УДК: 616.12.13 https://doi.org/10.47526/YJoHS-2025.1-11

ESTIMATING THE PREDICTIVE VALUE OF THE CARDIOVASCULAR DISEASE RISK MODEL “SCORE” AMONG THE KAZAKH PEOPLE

Saruarov Y.
Khoja Akhmet Yassawi International Kazakh-Turkish University, Turkistan, Kazakhstan

Abstract. Kazakhstan is the country with a high risk of cardiovascular diseases (CVDs) and one of the main reasons for this is the lack of early detection of the risk of CVDs. In this regard, the purpose of our study is to show the reliable CVD risk scale “SCORE” for determining the risk of CVDs, which are widely used in the world.

660 patients participated in the cohort study from 2012 to 2014 and 2019-2020. The diagnostic value and accuracy of SCORE was assessed using ROC/AUC analysis and Pearson correlation test. From these researchers, the main indicators of the scales for determining the risk of CVDs and changes in other risk factors based on 10-year dynamics were analyzed. AUC of SCORE risk score increased. Namely, AUC of SCORE model elevated from 0.88 in 2012 to 0.92 in 2020. The Pearson correlation rate was in the range 0.996 for following model with a p-value≤0.05. The proportion of the high-risk group was increased from 2.5% in 2012 to 4.4% in 2020. Predictive value of SCORE was investigated, and their accuracy was increased.

Keywords: SCORE, cardiovascular disease, risk score, predictive value, Kazakh population.

Қазақтар арасында жүрек-қан тамыр ауруларының қауіптілігін анықтаушы модел “SCORE”-нің диагностикалық құндылығына баға беру

Саруаров Е.
Қожа Ахмет Ясауи атындағы Халықаралық қазақ-түрік университеті, Түркістан қ., Қазақстан

Аңдатпа. Қазақстан жүрек-қан тамыр ауруларының (ЖҚА) даму қаупі жоғары ел болып табылады, және оның негізгі себептерінің бірі – ЖҚА қаупінің ерте анықталмауы. Осыған байланысты біздің зерттеуіміздің мақсаты – әлемде кеңінен қолданылатын ЖҚА қаупін анықтау үшін қолданылатын «SCORE» қауіптілік шкаласының диагностикалық құндылығына баға беру.

2012-2014 және 2019-2020 жылдар аралығында когорттық зерттеуге 660 респондент қатысты. SCORE диагностикалық мәні мен дәлдігі ROC/AUC талдауы және Пирсон корреляция сынағы арқылы бағаланды. Осы зерттеушілерден 10 жылдық динамикаға негізделген ЖҚА қаупін және басқа қауіп факторларының өзгеруін анықтауға арналған шкалалардың негізгі көрсеткіштері талданды. SCORE қауіптілік шкаласының AUC көрсеткіші жоғарылады. Атап айтқанда, SCORE моделінің AUC мәні 2012 жылы 0,88-ден 2020 жылы 0,92-ге дейін көтерілді. Пирсон корреляция коэффициенті көрсеткішінің p-мәні≤0,05-ке тең, және берілген үлгі үшін 0,996 диапазонында болды. Тәуекел тобының үлесі 2012 жылғы 2,5%-дан 2020 жылы 4,4%-ға дейін өсті. SCORE қауіптілік шкаласының болжамдық мәндері зерттеліп, олардың дәлдігі айқындалды.

Түйін сөздер: SCORE, жүрек-қан тамыр жүйесі аурулары, қауіптілік шкаласы, диагностикалық құндылығы, қазақ популяциясы.

Оценка прогностической ценности модели риска сердечно-сосудистых заболеваний "SCORE" среди казахов

Саруаров Е.
Международный казахско-турецкий университет имени Ходжа Ахмеда Ясави,
г.Туркестан, Казахстан

Аннотация. Казахстан относится к странам с высоким риском сердечно-сосудистых заболеваний (ССЗ), и одной из основных причин этого является отсутствие раннего выявления риска ССЗ. В связи с этим, цель нашего исследования – продемонстрировать надежность шкалы риска ССЗ «SCORE» для определения риска ССЗ.

