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Express assessment of the risk of cardiovascular diseases in people in the second half of middle age, as a means of pre-diagnostic evaluation and prediction of the effectiveness of rehabilitation measures

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Abstract

Purpose. The study is aimed at rapid assessment of cardiovascular disease risk in middle-aged individuals and is relevant from the perspective of modern physical culture and sports rehabilitation, as it promotes early intervention, optimization of rehabilitation measures, and prevention of cardiovascular disease progression. The useful model is designed for rapid diagnosis of cardiovascular disease risk in middle-aged individuals based on an integrated assessment of physiological, hemodynamic, metabolic, and psychoemotional indicators in women aged 36–45. The model is intended for use in sports medicine, physical education and sports rehabilitation, as well as in fitness programs to determine initial conditions and predict the effectiveness of rehabilitation measures. Purpose: develop an express assessment of the risk of developing cardiovascular diseases in middle-aged individuals in order to identify initial disturbances in the functional state of the cardiovascular system and predict the effectiveness of rehabilitation measures.

Material & Methods. The study was conducted at the Women's Health School, with 79 women aged 36-45 participating. The model was constructed using regression analysis based on data obtained from the study of women. It includes only those indicators that have been found to have a statistically significant impact on the risk of cardiovascular disease.

Results. To develop a model for rapid diagnosis of cardiovascular disease (CVD) risk in middle-aged women, we used stepwise multiple linear regression. The final model included five indicators that simultaneously had a strong statistical association with CVD risk, represented different areas of functional multistate regulation, and did not show collinearity with each other. To create an interpretive scheme of CVD risk levels based on the constructed regression model, a combined approach was used, which relies on both the actual values of the CVD risk assessment scale and the logic of calculating the regression level. The study used a validated tool that provides a gradation of CVD risk on a point scale: minimal risk – up to 21 points, apparent risk - 22-28 points, detected risk - 29-35 points, maximum risk – 36 points and above. For each risk level, typical predictor values were selected that correspond to the clinically reliable profile of a woman in the second period of mature age. Confirmation of typical average values of body mass index, systolic blood pressure, cervical curvature depth, and anxiety level

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(SHTlich) for each category allowed us to obtain predicted risk level values that closely match the limits defined in the original scale.

Conclusions. The high prevalence of modified risk factors indicates the presence of preclinical conditions and justifies the need for early implementation of preventive and rehabilitative measures. Express assessment of cardiovascular disease risk in the second period of adulthood is an informative and practically accessible method for early detection of initial functional disorders of the cardiovascular system and stratification by cardiovascular risk level. Statistically significant correlations between rapid risk assessment indicators and functional parameters of the cardiovascular system confirm the prognostic value of this approach for assessing the initial functional status of women in the second period of middle age.

Keywords: second period of mature age, cardiovascular risk, utility model, physical education and sports rehabilitation.

Introduction

The steady increase in the prevalence of cardiovascular diseases (CVD) among middle-aged individuals leads to a decline in quality of life, working capacity, and an increase in disability rates (Sirenko, 2018; World Health Organization 2023; Ruban, 2025; Fedynak & Vypasyak, 2025). At the initial stage of ontogenesis, asymptomatic disorders of the functional state of the cardiovascular system often develop, which remain undiagnosed and are not corrected in a timely manner (Diachuk, 2019; Mitchenko, 2020; Visseren & Mach, 2021; Kovtun, 2023). With the growing need for preventive and rehabilitative measures, the use of accessible, rapid, and informative methods for rapid assessment of cardiovascular risk is becoming particularly important (Karwa, 2024; Kashuba & Ruban, 2025). The development and implementation of such methods will allow for the rapid identification of individuals at increased risk (Gur'ieva & Pogorelova, 2021; Sureshbabu & Vasipalli, 2025), the individualization of rehabilitation programs and the prediction of their effectiveness; ensure preliminary assessment of individual CVD risk without the use of complex laboratory or instrumental methods, which is especially important for mass preventive examinations, dispensary observation, or the initial stage of physical culture and sports rehabilitation (Isaeva, 2019; Kashuba & Ruban, 2025).

The useful model developed is intended for rapid diagnosis of CVD risk in middle-aged individuals based on an integrated assessment of physiological, hemodynamic, metabolic, and psychoemotional indicators in women aged 36–45. The model is intended for use in family medicine, sports medicine, physical education and sports rehabilitation, as well as in fitness programs to determine initial conditions and predict the effectiveness of rehabilitation measures (Kashuba & Ruban, 2025).

