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ORIGINAL RESEARCH

Conducting a Screening Study Using the SCORE Cardiovascular Disease Risk Assessment Model and Discussion of the SCORE Model in Light of the Results

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Abstract

Objective and Aim

Cardiovascular diseases remain a leading cause of mortality and morbidity worldwide and in Türkiye. Contemporary preventive strategies emphasize reducing an individual's overall cardiovascular risk burden rather than focusing on isolated risk factors. Within this framework, the SCORE (Systematic Coronary Risk Evaluation) model has been developed as a widely used tool to estimate the 10-year risk of fatal cardiovascular disease. The aim of this study was to calculate SCORE risk values in patients presenting to the Family Medicine Outpatient Clinic of Mersin University and to evaluate the results according to the Türkiye and European SCORE algorithms.

Materials and Methods

This retrospective study was conducted with the approval of the Mersin University Clinical Research Ethics Committee. Data from 304 patients who met the inclusion criteria and presented to the Family Medicine Outpatient Clinic between 01.08.2018 and 01.08.2020 were analyzed. SCORE-Türkiye and SCORE-Europe risk percentages were calculated using age, sex, systolic blood pressure, total cholesterol, HDL cholesterol, and tobacco use status. Patients were classified according to body mass index (BMI), and the relationships between BMI categories and cardiovascular risk levels were statistically evaluated.

Results

Of the 304 patients included in the study, 72.7% were female and 27.3% were male. The mean cardiovascular risk value was 4.3 ± 6.2% according to the SCORE-Türkiye algorithm and 2.25 ± 3.1% according to the SCORE-Europe algorithm. Risk values calculated by both algorithms were significantly higher in men compared with

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women ($p<0.05$). No statistically significant difference was observed in mean risk scores among BMI categories.

Conclusion

Significant differences were observed between the SCORE-Türkiye and SCORE-Europe algorithms in terms of cardiovascular risk estimation. These findings highlight the importance of using country-specific mortality data in cardiovascular risk assessment. The use of risk models adapted to Türkiye is essential for more accurate risk estimation and for guiding appropriate preventive strategies.

Keywords: SCORE, Cardiovascular Risk Assessment Model, Screening Study

1. Introduction

Current recommendations and interventions aimed at preventing cardiovascular and coronary heart diseases have shifted from focusing on specific individual risk factors toward reducing an individual's total cardiovascular risk burden.1 This approach is consistent with the philosophy of personalized healthcare. Determining and monitoring an individual's overall risk rather than isolated risk factors facilitates the provision of sustainable and measurable personalized healthcare.

The SCORE project (The European Cardiovascular Disease Risk Assessment Model)2 was designed and developed based on this approach, with the initial objective of creating a cardiovascular risk calculation system applicable in clinical practice across Europe. The project was planned and implemented in three phases:3 (1) development of printed risk calculation charts for low-risk and high-risk populations within Europe; (2) development of a flexible, adaptable, and evidence-based calculation method based on mortality rates obtained from different countries and regions; and (3) conversion of the calculation tool into a computer-based digital application. During this development process, countries or regions categorized as "low risk" or "high risk" were classified according to total cholesterol levels and total cholesterol/HDL cholesterol ratios.

The data pool of the SCORE project was generated from cohort studies conducted in 12 different European countries. Most of these cohorts were population-based, while some were occupational cohorts.

As a result of these studies, printed SCORE charts were produced for "low-risk European countries/regions" and "high-risk European countries/regions."4 These printed SCORE charts can be described as two-dimensional. The third dimension of the calculation tool, HDL cholesterol, was assumed to be an estimated average value for all cases. Consequently, when a case with identical parameters is placed on different charts, varying risk percentages and risk levels may be obtained. Naturally, it is not feasible to integrate HDL cholesterol into a two-dimensional printed chart. For this reason, during the third development phase of the SCORE project, the calculation tool was converted into a computer-based digital version. The printed charts are intended to provide an approximate estimate of cardiovascular risk for cases in countries with different mortality profiles. For precise calculation of SCORE risk percentage and risk level, the use of the online calculation tool provided by the European Association of Preventive Cardiology (EAPC) is considered ideal.5

The present study aimed to calculate SCORE risk values in patients presenting to the Family Medicine Outpatient Clinic of Mersin University and to determine their cardiovascular risk status using this calculation tool. Risk values calculated according to both European and Turkish SCORE charts were analyzed in relation to body mass index. Within this context, the SCORE risk scoring model was discussed.

Materials and Methods

This study was conducted at the Department

Table 1. Distribution of cases according to body mass index and SCORE-Türkiye risk levels.