В когортном исследовании приняли участие 660 пациентов в период с 2012 по 2014 и с 2019 по 2020 годы. Диагностическая ценность и точность шкалы SCORE оценивались с помощью ROC/AUC-анализа и корреляционного теста Пирсона. По данным исследований, были проанализированы основные показатели шкал определения риска ССЗ и динамика других факторов риска на основе 10-летней динамики. AUC шкалы риска SCORE увеличилась. А именно, AUC модели SCORE увеличилась с 0,88 в 2012 году до 0,92 в 2020 году. Коэффициент корреляции Пирсона для данной модели находился в диапазоне 0,996 при p-значении ≤ 0,05. Доля группы высокого риска увеличилась с 2,5% в 2012 году до 4,4% в 2020 году. Прогностическая ценность SCORE была исследована, и ее повышенная точность была определена.

Ключевые слова: SCORE, сердечно-сосудистые заболевания, оценка риска, прогностическая ценность, казахская популяция.

Introduction. The social significance of cardiovascular diseases (CVDs) in population health is undoubtedly huge and they occupy first place among all other diseases globally [1]. Traditionally, in order to make an accurate diagnosis and treatment, patients must undergo a series of procedures and tests. However, conventional tests aimed at detecting the disease at an early stage may reduce the number of procedures in the assessment of the risk of CVDs.

Evaluation of the risk of cardiovascular events is challenging for clinicians due to multiple factors. Without risk calculators, physicians have been shown to overestimate risk by a factor of 2-6 [2]. However, more recent studies show that doctors working without a risk calculator assign patients to the appropriate risk categories in 59-71% of cases [3,4]. It is also difficult for patients to assess the degree of risk of cardiovascular pathology. If we define a high 10-year CVD risk above 20% and a low risk below 20%, then about four out of five high-risk patients underestimate their risk, and one in five low-risk patients overestimate their risks [5].

Current guidelines for primary prevention of CVD prioritize risk identification, mainly through traditional CVD risk factors, and risk stratification using clinical scores and risk assessments [6-10]. Researchers in the field have developed, and validated, multivariate risk prediction tools that synthesize information on CVD risk factors to predict future cardiovascular complications in various populations [10,11]. Since CVD is a long asymptomatic phase, from its clinical form to subclinical manifestations, the expansion of predictive studies of cardiovascular pathology has been supported [12]. The synergistic effect of several risk factors is greater than the effect of each risk factor in increasing overall cardiovascular risk. Therefore, calculating the overall risk of CVD is more important than identifying risk factors one at a time [13].

As a result, several clinical tools for predicting CVD have been developed, and the most commonly used are the SCORE risk score for European countries [6].

The use of risk assessments in clinical practice varies widely and often falls short of expectations [14-16]. The impact of applying these risk assessments in clinical practice is almost completely unknown, although their use is recommended in various national guidelines. The validation and impact of most predictive models have not been evaluated and there is a great need for such studies [17]. Similar studies assessing the risks of CVD using the SCORE model for the

Kazakh population were not conducted. Although the SCORE scale is recommended in national guidelines and introduced as a standard by order of the Ministry of Health of Kazakhstan for the use of the second stage of preventive medical examinations. Thus, the purpose of this study is to determine the diagnostic value and accuracy of CVD risk scales in the Kazakh population in accordance with the SCORE scale. This study also aims to evaluate the accuracy of the cardiovascular disease risk model of SCORE among the Kazakh population in the 8-year period. Moreover, the correlation of risk groups (low, medium and high) in the beginning and end of study timeframes was investigated.