The implementation of the proposed model provides a quick and accessible assessment of CVD development without the need for complex laboratory or hardware equipment. This facilitates the identification of women at increased risk of CVD for further in-depth examination or inclusion in a corrective and preventive program. The use of a set of simple measurements (anthropometry, blood pressure, heart rate, and anxiety assessment questionnaires) allows for a comprehensive assessment of physical, psycho-emotional, and hemodynamic status, which will help to individualize rehabilitation or prevention programs. It can be used in mass screening programs and sports clubs. All this will contribute to improving the effectiveness of physical and sports rehabilitation through early detection of disorders in the regulation of the cardiovascular system. Therefore, research aimed at rapid assessment of CVD risk in middle-aged individuals is relevant from the perspective of modern physical and sports rehabilitation, as it promotes early intervention, optimization of rehabilitation measures, and prevention of the progression of cardiovascular pathology.

The **purpose of the study:** develop an express assessment of the risk of developing cardiovascular diseases in middle-aged individuals in order to identify initial disturbances in the functional state of the cardiovascular system and predict the effectiveness of rehabilitation measures.

Material and Methods

Participants

The study was conducted at the Women's Health School at the Profizio Rehabilitation Center in Kharkiv, with 79 women aged 36-45 years participating. The selection criteria were the presence of modified risk factors for cardiovascular disease. All respondents were informed about the scientific study and provided written consent to participate in the study. The confidentiality of information about the participants was ensured by explaining that all data would be anonymous and

used for research purposes.

Ethics Statements and Participants. The study was conducted in compliance with all relevant national regulations and institutional policies, the principles of the Declaration of Helsinki adopted by the General Assembly of the World Medical Association (1964-2000), and the Council of Europe Convention on Human Rights and Biomedicine (1997).

Study design

The model was constructed using regression analysis based on data obtained from a study of women aged 36–45 years. It includes only those indicators that had a statistically significant impact on the risk of CVD.

Statistical analysis

Statistical processing of the obtained results was carried out using the statistical software package "Statistica 13.0." Descriptive statistics were obtained, which included calculations of the arithmetic mean (M), standard deviation (s), standard error of the mean (m), median (Me), minimum (min) and maximum values (max), as well as quartiles of distributions (25%, 75%). The justification for the choice of variables is based on the following criteria: a) statistically significant association with the risk of CVD (at the level of "p" not exceeding 0.05); b) functional and clinical significance, i.e., the inclusion of indicators that directly or indirectly reflect the functional state of the cardiovascular system, adaptive mechanisms, and psychoemotional background; c) the absence of multicollinearity between predictors.

Results

The selection of variables was determined by 10 indicators whose correlation with CVD risk was statistically significant. Figure 1 shows scatter plots illustrating the relationships between CVD risk and key physiological, morphofunctional, biomechanical, metabolic, and psychological indicators in women. Each graph shows the interdependence between the risk of CVD (on the Y-axis) and one of the parameters (on the X-axis). The points on the graphs represent individual data for women, allowing for a visual assessment of the spread of values and anxiety assessment questionnairerelationship. Lines with a positive slope indicate that as the value of the indicator increases, the risk of CVD increases, as shown for body mass index, glucose level, and personal anxiety level. Lines with a negative slope reflect an inverse relationship – the higher the value of the indicator, the lower the risk, as shown for the Pirogov test or the REEDCO posture indicator.

Systolic blood pressure (SBP) ($r=0.499$, $p<0.01$) is a direct marker of the state of the cardiovascular system. Elevated SBP is considered an early indicator of hypertension and a risk factor for stroke, myocardial infarction, and heart failure. Therefore, it has both high clinical value and statistical significance.

Diastolic blood pressure (DBP) ($r=0.405$, $p<0.01$) also correlates with the risk of CVD, reflecting the load on peripheral vessels. Given its role in the pathophysiology of hypertension and vascular disorders, this indicator complements the picture of hemodynamic status.

The Pirogov test, which reflects the overall level of physical condition ($r=-0.238$, $p<0.05$), shows an inverse relationship with the risk of CVD, which is logically explained by the fact that the better the overall functional condition, the lower the likelihood of cardiovascular pathology. Its integrative nature allows us to assess the cumulative effect of several key physiological parameters.