		Body Mass Index					
		18,5-24,9 (normal weight) n (%)*	25,0-29,9 (over weight) n (%)*	30,0-34,9 (grade-1 obese) n (%)*	35,0-39,9 (grade-2 obese) n (%)*	≥ 40 (grade-3 obese) n (%)*	Total n (%)*
SCORE risk level (Türkiye)	< % 1 (low risk)	9 (22,5)	31 (34,4)	20 (23,8)	15 (23,4)	9 (34,6)	84 (27,6)
	% 1-4 (medium risk)	17 (42,5)	31 (34,4)	43 (51,2)	25 (39,1)	10 (38,5)	126 (41,4)
	% 5-9 (high risk)	5 (12,5)	12 (13,3)	12 (14,3)	14 (21,9)	2 (7,7)	45 (14,8)
	≥ %10 (very high risk)	9 (22,5)	16 (17,8)	9 (10,7)	10 (15,6)	5 (19,2)	49 (16,1)
	Total	40 (100,0)	90 (100,0)	84 (100,0)	64 (100,0)	26 (100,0)	304 (100,0)

* column %

of Family Medicine, Faculty of Medicine, Mersin University, with the approval of the Mersin University Clinical Research Ethics Committee (decision dated 19/08/2022, number 582). Cases were selected from patient records of individuals who presented to the Family Medicine Outpatient Clinic between 01.08.2018 and 01.08.2020. Due to limitations in the thesis completion period, patient records covering a two-year period were reviewed.

The following cases were excluded: (1) patients younger than 40 years; (2) patients with conditions that independently placed them in the "high-risk" category regardless of other SCORE parameters, including uncomplicated diabetes mellitus, blood pressure > 180/110 mmHg, familial hyperlipidemia, and glomerular filtration rate (GFR) between 30–60 mL/min; and (3) patients with conditions that independently placed them in the "very high-risk" category, including complicated diabetes mellitus, established cardiovascular disease, history of cerebrovascular events, and GFR < 30 mL/min. Since the SCORE model was developed for individuals aged 40 years and older, patients younger than 40 years were excluded. Additionally, because the primary aim of the study was to determine cardiovascular risk in asymptomatic individuals, patients with the aforementioned comorbid conditions were excluded. Ultimately, data from 304 cases were included in the analyses.

Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared (kg/m^2). Patients were classified as normal weight (BMI 18.5–24.9), overweight (BMI 25.0–29.9), class I obese (BMI 30.0–34.9), class II obese (BMI 35.0–39.9), or class III obese (BMI ≥ 40). SCORE risk percentages were calculated using age, sex, systolic blood pressure, total cholesterol, HDL cholesterol, and smoking status. Risk percentages were calculated according to both the Turkish and European SCORE charts.

Statistical analyses were performed using IBM Statistics software. Descriptive data were expressed as number and percentage for categorical variables and as mean ± standard deviation for continuous variables, as appropriate. Fisher's exact test was used for comparisons of categorical variables. The distribution of continuous variables was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests. The Mann–Whitney U test and Kruskal–Wallis test were used for non-normally distributed continuous variables, while one-way ANOVA was used for normally distributed variables. A p-value < 0.05 was considered statistically significant.

Results

Of the 304 cases included in the study, 221 (72.7%) were female and 83 (27.3%) were male. The mean age of the participants was 52.9 ± 10.4 years (range: 40–77). The mean age was 52.4 ± 9.9 years (range: 40–77) for women and 54.2 ± 11.5 years (range: 40–76) for men. The majority of both female and male participants were in the 40–49 age group (43.4%).

Table 2. Distribution of cases by gender and SCORE risk level (according to the Turkish scoring system).

		Gender					
		Female		Male		Total	
		n	%*	n	%*	n	%*
SCORE risk level	< % 1 (low risk)	79	35,7	5	6,0	84	27,6
	% 1-4 (medium risk)	86	38,9	40	48,2	126	41,4
	% 5-9 (high risk)	31	14,0	14	16,9	45	14,8
	≥ %10 (very high risk)	25	11,3	24	28,9	49	16,1
	Total	221	100,0	83	100,0	304	100,0

* column %

The mean risk score was 4.4 ± 5.6 (range: 0–21) in normal-weight individuals, 4.0 ± 5.5 (range: 0-28) in overweight individuals, and 4.4 ± 6.7 (range: 0–44) in obese individuals (BMI ≥ 30) (Table 1). According to the SCORE-Türkiye model, no statistically significant difference was found among these three groups in terms of risk scores. In all three groups, the majority of individuals were classified in the moderate-risk category (42.5% of normal-weight, 31% of overweight, and 44.8% of obese individuals).