Methods. The study was conducted at the Clinical Diagnostic Center of the Khoja Akhmet Yassawi International Kazakh-Turkish University (Turkistan city, Kazakhstan) in the period of 2012-2014 and 2019-2020. Due to the death of 28 participants, the final sample for this study included 632 participants (Figure 1). The age variable was divided into five categories: under 40 years old, 40-49 years old, 50-59 years old and 60-69 years old. The inclusion criteria for the study were age 18-69 years and written informed consent to participate in the study, whereas the participants of age over 69 years were excluded.

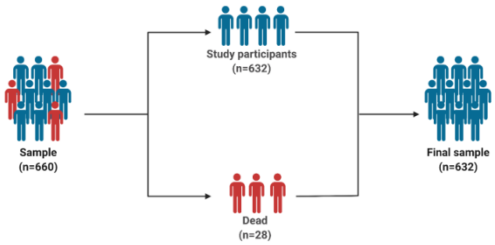

Figure 1. Formation of the final sample (Created with BioRender.com)

Data on study participants were collected in a patient survey card that contained a summary of the study, a written voluntary informed consent form, passport and demographic data, questionnaires on smoking, alcohol consumption, physical activity and stress, as well as anthropometric and laboratory studies.

The Fagerstrom test was used as a questionnaire to determine smoking status, and the Alcohol Use Disorders Identification Test (AUDIT) questionnaire was used for alcohol. The level of physical activity was determined according to the International Physical Activity Questionnaire (IPAQ), and patients were divided into three groups – with low, medium and high physical activity. According to the results of the Perceived Stress Questionnaire (PSQ) to determine the level of stress, among the study participants, were identified individuals with low, moderate and significant levels of stress.

The anthropometric study determining height, weight for which BMI was calculated. Laboratory research methods included the determination of total cholesterol, triglycerides, high-density lipoprotein (HDL) and low-density lipoprotein (LDL). Blood sampling was carried out from the cubital vein after a 12-hour fast. Biochemical studies were determined in the biochemical analyzer Cobas Integra-400 from Roche (Germany). The listed laboratory studies were carried out in the laboratory of the Clinical Diagnostic Center of Khoja Akhmet Yassawi International Kazakh-Turkish University.

Assessment of the accuracy of all risk score models was achieved using the values of the receiver operating characteristic (ROC) curve and calculating the area under the ROC curve (AUC). Pearson correlation coefficient was used to test the association between the risk scores in 2012 and 2020 for SCORE, significant if p-value$\leq$0.05.

This study was approved by the Commission on Clinical Ethics of the Faculty of Medicine of Khoja Akhmet Yassawi International Kazakh-Turkish University. Before attending the study, participants were provided with personal explanations regarding the purpose and method of the study, as well as information regarding the processing of the results. The written consent was achieved.

Results. The socio-demographic characteristics of the subjects are depicted in Table 1. The age of the respondents ranges from 27 to 69 years with a mean age of 51.2 ± 11.7 years. The study sample was dominated by women (69.9%), persons of Kazakh nationality (89.2%), patients with higher/incomplete higher education (64.8%), civil servants (72.7%), and married (89.3%) participants. Among patients, 13.4% smoked, 25.8% drank alcohol, 17.7% engaged in an average level of physical activity, 59.7% had a moderate degree of stress, 34.4% and 39.8% were overweight and obese, respectively.

Table 1. Social and demographic characteristics of the study participants (n=632)

No	Parameters		Number	Proportion, %
1	Gender	males	190	30.1
		females	442	69.9
2	Age	under 40	125	19.8
		40-49 years	152	24.1
		50-59 years	190	30.1
		60-69 years	165	26.0
3	Nationality	Kazakhs	564	89.2
		Others	68	10.8
4	Education	higher/incomplete higher	409	64.8
		average/below average	223	35.2
5	Occupation	civil servants/students	459	72.7
		private sector worker/entrepreneur	166	26.2
		unemployed (able or unable to work) / housewife / retired	7	1.1
6	Marital status	married	564	89.3
		single/divorced/widower	68	10.7
7	Smoking	yes	85	13.4
		no	547	86.6
8	Alcohol consumption	yes	163	25.8
		no	469	74.2
9	Physical activity	low	465	73.6
		average	112	17.7
		high	55	8.7
10	BMI	normal BMI	163	25.8
		overweight	218	34.4
		obese (I, II, III degrees)	251	39.8
11	Degree of stress	low	128	20.3
		average	377	59.7
		high	127	20.0