Adaptive potential according to the method of R.M. Baevsky ($r=0.416$, $p<0.01$) indicates the effectiveness of the regulatory mechanisms of the cardiovascular system, in particular its ability to adapt in response to stress and physiological loads. Its violation is associated with an increased risk of cardiac decompensation.

The REEDCO posture index ($r=-0.297$, $p<0.01$) is an indicator of the body's biomechanical balance. Postural disorders, especially in the upper thoracic and cervical regions, can indirectly affect hemodynamics through compression of blood vessels or disturbances in nervous regulation, so the inclusion of this indicator is of practical importance.

The depth of the cervical curve ($r=-0.389$, $p<0.01$) is another parameter that characterizes the state of the musculoskeletal system and indicates age-related or functional changes in the spine. These changes, in turn, affect the vegetative regulation of the cardiovascular system and must therefore be taken into account.

The level of personal anxiety (SHTlich) ($r=0.401$, $p<0.01$) and reactive anxiety (SHTreak) ($r=0.372$, $p<0.01$) have a direct positive correlation with the risk of CVD. Chronic psychoemotional stress and anxiety activate the sympathoadrenal system, leading to an increase in heart rate, blood pressure, and vascular tone disorders – the main links in the pathogenesis of cardiovascular diseases.

Blood glucose level ($r=0.399$, $p<0.01$) is a metabolic marker that signals the possibility of carbohydrate metabolism disorders, insulin resistance, or the early stages of diabetes mellitus – all of which are powerful risk factors for the development of CVD.

As these data show, each of the ten indicators selected for inclusion in the regression model is statistically significant and functionally or clinically important for building a useful model for rapid diagnosis of CVD risk.

Figure 1 shows that variables according to the first criterion can be included in the model for predicting the risk of cardiovascular disease. Thus, body mass index (BMI) ($r=0.784$, $p<0.01$) has the highest level of correlation with the risk of CVD among all parameters. It indicates excess body weight, which is one of the main components of metabolic syndrome and a cause of hypertension, atherosclerosis, and type 2 diabetes mellitus. Its inclusion in the model is both statistically and clinically justified.

The stepwise multiple linear regression method was used to develop a model for rapid diagnosis of CVD risk in middle-aged women. Initially, the 10 above-mentioned indicators were included in the analysis. All included changes were also checked for multicollinearity using the CDI (coefficient of dispersion inflation), the critical value of which was less than 10, indicating the absence of multicollinearity.

During the stepwise analysis, some variables were automatically removed because they did not contribute significantly to the model ($p>0.05$) or their inclusion did not lead to a statistically significant improvement in explanatory power. This applied, in particular, to Baevsky's adaptive potential indicators, diastolic pressure, reactive anxiety level, Pirogov's test, and stoop index.

Instead, five indicators were included in the final model, which simultaneously had a strong statistical association with the risk of CVD, represented different areas of functional multistate regulation, and did not show collinearity between each other (CRD values were less than 2). First, this is BMI, which proved to be the most powerful predictor of CVD risk ($\beta=0.69–0.83$; $p<0.001$). Its high value reflects excess body weight, a key factor in the development of metabolic syndrome, hypertension, insulin resistance, and lipid metabolism disorders. Second, the model included ATC, which adds variability in explaining risk ($\beta\approx0.19$; $p<0.01$) and shows the state of vascular tone and the risk of hypertensive lesions. The third indicator was the depth of the cervical curve, a biomechanical indicator whose contribution to the model was statistically marginal ($p=0.051$), with an RCD=1.205 indicating independence from other predictors. The model also included the indicator of personal anxiety (SHTlich), which was statistically significant ($p<0.05$), indicating the role of chronic stress in the activation of the sympathoadrenal system, increased heart rate, and blood pressure. Finally, it was appropriate to include glucose levels, but their contribution was not statistically significant ($p>0.05$), although they correlated consistently with the risk of CVD ($p<0.01$) and have clinical value in predicting the development of cardiovascular pathologies (Fig. 1).

Therefore, the final model included four independent variables – BMI, SBP, cervical curvature depth, and SHTlich – which were statistically, functionally, and clinically valid predictors of CVD risk and did not show mutual collinearity, making the model reliable and suitable for practical application. This set of indicators ensured a balance between informativeness, ease of data collection, and practical cost for rapid risk assessment. It was used as the basis for the final construction of the regression model with the determination of weight coefficients and the interpretive threshold value.

