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Cardiovascular risk assessment based on SCORE and SCORE2

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ABSTRACT

Introduction: The 2021 European Society of Cardiology (ESC) guidelines on cardiovascular disease prevention introduced significant changes compared to the previous 2016 edition. Particular attention should be paid to the stepwise approach to treating patients with cardiovascular risk factors, based on individual risk stratification. The SCORE scale previously recommended for risk assessment and its Polish adaptation Pol-SCORE have been replaced by SCORE2 and SCORE2-OP in the latest guidelines.

The aim of the study: The aim of this study is a parallel cardiovascular risk assessment with Pol-SCORE and SCORE2 in the same patient population.

Material and methods: The study included 159 patients aged 40 to 70 years without prior cardiovascular events that were diagnosed with hypertension or hypercholesterolemia between 6 and 24 months before the start of the study. Patients with diabetes mellitus, chronic kidney disease, and familial hypercholesterolemia were excluded from the study.

Results: The 10-year risk of cardiovascular event (SCORE2) was twice as high as the risk of cardiovascular death (Pol-SCORE). In the Pol-SCORE scale, most patients were at moderate risk (65.41%), while based in the SCORE2 scale the dominant group was in the low-to-moderate risk category (49.06%). Among the patients with moderate risk of cardiovascular death (Pol-SCORE), low-to-moderate, high, and very high CVD risk groups (SCORE2) were reported. In other cases, the risk assessments of cardiovascular death and cardiovascular event appear to be consistent. This observation is confirmed by the strong positive correlation ($R = 0.7493$; $p < 0.0001$) between the Pol-SCORE and SCORE2 scales.

Conclusions: Cardiovascular risk assessments based on the SCORE and SCORE2 scales are broadly consistent, but in individual cases, the results fall into radically different risk categories.

Key words: cardiovascular risk, SCORE, SCORE2

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Introduction

The presence of risk factors is associated with cardiovascular events occurrence. The INTERHEART study, whose results have been shown to be relevant for cardiovascular preventive measures, indicated nine independent factors influencing the risk of myocardial infarction [1]. The risk factors include lipid disorders, smoking, psychosocial factors, abdominal obesity, hypertension, and diabetes mellitus, while physical activity, fruit and vegetable consumption, and moderate alcohol consumption reduce this risk [1, 2].

Until recently, the instrument recommended by the European Society of Cardiology (ESC) to estimate individual 10-year risk of cardiovascular death was the Systemic Coronary Risk Estimation (SCORE) algorithm introduced in 2003 [3, 4]. It allows for risk estimation in people between 40 and 65 years of age. In 2015, a modified SCORE scale for the Polish population (aged 40 to 70 years) was published under a name of Pol-SCORE [5]. Last year, the new ESC guidelines introduced significant changes to the preferred cardiovascular risk assessment tools [6]. Two new models have been published to estimate individual 10-year risk

Table 1. Characteristics of the study population

Parameter		n	%
Age	50.73 ± 13.74		
Sex	Female	111	69.80
	Male	48	30.18
Hypertension	Yes	114	71.69
	No	45	28.31
Hypercholesterolemia	Yes	76	47.79
	No	83	52.21

Table 2. Comparison of the parameters of the Pol-SCORE and SCORE2 scales

Pol-SCORE	SCORE2
Sex	Sex
Age between 40 and 70 years	Age between 40 and 69 years
Systolic blood pressure	Systolic blood pressure
Total cholesterol (mmol/L or mg/dL)	Non-HDL cholesterol (mmol/L)
Smoking status	Smoking status

of fatal and non-fatal (myocardial infarction, stroke) cardiovascular disease (CVD) in apparently healthy people with risk factors that are untreated or have been stable for several years. These are the SCORE2 and SCORE2-OP scales. The SCORE2 scale is intended for people aged between 40 and 69 years, while the SCORE2-OP is used for risk assessment in people aged between 70 and 89 years [6–8].

The aim of this study is a parallel cardiovascular risk assessment with Pol-SCORE and SCORE2 in the same patient population.