The accuracy of risk score model was assessed using the values of ROC and calculating the area under the curve. So, for the SCORE CODE at the beginning of the study period, AUC was 0.88 (95% CI, 0.22 – 0.94), whereas this value increased to 0.92 (95% CI, 0.19 – 0.94) in 2020 (Figure 2).

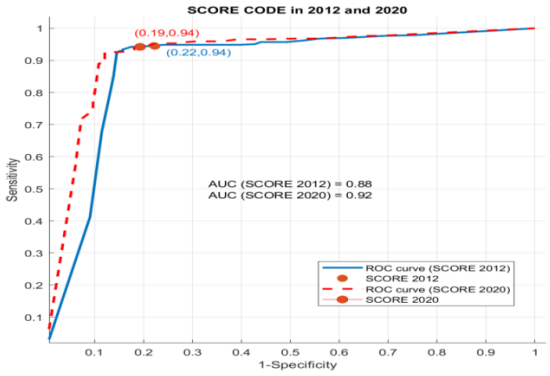

Figure 2. ROC curves and AUC values of risk score "SCORE" in 2012 and 2020

The Pearson correlation coefficients between the SCORE risk scores scales are displayed in Table 3. All risk scales correlated significantly with each other. The correlation rate was 0.996 for all scales with a p-value≤0.05. Also, it should be noted that the transition from low risk to medium risk and medium risk to high risk was observed from 2012 to 2020. Namely, in the SCORE scale, the proportion of high risk was increased from 2.5% in 2012 to 4.4% in 2020.

Table 3. Pearson correlation coefficients between SCORE risk score scales

Scales	2012	2020	correlation	p-value
SCORE	*n* (%)	*n* (%)		
Low risk (0-4%)	516 (81.6)	466 (73.7)		
Medium risk (4-9%)	100 (15.8)	138 (21.8)	0.996	0.054
High risk (≥10%)	16 (2.5)	28 (4.4)		

Discussion. In this study, we assessed the accuracy of the most common cardiovascular disease risk score model among the Kazakh ethnicities. SCORE model accuracy increased slightly from 2012 to 2020.

Nonetheless, according to the values of the area under the ROC curve, the most accurate result in 2020 was observed in the SCORE model. Also, in the SCORE scale, low-, medium- and high-risk groups outcomes in 2012 correlated significantly with the results of cardiovascular disease risk scores in 2020. The use of ROC/AUC for the evaluation of the accuracy of risk scores was demonstrated in the studies of Cooper et al. [18] and Versteylen et al. [19].

There are multiple contributing risk factors to the progression of cardiovascular diseases, and alcohol consumption [20], smoking [21] and body mass index [22] are not the exception. Especially, alcohol intake had the strongest relationship to the outcomes of all risk models. Based on our findings, the presence of cardiovascular diseases did also affect the values of the regression model of the scoring scales. Among the CVD parameters, BMI had the weakest relationship to the results of SCORE model in this study.

Among the limitations of the study, it should be noted that the predisposing risk factors for cardiovascular diseases were not investigated in terms of gender, although it was out of the scope of this study. Moreover, the predictive value of risk score models was irrespective of gender in the study of Hence et al. [23]. Also, long-term follow-up will be needed to identify the best predictive value among the compared risk models.

The study was limited by the application of SCORE risk model, and other risk scores such as SMART and Diamond-Forrester (DF) were not used. They could also provide the variability for doctors in the prediction of cardiovascular events, especially in patients with atherosclerosis, which

was assessed by SMART score in the study of Uthoff et al. [24], whereas the performance of updated DF was compared in the predicting obstructive coronary artery disease by Baskaran et al. [25].