To construct the final regression level, the forced-entry method was used, which allowed the selected indicators to remain in the model without repeated automatic selection, ensuring the stability of the model structure and allowing the regression coefficients for each of the predictors to be fine-tuned. This resulted in the final equation (Table 1).

The data presented in Table 1 demonstrate the reliability and effectiveness of the constructed model. The multiple correlation coefficient R is 0.865, which indicates a strong relationship between the set of independent variables (BMI, SBP, cervical curvature depth (*CCH)*, SHTlich) and the dependent variable – the degree of CVD risk. The R-squared value (0.748) shows that about 75% of the variation in CVD risk is explained by this model. Fisher's F-test (54.9 at $p<0.001$) confirms the statistical significance of the model as a whole. Thus, the final regression equation constructed using the forced inclusion method is statistically significant and internally consistent.

The equation constructed on the basis of these data has the following form:

$$CVD\ risk = -14.875 + 1.226 \times BMI + 0.05 \times SBP - 0.91 \times CCH + 0.063 \times SHTlich,$$

where:

CVD risk – degree of cardiovascular disease risk (points);

BMI – body mass index (kg/m²);

SBP – systolic blood pressure (mm Hg);

CCH – cervical curvature depth (cm);

SHTlich – personal anxiety index (points).

It allows predicting the risk of cardiovascular disease in women in the second period of middle age. BMI has the greatest contribution to the model; its index in the equation shows that each 1

