participants (n=222)
Age (mean±SD)		46.5±8.08
Sex, n (%)	Male	162 (73)
	Female	60 (27)
Average work experience (years, mean±SD)		18.91±7.19
SBP (mean±SD)		123.02±12.27
DBP (mean±SD)		78.14±9.43
HTN, n (%)	Prior HTN	11 (4.9)
	Elevated BP	31 (13.9)
	New grade 1	24 (10.8)
	New grade 2	1 (0.4)
Dyslipidemia, n (%)	Prior	1 (0.4)
	New abnormal HDL	127 (57.2)
	New abnormal LDL	37 (16.6)
	New abnormal TG	14 (6.3)
	New abnormal TC	1 (0.4)
DM, n (%)	Prior DM	9 (4)
	Prediabetes	27 (12.1)
	New DM	7 (3.1)
Smoking, n (%)	Current smoker	21 (9.4)
Family history of CVD, n (%)	Positive	7 (3.1)
BMI (n, %)	Underweight	2 (0.9)
	Normal	56 (25.2)
	Overweight	6108 (48.6)
	Obese	54 (24.3)
FBS (mean±SD)		
TG (mean±SD)		131.82±56.78
TC (mean±SD)		151.07±35.31
LDL-C (mean±SD)		98.59±30.26
HDL-C (mean±SD)		41.08±9.72

SBP – systolic blood pressure; DBP – diastolic blood pressure; HTN – hypertension; DM – diabetes mellitus; CVD – cardiovascular disease; BMI – body mass index; FBS – fasting blood sugar; TG – triglycerides; TC – total cholesterol; LDL-C – low-density lipoprotein cholesterol; HDL-C – high-density lipoprotein cholesterol.

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Table 2. The 10-year risk of cardiovascular events using the Framingham Risk Score (FRS), Systematic Coronary Risk Evaluation 2 (SCORE2), and Atherosclerotic Cardiovascular Disease (ASCVD) tools.

Risk Calculator		Low to moderate risk	High risk	Very high risk	Low risk	Borderline risk	Intermediate risk
SCORE2 (n, %)	Low risk region	205 (92.3)	17 (7.7)	–	–	–	–
	Moderate risk region	182 (82)	40 (18)	–	–	–	–
	High risk region	181 (81.5)	41 (18.5)	–	–	–	–
	Very high risk region	63 (28.4)	136 (61.3)	23 (10.4)	-	–	–
ASCVD (n, %)	-	–	1 (0.45)	–	190 (85.6)	15 (6.8)	16 (7.2)
FRS (n, %)	-	–	–	–	217 (97.7)	–	5 (2.3)