Recent studies have shown that the compared risk models are effective across various populations in predicting relative and absolute risks of cardiovascular events [18,19,23]. Similarly, the accuracy of the predictive values of SCORE model among the Kazakh population in the risk of CVDs was increased. A strong correlation of low- to high-risk groups was observed at the beginning and end of the study period.

Conclusion: The predictive value of the SCORE risk scale were investigated and their accuracy was determined for Kazakh population.

References

1. Roth GA, Mensah GA, Johnson CO, Addolorato G, Ammirati E, Baddour LM, Barengo NC, et al. Global Burden of Cardiovascular Diseases and Risk Factors, 1990–2019: Update From the GBD 2019 Study. Journal of the American College of Cardiology 2020;76(25):2982-3021 https://doi.org/10.1016/j.jacc.2020.11.010.

2. Grover SA, Lowensteyn I, Esrey KL, et al. Do doctors accurately assess coronary risk in their patients? Preliminary results of the Coronary Health Assessment Study. BMJ 1995; 310:975-978.

3. Sposito AC, Ramires JA, Jukema JW, et al. Physicians' attitudes and adherence to use of risk scores for primary prevention of cardiovascular disease: cross-sectional survey in three world regions. Curr Med Res Opin 2009; 25:1171-1178.

4. McManus RJ, Mant J, Meulendijks CF, et al. Comparison of estimates and calculations of risk of coronary heart disease by doctors and nurses using different calculation tools in general practice: cross sectional study. BMJ 2002; 324:459-464.

5. van der Weijden T, van Steenkiste B, Stoffers HE, et al. Primary prevention of cardiovascular diseases in general practice: mismatch between cardiovascular risk and patients' risk perceptions. Med Decis Making 2007; 27:754-761.

6. Piepoli MF, Hoes AW, Agewall S, Albus C, Brotons C, Catapano AL, Cooney MT, Corrà U, Cosyns B, Deaton C et al. Guidelines: Editor's choice: 2016 European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts) Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR). Eur. Heart J. 2016, 37, 2315.

7. Stone NJ, Robinson JG, Lichtenstein AH. 2013 ACC/AHA guideline on the treatment of blood cholesterol to reduce atherosclerotic cardiovascular risk in adults: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Circulation 2014, 129 (Suppl. 2), S1–S45.

8. Goff DC Jr, Lloyd-Jones DM, Bennett G. 2013 ACC/AHA guideline on the assessment of cardiovascular risk: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Circulation 2014, 129 (Suppl. 2), S49–S73.

9. Bibbins-Domingo K, Grossman DC, Curry SJ, Davidson KW, Epling JW, García FA, Gillman MW, Kemper AR, Krist AH, Kurth AE, et al. Statin Use for the Primary Prevention of Cardiovascular Disease in Adults: US Preventive Services Task Force Recommendation Statement. JAMA 2016, 316, 1997–2007.

10. Singh SS, Pilkerton CS, Shrader CD, Frisbee SJ. Subclinical atherosclerosis, cardiovascular health, and disease risk: Is there a case for the Cardiovascular Health Index in the primary prevention population? BMC Public Health 2018, 18, 429.

11. Li F, Wang X. Relationship between Framingham risk score and subclinical atherosclerosis in carotid plaques: An in vivo study using multi-contrast MRI. Sci. China Life Sci. 2017, 60, 23–27.

12. Simon A, Levenson J. May subclinical arterial disease help to better detect and treat high-risk asymptomatic individuals? J. Hypertens. 2005, 23, 1939–1945.

13. Cooney MT, Dudina AL, Graham IM (2009). Value and limitations of existing scores for the assessment of cardiovascular risk. Journal of American College of Cardiology, 54(14), 1209–1227.

14. D'Agostino RB, Vasan RS, Pencina MJ, Wolf PA, Cobain M, Massaro JM, Kannel WB. General cardiovascular risk profile for use in primary care: The Framingham heart study. Circulation 2008, 117, 743–753.