Material and methods

The study included 159 patients aged 40 to 70 years without prior cardiovascular events that were diagnosed with hypertension or hypercholesterolemia between 6 and 24 months before the start of the study. Patients with diabetes mellitus, chronic kidney disease, and familial hypercholesterolemia were excluded from the study. The majority of participants were women (n = 111; 69.80%). The mean age of the patients was 51 (50.73 ± 13.74) years. Detailed characteristics of the study group are presented in Table 1.

The study used Pol-SCORE and SCORE2 scales to assess cardiovascular risk. To estimate the individual risk in both scales, the following biochemical tests were performed: total cholesterol (mg/dL), HDL cholesterol (mg/dL), LDL cholesterol (mg/dL), triglycerides (mg/dL), creatinine (mg/dL), GFR (mL/min/1.73m^2), and glucose (mg/dL), as well as the anthropometric examinations: height, body weight, and waist circumference. In addition, blood pressure and concentration of CO_2 in exhaled air were measured.

The study was approved by the Bioethics Committee of the Nicolaus Copernicus University in Toruń functioning at the Ludwik Rydygier Collegium Medicum in Bydgoszcz, Poland (KB 586/2017).

The Pol-SCORE scale uses information about the patient's age, sex, systolic blood pressure, total cholesterol, and smoking dependence to estimate the risk of cardiovascular death within 10 years. The risk assessed by Pol-SCORE allows for assigning patients into low (< 1%), moderate (≥ 1% and < 5%), high (≥ 5% and < 10%), or very high (≥ 10%) risk group [8].

The SCORE2 scale estimates 10-year fatal and non-fatal CVD risk in apparently healthy individuals under 70 years of age, that is in people without established atherosclerotic CVD, type 2 diabetes mellitus, or severe comorbidities such as chronic kidney disease and genetic or rare lipid or blood pressure disorders. SCORE2 divides patients into one of three categories of CVD risk: low-to-moderate, high, or very high. Interpretation of the result depends on the patient's age as the cut-off risk levels are numerically different for various age groups: low-moderate CVD risk (< 2.5% for < 50 years; < 5% for 50–69 years), high CVD risk (2.5% to < 7.5% for < 50 years; 5% to < 10% for 50–69 years), very high CVD risk (≥ 7.5% for < 50 years; ≥ 10% for 50–69 years). The scale was calibrated for four clusters of countries (low, moderate, high, and very high CVD risk). The clusters are defined based on national cardiovascular mortality rates published by the World Health Organization. Poland is in the high-risk cluster [8].

A detailed comparison between the parameters considered in cardiovascular risk assessment using the Pol-SCORE and SCORE2 scales is shown in Table 2.

The statistical analysis was carried out using the Statistica 13.0 package (TIBCO Software Inc, California, USA). Continuous variables were presented as means with standard deviations, medians with interquartile range, minimum and maximum value. The Shapiro-Wilk test demonstrated non-normal distribution of the investigated continuous variables. Therefore, non-parametric tests were used for statistical analysis. For comparisons of medians between groups the Kruskal–Wallis one-way analysis of variance was used. To assess the relationship between two quantitative variables, Spearman's rank correlation was used. Categorical variables were expressed as the number and the percentage and were compared using the $\chi 2$ test. Results were considered significant at $p < 0.05$.

Table 3. Descriptive statistics of the Pol-SCORE and SCORE2 scales

	N	Mean	SD	ME	Q1	Q3	Min	Max
Pol-SCORE	159	2.86	4.50	2.00	1.00	3.00	0.00	28.00
SCORE 2	159	6.11	7.24	4.00	1.00	7.00	1.00	44.00

Table 4. Comparative analysis of the Pol-SCORE and SCORE2 scales

Scale	Risk	n	%
Pol-SCORE	Low	31	19.50
	Moderate	104	65.41
	High	12	7.55
	Very high	12	7.55
SCORE2	Low-to-moderate	78	49.06
	High	65	40.88
	Very high	16	10.06

Table 5. Percentage analysis of the Pol-SCORE and SCORE2 scales ($p < 0.0001$)

Risk			Pol-SCORE				p
			Low	Moderate	High	Very high	
SCORE2	Low-to-moderate	n	27	49	0	2	< 0.0001
		%	87.10%	47.12%	0.00%	16.67%	
	High	n	4	53	7	1	
		%	12.90%	50.96%	58.33%	8.33%	
	Very high	n	0	2	5	9	
		%	0.00%	1.92%	41.67%	75.00%	

Results

The 10-year mortality risk (Pol-SCORE), as well as the risk of cardiovascular event defined as fatal and non-fatal (myocardial infarction, stroke) CVD (SCORE2), were within a very wide range, with the risk of an event more than twice as high as the risk of death (Tab. 3).