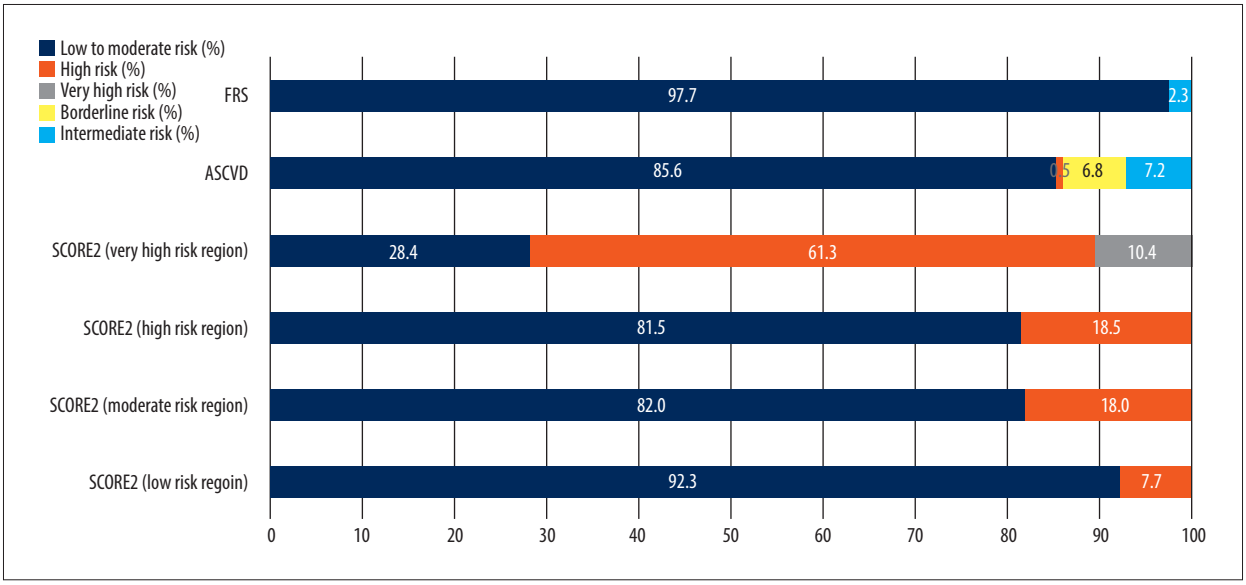

Figure 1. The 10-year risk of cardiovascular events using the Framingham Risk Score (FRS), Systematic Coronary Risk Evaluation 2 (SCORE2), and Atherosclerotic Cardiovascular Disease (ASCVD) tools.

the SCORE2 low-risk region and the ASCVD risk score, with a kappa coefficient of 0.236 (95% CI 0.02, 0.44, *P*<0.001). This finding indicated that there were still considerable discrepancies in the classification of low-risk individuals between the 2 scoring systems (**Table 3**).

Furthermore, the study revealed slight agreement between the FRS and SCORE2 risk regions. The kappa coefficients for the FRS and SCORE2 were as follows: low-risk region (κ=0.152, 95% CI -0.06, 0.36, *P*=0.006), moderate-risk region (κ=0.190, 95% CI 0.04, 0.33, *P*<0.001), high-risk region (κ=0.185, 95% CI 0.04, 0.32, *P*<0.001), and very high-risk region (κ=0.018, 95% CI 0.001, 0.03, *P*=0.155). Notably, the kappa coefficient for the agreement between the FRS and ASCVD scores was 0.435 (95% CI 0.17, 0.69, *P*<0.001), indicating fair to good agreement. This suggests a moderate level of consistency in cardiovascular risk assessment between these 2 tools.

Discussion

In this study, we assessed cardiovascular risk factors and compared 3 widely used risk assessment tools – SCORE2, ASCVD, and FRS – among healthcare professionals in Iran. The results revealed a significant burden of cardiovascular risk factors, with hypertension, dyslipidemia, and obesity being prevalent in this population. Our findings revealed a broad spectrum of risk levels, with a significant proportion categorized as moderate to high risk. This underscores the pressing need for targeted preventative strategies to address cardiovascular risk factors in Iran. Previous studies, including the Fasa and Pars cohort studies, have similarly reported a high prevalence of moderate to high cardiovascular risk in the Iranian population over a decade [32]. Iranians may exhibit a different cardiovascular risk profile than other countries due to factors like higher prevalence of hypertension, diabetes, and dyslipidemia, influenced

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Table 3. Concordance analysis of cardiovascular risk assessment tools.

Agreement	Linear weighted kappa	95% Confidence interval	*P* value	Kappa rating
ASCVD vs SCORE2 (low risk)	**0.236**	0.02, 0.44	**<0.001**	Fair
ASCVD vs SCORE2 (moderate risk)	**0.43**	0.29, 0.59	**<0.001**	Moderate
ASCVD vs SCORE2 (high risk)	**0.45**	0.29, 0.61	**0.007**	Moderate
ASCVD vs SCORE2 (very high risk)	0.06	0.03, 0.09	**0.007**	None to slight
FRS vs SCORE2 (low risk)	0.152	-0.06, 0.36	**0.006**	Slight
FRS vs SCORE2 (moderate risk)	0.19	0.04, 0.33	**<0.001**	Slight
FRS vs SCORE2 (high risk)	0.185	0.04, 0.32	**<0.001**	Slight
FRS vs SCORE2 (very high risk)	0.018	0.001, 0.03	0.155	None
FRS vs ASCVD	**0.435**	0.17, 0.69	**<0.001**	Moderate