15. Assmann G, Cullen P, Schulte H. Simple scoring scheme for calculating the risk of acute coronary events based on the 10-year follow-up of the prospective cardiovascular Munster (PROCAM) study. Circulation 2002; 105: 310-5.

16. Aspelund T, Thorgeirsson G, Sigurdsson G, Gudnason V (2007). Estimation of 10-year risk of fatal cardiovascular disease and coronary heart disease in Iceland with results comparable with those of the Systematic Coronary Risk Evaluation Project. European Journal Cardiovascular Preventive Rehabilitation, 14, 761-768.

17. Van Dieren SW, Beulens JW J, Kengne AP, Peelen LM (2012). Predictions models for the risk of cardiovascular disease in patient with type 2 diabetes: A systematic review. Heart, 98(5), 360-369.

18. Cooper JA, Miller GJ, Humphries SE. A comparison of the PROCAM and Framingham point-scoring systems for estimation of individual risk of coronary heart disease in the Second Northwick Park Heart Study. Atherosclerosis 2005;181(1):93-100.

19. Versteylen MO, Joosen IA, Shaw LJ, Narula J, Hofstra L. Comparison of Framingham, PROCAM, SCORE, and Diamond Forrester to predict coronary atherosclerosis and cardiovascular events. J. Nucl. Cardiol. 18, 904 (2011). https://doi.org/10.1007/s12350-011-9425-5.

20. Piano MR. Alcohol's Effects on the Cardiovascular System. Alcohol Res. 2017;38(2):219-241.

21. Banks E, Joshy G, Korda RJ, Stavreski D, Soga K, Egger S, Day C, Clarke NE, Lewington S, Lopez AD. Tobacco smoking and risk of 36 cardiovascular disease subtypes: fatal and non-fatal outcomes in a large prospective Australian study. BMC Med 17, 128 (2019). https://doi.org/10.1186/s12916-019-1351-4.

22. Susanna C Larsson, Magnus Bäck, Jessica M B Rees, Amy M Mason, Stephen Burgess, Body mass index and body composition in relation to 14 cardiovascular conditions in UK Biobank: a Mendelian randomization study, European Heart Journal, Volume 41, Issue 2, 7 January 2020, Pages 221–226, https://doi.org/10.1093/eurheartj/ehz388.

23. Hans-Werner Hense, Helmut Schulte, Hannelore Löwel, Gerd Assmann, Ulrich Keil, Framingham risk function overestimates risk of coronary heart disease in men and women from Germany—results from the MONICA Augsburg and the PROCAM cohorts, European Heart Journal, Volume 24, Issue 10, 1 May 2003, Pages 937–945, https://doi.org/10.1016/S0195-668X(03)00081-2.

24. Uthoff; Staub; Socrates; Meyerhans; Bundi; Schmid; Frauchiger. PROCAM-, FRAMINGHAM-, SCORE- and SMART-risk score for predicting cardiovascular morbidity and mortality in patients with overt atherosclerosis. Vasa 2010;39(4):325-333.

25. Baskaran L, Danad I, Gransar H, Hartaigh BÓ, Schulman-Marcus J, Lin FY, Peña JM, Hunter A, Newby DE, Adamson PD, Min JK. A Comparison of the Updated Diamond-Forrester, CAD Consortium, and CONFIRM History-Based Risk Scores for Predicting Obstructive Coronary Artery Disease in Patients With Stable Chest Pain: The SCOT-HEART Coronary CTA Cohort. J Am Coll Cardiol Img. 2019 Jul, 12 (7_Part_2) 1392–1400.

Saruarov Yerbolat Galymzhanuli, MD, PhD, Head Secretary of the Faculty of Medicine, Khoja Akhmet Yassawi International Kazakh-Turkish University, Turkistan city, Republic of Kazakhstan. Phone: +7 775 897 2891, e-mail: yerbolat.saruarov@ayu.edu.kz, ORCID: https://orcid.org/0000-0002-1786-5209