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Vol. 10 No. 6, 2025

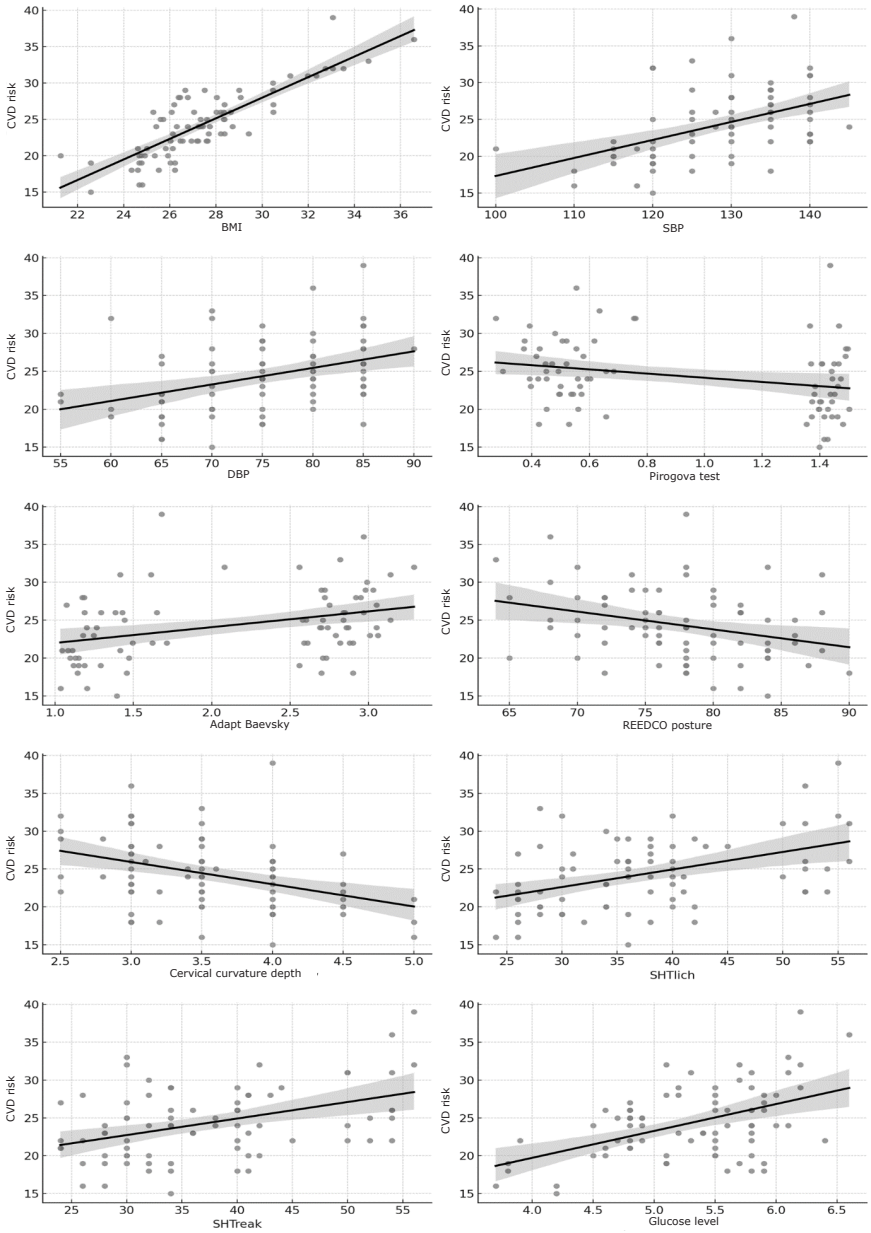

Figure 1. **Statistically significant correlations between CVD risk and metabolic, hemodynamic, functional, biomechanical, and psychological parameters in women aged 36–45**, where CVD risk is the risk of cardiovascular disease, BMI is body mass index, SBP – systolic blood pressure, DBP – diastolic blood pressure, Pirogova test – level of physical health according to the method of O.Ya. Pirogova, Adapt Baevsky – adaptive potential of the circulatory system according to the method of R.M. Baevsky, REEDCO posture – stoop index, SHTreak – reactive anxiety, SHTlich – personal anxiety.

Table 1. **Characteristics of the regression equation with the determination of weight coefficients and the interpretation threshold value**

N=79	Regression equation for the dependent variable: Risk of CVD (women in the second period of adulthood); R=0.865; R^2=0.748; Adjusted coefficients of determination R^2=0.734; F(4;74)=54.902, p<0.001; Standard error of estimate: 2.41.						
	Non-standardized coefficients		Standardized coefficients	t	p	Collinearity statistics	
	B	Standard error	β			Tolerance	KRD
Free member	–14,875	6,189		–2,403	0,019		
BMI	1,226	0,111	0,723	11,055	0	0,796	1,257
SBP	0,050	0,039	0,096	1,281	0,204	0,601	1,664
CCH	-0,910	0,528	–0,119	–1,725	0,089	0,713	1,403
SHTlich	0,063	0,035	0,119	1,792	0,077	0,767	1,304

Notes: B - coefficient in the regression equation, which shows the change in the dependent variable when the independent variable changes by one unit in the original units of measurement; std. error – standard error of coefficient B; β (beta) – standardized coefficient showing the effect of the variable without taking into account the dimension of measurement, allowing comparison of the strength of the effect of different variables; t – value of the t-statistic of the coefficient; p – significance level; Tolerance – part of the variation of the variable that is not explained by other variables; KRD – dispersion inflation index, inverse to tolerance.

kg/m² increase in BMI is associated with a 1.226 point increase in the risk of CVD. An increase in SBP of 1 mmHg is accompanied by an increase in the risk of CVD by 0.05 points.

The depth of the cervical curve has a negative contribution to the model (B=–0.910), i.e., the shallower the curve, the higher the risk of CVD. According to the formula, a 1 cm decrease in the depth of the cervical curve is predicted to increase the risk of CVD by 0.91 points. A 1 cm increase in the depth of the curve reduces the risk of CVD by 0.91 points. The statistical significance of this indicator is slightly higher than the threshold of 0.05, but it indicates a trend whereby a more upright position of the cervical spine indicates muscle tension that disrupts the autonomic regulation of the cardiovascular system, for example, through impaired blood flow.

SHTlich (personality anxiety) has a positive correlation with the risk of CVD, and therefore, an increase in anxiety by 1 point on the Spielberger scale is accompanied by an increase in the risk of CVD by 0.063 points. This indicates the influence of stress on the activation of the sympathetic nervous system and disruption of cardiac regulation.

The validity of the model for determining the level of CVD was tested on a sample of 79 women who participated in our study. For this purpose, the risk of CVD was measured in two ways. The first was using the method for assessing cardiovascular disease risk factors according to A.Z. Zapesochny, and the second was through anthropometric measurements of height and weight with subsequent calculation of BMI in kg/m², blood pressure measurement using the Korotkov method with a membrane tonometer in mm Hg, cervical curvature depth in cm according to the method of Z.P. Kovalkova, and self-assessment of personal anxiety level using the Spielberger-Hanin scale. Based on the results of these objective measurements, model values of CVD risk were obtained according to the proposed regression equation. We present the generalized data in the form of a comparative graph (Fig. 2), which shows the percentage distribution of women in the second period of mature age according to the levels of CVD risk determined both on the basis of the actual questionnaire and using a model forecast obtained using a regression equation. The graph shows four risk categories according to the author's scale: minimal (14–21 points), obvious (22–28 points), detected (29–35 points), and maximum (36 points and above).