According to the Turkish SCORE chart, the mean risk value was 4.3 ± 6.2% (range: 0-44) (Table 2). The mean risk value was 3.3 ± 5.0% (range: 0-31) in women and 6.9 ± 8.2% (range: 0-44) in men, and this difference was statistically significant. The distribution of individuals across low-, moderate-, high-, and very high-risk groups was 27.6%, 41.4%, 14.8%, and 16.1%, respectively.

According to the European SCORE chart, the mean risk value was 2.25 ± 3.1% (range: 0–22) (Table 3). The mean risk value was 1.4 ± 1.9% (range: 0–12) in women and 4.4 ± 4.5% (range: 0–22) in men ($p < 0.05$). The distribution of individuals across low-, moderate-, high-, and very high-risk groups was 34.5%, 47.4%, 14.5%, and 3.6%, respectively.

Discussion

Cardiovascular diseases remain the leading cause of death among men aged over 40 years in European countries.6 According to the TEKHARF study, the prevalence of coronary heart disease was reported as 6% in the 45–54 age group, 17% in the 55–64 age group, and 28% in individuals aged 65 years and older.7 Cardiovascular mortality in Türkiye among individuals aged 40–65 years is among the highest compared with European countries.

Table 3. Distribution of cases by gender and SCORE risk level (according to the European scoring

system).

		Gender					
		Female		Male		Total	
		n	%*	n	%*	n	%*
SCORE risk level	< % 1 (low risk)	98	44,3	7	8,4	105	34,5
	% 1-4 (medium risk)	103	46,6	41	49,4	144	47,4
	% 5-9 (high risk)	19	8,6	25	30,1	44	14,5
	≥ %10 (very high risk)	1	0,5	10	12,0	11	3,6
	Total	221	100,0	83	100,0	304	100,0

* column %

In the present study, no statistically significant difference was found between normal-weight, overweight, and obese individuals in terms of mean cardiovascular risk scores. This finding differs from previous studies examining the relationship between obesity and cardiovascular risk. In a meta-analysis including 57 prospective studies and 900,000 adults, each 5-unit increase in BMI above 25 was associated with a 30% increase in all-cause mortality and an approximately 40% increase in cardiovascular mortality, while a marked reduction in mortality was observed in individuals with a BMI between 22 and 25.8

In our study, mean cardiovascular risk values calculated using the Turkish and European SCORE algorithms were 4.3% and 2.3%, respectively, indicating a marked difference between the two algorithms. According to the Turkish algorithm, 27.6% of individuals were classified as low risk and 16.1% as very high risk, whereas these proportions were 34.5% and 3.6%, respectively, according to the European algorithm.

The SCORE algorithm was developed using pooled data from prospective cohort studies conducted in 12 countries between 1972 and 1988 and was published as “the SCORE Project” in November 2002.3 This system estimates the 10-year risk of fatal cardiovascular disease based on sex, age, smoking status, systolic blood pressure, and total cholesterol levels. A major advantage of the SCORE system is its ability to provide risk calculations tailored to populations classified as low- or high-risk according to their cardiovascular risk profiles. The Turkish population is considered to be at high cardiovascular risk, and therefore the SCORE algorithm adapted for high-risk countries is recommended. Another important advantage of the SCORE system is that it allows recalibration based on country-specific mortality data. Using national mortality data, the SCORE-Türkiye algorithm was developed, and the printed SCORE-Türkiye charts have been published on the official website of the Turkish Society of Cardiology.9

Risk estimation using printed SCORE charts may be challenging, and meaningful differences in results may occur. For example, the total cholesterol thresholds of 230–270 mg/dL represent a difference of 40 mg/dL. Our observations indicate that such differences, although seemingly small, may result in a 1–2 point difference in cardiovascular risk scores, potentially shifting individuals from a 4% to 5% risk category or from 9% to 10%.

Differences between European, Turkish, and other high-risk country algorithms may lead to significantly higher indications for statin

therapy in high-risk populations. The exclusion of HDL cholesterol values from printed SCORE charts also raises concerns regarding the accuracy of risk assessment.

As the number of studies and cases in this field increases, the development and publication of new SCORE versions will be inevitable and appropriate. Given the differences in cardiovascular risk profiles among countries, significant variations may occur in calculation algorithms, risk estimates, and consequently in treatment and follow-up strategies. Therefore, it is recommended that larger and more systematic studies including Turkish populations be conducted to actively contribute to risk assessment models and to further refine country-specific algorithms.

Conflict of interest

The authors declare no conflict of interest.

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