FRS – Framingham Risk Score, SCORE2 – Systematic Coronary Risk Evaluation 2, ASCVD – Atherosclerotic Cardiovascular Disease.

by urbanization and lifestyle changes; however, lower alcohol consumption may offer some protection [33-38].

A significant number of cardiovascular risk factors, including dyslipidemia (65.7%), hypertension (30.1%), diabetes (7.2%), and smoking (9.4%), were present in the study population at Jamaran Hospital. In addition, 72.9% of the participants met the criteria for obesity or overweight. These results align with more general patterns seen among Iranians, in which age, sex, dyslipidemia, hypertension, obesity, and diabetes are major cardiovascular risk factors [33,34]. Similarly, studies conducted in southern Iran have demonstrated the prevalence of smoking, diabetes, hypertension, and high cholesterol, as well as the large increase in the risk of cardiovascular illnesses associated with advanced age, inactivity, obesity, and abnormal blood glucose levels [32,35,36]. Further research in Tabriz and Tehran reported a high prevalence of obesity, overweight, hypertension, and poor lipid profiles among women [37,38].

Furthermore, research focusing on older populations has revealed increasing trends in hypertension, diabetes, central obesity, and chronic kidney disease, highlighting the need for improved risk factor management strategies [39]. A longitudinal study from 2007 to 2016 demonstrated trends in cardiovascular risk factors, highlighting the need for immediate efforts to manage these risks and alleviate the impact of cardiovascular illnesses in Iran [40]. Researchers have identified lifestyle factors, such as physical activity, smoking, and dietary habits, as significant contributors to obesity and abdominal obesity in Iranian adults, highlighting the importance of promoting healthier behaviors to combat cardiovascular risk factors in the country [41]. These findings emphasize the urgent need to address modifiable risk factors to reduce the impact of cardiovascular illnesses on the Iranian healthcare community and the wider public [42,43].

In terms of risk assessment tools, our study is the first to evaluate the SCORE2 in Iran, revealing that its moderate- and high-risk region charts exhibit better concordance with the ASCVD and FRS than do other risk region charts. This higher level of agreement implies that SCORE2 moderate-risk and high-risk charts are more effective in identifying high-risk individuals in the Iranian population than are other risk region charts. The study also assessed the agreement between the FRS and ASCVD, revealing a generally fair to excellent agreement. Previous studies comparing the ASCVD and FRS in Iranian individuals with obesity have reported fair agreement between the 2 scores [13]. Moreover, the comparison of ASCVD and WHO risk scores in Iran revealed moderate concordance, although the ASCVD classified more individuals as high risk than the WHO [22]. A study comparing Iran's Package of Essential Noncommunicable Diseases (Ira-PEN) and FRS in Yazd showed slight agreement between the 2 scores, highlighting the need for more reliable tools to assess cardiovascular risk in the Iranian population [44]. Additionally, a study from southern Iran evaluating FRS models for CVD risk assessment revealed moderate agreement between models using laboratory data and those that did not, suggesting potential areas for improvement in the risk assessment methodology [45]. Moreover, the ASCVD detected a greater portion of participants as high-risk than did the FRS (28.7% vs 15.7%) and demonstrated higher discriminative ability (AUC: 0.794 vs 0.746) among an Iranian population, particularly in women [46]. These findings underscore the necessity for further refinement and validation of cardiovascular risk assessment tools tailored to the Iranian population, to enhance their accuracy and reliability.