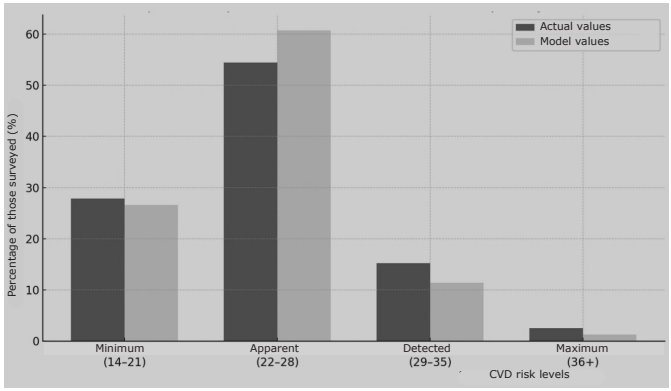

Figure 2. Distribution of women aged 36-45 years by CVD risk levels determined by actual values and using objective tests with calculation of the regression equation (n=79), where dark columns are actual data obtained using the method of assessing cardiovascular disease risk factors according to A.Z. Zapesochny, light columns are model values calculated based on the regression level (predictors: BMI; ATS; depth of cervical curvature; SHTlich)

Analysis of the graph demonstrates a high correspondence of the model to real data. The largest proportion of women, both in the actual and model distribution, is concentrated in the group with a clear risk (54.4% and 60.8%, respectively). The percentages of women with minimal risk are also similar (27.9% and 26.6%, respectively). In the groups of detected and maximum risk, the prediction accuracy is somewhat lower, but the differences do not exceed 1-4% percent, which is acceptable for socio-medical research. Overall, the graph demonstrates a good

Table 2. Information on the validity of a useful model for rapid diagnosis of cardiovascular disease risk in women in the second period of adulthood

Statistical indicator	Actual values (scores)	Model values (scores)
n	79	79
M	24,34	24,34
s	4,68	4,05
min	15	15,45
max	39	37,02
25%	21	21,54
Me	24	24,32
75%	27	26,01
Spearman correlation coefficient	$r=0,819^{**}$	$p=28 \cdot 10^{-20}$
Wilcoxon signed-rank test	Z=-0,528	p=0,598

predictive ability of the regression model, which allows it to be used for preliminary detection of the level of CVD risk in women without the need for a full questionnaire survey. This can become an effective tool for express risk diagnostics and selection for a physical education and sports rehabilitation or prevention program. A comparison of descriptive statistics of actual and model risk values showed a high correspondence of the model (Table 2). The mean value completely coincides with the actual data (24.34), the standard deviations are also similar (4.68 in fact and 4.05 in the model), but the model has less variability, that is, it slightly smooths out extreme values. Regarding extreme values, the model does not reflect the lowest and highest values completely, which is typical for regression models. The medians are almost identical (24 in fact and 24.32 in the model). The same deviations have the values of the first and third quartiles – The model slightly shifts the distribution towards the middle line, reducing the range between 25% and 75%.

We also note that the Spearman correlation coefficient (r=0.819) demonstrates a strong positive relationship between the actual and model estimates of CVD risk.

Exceeding the critical value (r>0.7), this coefficient confirms the validity of the constructed model, its high predictive relevance and adequacy as a screening tool for assessing the individual risk of cardiovascular diseases in women of the second period of mature age.

The Wilcoxon signed-rank test also showed the absence of statistically significant differences between the actual and model values of the degree of risk of cardiovascular diseases (Z=–0.528; p=0.598), which confirms the consistency of the regression model with empirical data.

Thus, we have proven that the constructed model adequately reproduces the actual level of CVD risk, which allows us to consider it a reliable tool for assessing the individual state of the cardiovascular system of women of the second period of older age, is convenient for predicting group risk. Small differences in extreme values and dispersion are not critical for practical application, on the contrary, have a positive meaning, since they reduce sensitivity to outliers.

Thus, the model provides a reliable generalization of CVD risk, adequately reflects the structure of the data and can be used for screening and stratification, provided that an interpretive scheme is created to simplify the identification of the degree of CVD risk for its users.