According to the Pol-SCORE scale, most patients were at moderate risk (65.41%), while based on the SCORE2 scale the dominant group was in the low-to-moderate risk category (49.06%) (Tab. 4).

A parallel risk assessment with Pol-SCORE and SCORE2 (Tab. 5) showed that the vast majority of patients whose risk of cardiovascular event in the SCORE2 scale was low-to-moderate were also within the range of low or moderate risk of cardiovascular death in the Pol-SCORE scale. However, a number of individuals with a low risk of cardiovascular event (SCORE2) were diagnosed with a very high risk of death (Pol-SCORE). Among the patients with moderate risk of cardiovascular death (Pol-SCORE), low-to-moderate, high, and very high CVD risk groups (SCORE2) were reported (Tab. 5). In other cases, the risk assessments of cardiovascular death and cardiovascular event appear to be consistent. The differences in the distribution of risk assessment results between groups were statistically significant ($p < 0.0001$) (Tab. 5).

Apart from the observed inconsistencies in individual risk estimation between the two scales, it was noted that the mean CVD risk score in SCORE2 increased across the Pol-SCORE ranges from low to very high risk of cardiovascular death ($p < 0.0001$) (Tab. 6).

This observation is confirmed by the strong positive correlation ($R = 0.7493$; $p < 0.0001$) between the Pol-SCORE and SCORE2 scales (Fig. 1).

Discussion

The 2021 ESC guidelines on cardiovascular disease prevention [6] introduced significant changes compared to the previous 2016 edition [4]. Particular

Table 6. Analysis of risk scores in the Pol-SCORE and SCORE 2 scales ($p < 0.0001$)

Pol-SCORE	SCORE2								p*
	N	Mean	SD	ME	Q1	Q3	Min	Max	
Low	31	1.61	1.20	1.00	1.00	2.00	1.00	5.00	< 0.0001
Moderate	104	4.50	3.41	4.00	2.00	6.00	1.00	23.00	
High	12	15.75	4.99	16.00	11.50	20.00	8.00	23.00	
Very high	12	22.08	12.43	19.50	18.00	30.50	1.00	44.00	