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Notably, the SCORE2 tool classified individuals differently based on regional adjustments, with a higher percentage of high-risk individuals identified in very high-risk region charts. This demonstrates the importance of region-specific calibrations, as evidenced by studies validating SCORE2-Diabetes and SCORE2 algorithms in various cohorts [17,47]. In line with this, other studies have validated the SCORE2 algorithm in cohorts, such as the Cyprus Epidemiological Study on Atherosclerosis and the European Prospective Investigation of Cancer Norfolk, underscoring the significance of region-specific adjustments for better risk estimation [48,49]. Moreover, research on cardiovascular risk prediction tools such as the SCORE2 has shown mixed results. A study in a Portuguese population revealed significant differences in 10-year cardiovascular risk prediction between the SCORE2 and SCORE, highlighting the potential of updated tools such as the SCORE2 for better risk assessment [50]. Furthermore, a large population cohort was used to assess the predictive performance of the SCORE2 in people without prior myocardial infarction, stroke, or diabetes, demonstrating acceptable discriminative ability and accurate risk estimations in low-risk individuals [51]. The comparative evaluation of cardiovascular risk among healthcare professionals via the SCORE2, ASCVD, and FRS tools provides valuable insights into the diversity of risk prediction methodologies and their implications for preventive strategies.

The observed differences in risk stratification between the SCORE2 and American-based risk scores such as the ASCVD and FRS highlight the importance of population-specific calibrations. In particular, the European baseline categorization of the SCORE2 may have overestimated risk levels in specific subgroups, compared with the ASCVD and FRS. While the SCORE2 algorithm is widely validated for European populations, recalibration for the Iranian cohort would likely improve its predictive accuracy. Due to resource and data limitations, recalibration was not performed in this study. Future research should consider recalibrating cardiovascular risk scores to reflect the Iranian population's baseline risk. On the other hand, the participants in this study were healthcare professionals, a group likely to be more health-conscious than the general population. This heightened awareness of health could influence their cardiovascular risk profile through better lifestyle choices, such as healthier dietary habits and greater adherence to medical guidelines. Consequently, the cardiovascular risk estimated in this cohort might be lower than that of the general population. While the findings provide valuable insights into cardiovascular risk among healthcare professionals, they may not be fully generalizable to the wider population.

Limitations

Despite being the first study to assess the SCORE2 tool in Iran and providing comprehensive insights into cardiovascular risk among healthcare professionals, this study had some limitations. The use of a cross-sectional design limited our capacity to determine cause-and-effect linkages. To confirm these findings, longitudinal research is essential. In addition, the study was conducted exclusively at a solitary hospital in Tehran, Iran, which can restrict the applicability of the findings to more diverse populations. Finally, without recalibrating the SCORE2 tool to match Iran's specific cardiovascular baseline, there may be an overestimation or underestimation of actual risk levels. Further studies with recalibrated models, larger sample sizes, and broader regional representation would strengthen the reliability of cardiovascular risk predictions for diverse populations across Iran.

Conclusions

In conclusion, this study highlights the significant burden of cardiovascular risk factors among healthcare professionals in Iran, with a notable prevalence of hypertension, dyslipidemia, and obesity. The use of 3 widely recognized cardiovascular risk assessment tools – SCORE2, ASCVD, and FRS – revealed varying levels of agreement in risk classification, emphasizing the need for population-specific recalibration. While the SCORE2 demonstrated better concordance in moderate- and high-risk regions, the differences in risk stratification underscore the importance of tailoring cardiovascular risk models to the unique risk profile of the Iranian population. The findings suggest that recalibration of these models could enhance the accuracy of cardiovascular risk prediction, ultimately improving preventive strategies and health outcomes. Future research should focus on optimizing these tools for Iran's specific demographic and health characteristics to support more targeted interventions and effective risk management strategies.

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Patient Permission/Consent Declarations

Informed consent was obtained from all participants included in the study, and all data were fully anonymized to ensure confidentiality.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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