To do this, it is necessary to determine the

Table 3. Results of one-way analysis of variance (ANOVA) of the components of a useful model for rapid diagnosis of cardiovascular disease risk in women of the second period of maturity with different levels of CVD risk (df1=3; df2=75)

CVD risk	Statistical indicators	BMI	SBP	CCH	SHTlich	CVD risk
Minimal (n=21)	**M**	24,74	118,14	4,03	31,62	19,7
	s	1,25	6,56	0,6	5,35	1,6
	min	21,26	100	3	24	15,4
	max	26,22	130	5	42	21,9
Clear (n=48)	**M**	27,47	132,63	3,42	38,33	24,7
	s	1,29	6,06	0,52	8,17	1,5
	min	25,28	115	2,5	24	22,1
	max	30,49	140	4	56	28,3
Identified (n=9)	**M**	32,56	132	3,11	44,44	31,6
	s	1,23	8,5	0,49	11,47	1,2
	min	30,47	120	2,5	28	29,1
	max	34,6	145	4,5	56	33,4
Maximum (n=1)	**M**	36,58	130	3	52	37,0
	s	-	-	-	-	-
	min	36,58	130	3	52	37,0
	max	36,58	130	3	52	37,0
Significance of differences	F	97,347	25,109	8,854	7,371	154,278
	p	$8{,}6\cdot10^{-26}$	$2{,}4\cdot10^{-11}$	$4{,}3\cdot10^{-5}$	$2{,}2\cdot10^{-4}$	$5{,}3\cdot10^{-32}$

Notes: CVD risk – model values of cardiovascular disease risk (scores); BMI – body mass index (kg/m²); SBP – systolic blood pressure (mm Hg); CCH – cervical curvature depth (cm); SHTlich – personal anxiety index (scores); F – Fisher's exact test value; p – significance level of differences; Fcr(3; 75; 0.01)=4.08.

Table 4. Interpretation scheme for the results of rapid diagnostics of cardiovascular disease risk in women of the second period of maturity (df1=3; df2=75)

Indicators	CVD risk levels			
	Minimal	Clear	Identified	Maximum
CVD risk (points)	< 22	≥22 та <29	≥29 та <36	≥36
BMI (kg/m²)	21,3 – 26,2	25,3 – 30,5	30,5 – 36,5	≥36,6
SBP (mm Hg)	100 – 130	115 – 145	120-145	≥130
CCH (cm)	3 – 5	2,5-4	2,5 – 4,5	<3
SHTlich (points)	24 – 42	24 – 56	28 – 56	>52
Forecast	CVD risk low, general physiological and psycho-emotional state is stable	Pronounced risk of CVD due to a combination of functional and emotional factors	High probability of developing cardiovascular complications in the coming years	Critical condition. High risk of any cardiovascular events
Recommen-dations	Maintaining an active lifestyle, regular monitoring of psycho-emotional state, preventive examinations	Basic cardiac rehabilitation, regulation of psycho-emotional state (relaxation practices, consultation with a psychologist), blood pressure control are recommended	Comprehensive prevention: physical education and sports rehabilitation, psychotherapeutic support, lifestyle changes, inclusion of anti-stress programs	Emergency medical care, prescribed medication, intensive psycho-emotional rehabilitation, support from a psychologist or psychiatrist if necessary

Notes: CVD risk – degree of risk of cardiovascular diseases (scores); BMI – body mass index (kg/m²); SBP – systolic blood pressure (mm Hg); CCH – cervical curvature depth (cm); SHTlich – personal anxiety index (scores).

boundaries of each of the indicators that correspond to the following levels of risk: absent, minimal, obvious, detected, maximum. Table 3 illustrates the mean values, variability and indices of key predictors, as well as model values of the integral CVD risk.