*for median comparison

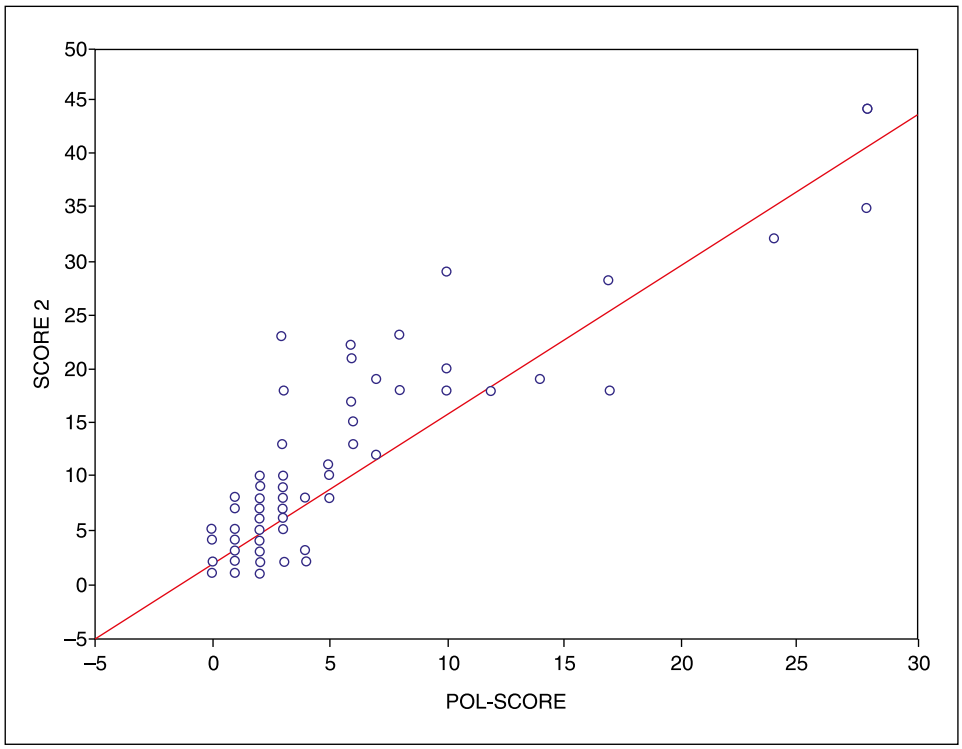

Figure 1. Correlation of the Pol-SCORE and SCORE2 scales

attention should be paid to the stepwise approach to treating patients with cardiovascular risk factors, based on individual risk stratification. The SCORE scale [3, 4] previously recommended for risk assessment and its Polish adaptation Pol-SCORE [5] have been replaced by SCORE2 and SCORE2-OP in the latest guidelines [6–8]. We operated under the assumption that patients should remain in their respective risk categories regardless of changing the risk assessment method. Our parallel risk assessment with the use of Pol-SCORE and SCORE2 showed a strong positive correlation between the results in both scales. However, significant differences were noted in individual cases, including instances where the results fell into radically different risk categories.

The interpretation of these differences is not obvious, since the replacement of the SCORE scale [4] with the SCORE2 scale is the result of a fundamental change of concept: the assessment of the risk of cardiovascular death was replaced by one of a cardiovascular event, which not only includes death but also myocardial infarction and stroke [6]. In addition, the age range for risk assessment has been expanded: while SCORE covered persons aged between 40 and 65 years (with some margin of error it could have been used in those aged between 35 and 70 years), the new SCORE2 scale, by the use of an additional module SCORE2-OP, allows for a risk assessment up to the age of 90 years [6, 8]. Under the new system, the risk assessment is based on, among others non-HDL cholesterol and not on total cholesterol, which is also a significant change from its predecessor. Another difference between SCORE and SCORE2 is the different risk categorization as instead of four levels, three were introduced: low-to-moderate, high, and very high [3, 4, 6, 7].

The individual risk assessment is the starting point for setting the treatment targets as well as for the initiation or the possible intensification of treatment [6, 9–11]. This stepwise approach is intended to help physicians

and patients achieve their treatment targets, accounting for the individual risk profiles and preferences of patients. Successful implementation of the treatment plan, expressed by a high adherence of patients to therapy, is to be ensured by education and motivation of patients and joint treatment decision-making between healthcare professionals and patients [12–17]. This aspect of preventive measures appears to be particularly important as previous studies have shown that treatment failures both in primary and secondary prevention are due to the decreasing implementation of the treatment plan over time [18–28].

Patients with established atherosclerotic CVD, type 2 diabetes mellitus, and other specific risk factors — in particular patients with chronic kidney disease and familial hypercholesterolemia — are considered high risk by definition and therefore require preventive treatment. Whereas in the case of apparently healthy individuals the ESC guidelines [6] recommend initiating and possibly intensifying preventive treatment based on an individual cardiovascular risk assessment performed with the use of SCORE2 and SCORE2-OP and considering patients' age [7, 8].

The new ESC guidelines [6] are an important and needed document, although they raise controversies and discussions. The differences in results of the cardiovascular risk assessment are undoubtedly part of this discussion. However, it should be noted that, according to current guidelines, the intensity of treatment should increase with the increase in cardiovascular risk, but no risk threshold so low as to preclude treatment of risk factors has been identified. Similarly, no cardiovascular risk threshold has been defined that would imply "compulsory" treatment [6].

The main limitation of our project is the limited number of people enrolled in the study and the lack of follow-up observations.

Conclusions

Cardiovascular risk assessments based on the SCORE and SCORE2 scales are broadly consistent, but in individual cases, the results fall into radically different risk categories.

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