It shows that with increasing risk level, there is a pronounced increase in the mean values of BMI (from 24.74 to 36.58), ATS (from 118.14 to 132) and SHTlich (from 31.62 to 52), as well as a decrease in the depth of cervical curvature (from 4.03 to 3), which corresponds to the expected differences. The highest values of model CVD risk are observed in groups with the maximum actual risk (37), and the lowest - in groups with the minimum risk (19.7), which demonstrates the correspondence of the calculated values to the actual clinical division. The analysis of variance (ANOVA) data showed statistically significant differences between groups for all variables ($p<0.001$), and the model CVD risk values revealed the highest F-statistic ($F=154.28$), which confirms the powerful differential ability of the constructed model. Thus, the validity and prognostic value of the regression level for the stratification of CVD risk in women of the second period of maturity is confirmed, and therefore we began to develop an interpretative scheme based on these data (Table 4). To create an interpretative scheme of cardiovascular disease risk levels based on the constructed regression model, a combined approach was used, which is based on both the actual values of the CVD risk assessment scale and the logic of calculating the regression level. The study used a validated tool that provides a gradation of the degree of CVD risk on a point scale: minimal risk – up to 21 points, obvious risk - 22–28 points, detected risk – 29–35 points, maximum risk – 36 points and more. For each risk level, typical values of predictors were selected that correspond to a clinically plausible profile of a woman of the second period of maturity. Confirmation of typical mean values of BMI, systolic blood pressure, cervical flexion depth, and anxiety level (SHTlich) for each of the categories allowed us to obtain predicted values of the risk level, which coincide with the limits defined in the original scale with high accuracy.

This approach allows you to keep the value of the points within the approved limits, as well as ensure the logical and clinical significance of the interpretation of the result, which proceeds from the peculiarities of the physiological state, somatic load and psycho-emotional state of the woman. In addition, for each level of risk, a clinical characteristic of the condition was proposed from satisfactory without risk factors to the presence of a complex of threats and the need for intensive prevention or rehabilitation.

Thus, the model not only allows you to accurately predict the risk of CVD, but also provides the ability to interpret the results in an understandable practical context for further use in the practice of physical education and sports rehabilitation.

Discussion

The constructed useful model for rapid diagnosis of CVD risk in women of the second period of maturity has a number of significant advantages compared to existing classical models. Modern cardiovascular risk assessment models, in particular Framingham Risk Score, SCORE and the ACC/AHA equation, are widely used in clinical practice to predict the 10-year probability of developing cardiovascular events and remain validated population-level tools (D'Agostino, 2008; Gorbas, 2009; American Heart Association, 2019; SCORE2 Working Group, 2021). At the same time, the results of the study indicate that their use has a number of limitations in the context of rapid diagnosis of cardiovascular risk in women of the second period of maturity. First of all, these models are focused mainly on predicting remote clinically significant or fatal cardiovascular events and are not intended to detect early, pre-nosodical changes in the functional state of the cardiovascular system. In women aged 36–45 years, the dominant influence of the age factor in the structure of these scales leads to an underestimation of the total risk, even in the presence of functional, metabolic or psycho-emotional disorders, which limits the possibilities of timely prevention and rehabilitation intervention. In addition, Framingham, SCORE and ACC/AHA are based mainly on a limited set of classical biomedical indicators, such as age, gender, blood pressure level, lipid profile, smoking and the presence of diabetes mellitus (Lloyd-Jones, 2019; Mu X & Wu A, 2022). At the same time, these models do not take into account indicators of autonomic regulation, psycho-emotional state and functional reserves of the body, which play an important role in the formation of cardiovascular risk in middle-aged women. Ignoring these factors reduces the sensitivity of traditional scales to initial adaptation disorders. Unlike traditional models, the constructed useful model of express diagnostics of CVD risk is based on an integral assessment of physiological, hemodynamic, metabolic and psychoemotional indicators. This approach allows for a comprehensive assessment of the functional state of the cardiovascular system, the level of adaptive reserves and early violations of regulatory mechanisms, which increases the informativeness of risk assessment, especially in women of the second period of mature age.

An important advantage of the proposed model is its express nature and practical suitability for use in primary healthcare, physical therapy and rehabilitation, and physical education and sports rehabilitation. Unlike Framingham, SCORE and ACC/AHA, which do not provide for the assessment of short-term dynamics of the condition (Kotseva, 2016; SCORE2 Working Group, 2021), the integrated model allows not only to stratify risk, but also to predict the effectiveness of rehabilitation measures and monitor changes in functional and psycho-emotional state under the influence of individualized rehabilitation programs.

Thus, the results of the study indicate that the constructed useful model is a more sensitive, comprehensive and practically oriented tool for express diagnostics of cardiovascular risk compared to the traditional Framingham, SCORE and ACC/AHA models. Its application allows to identify pre-nosoological disorders, optimize rehabilitation interventions and increase the effectiveness of cardiovascular disease prevention in women of the second period of maturity.

Conclusions

The revealed high prevalence of modified risk factors indicates the presence of pre-nosodic conditions and justifies the need for early implementation of preventive and rehabilitation measures. Express assessment of the risk of cardiovascular diseases in the second period of adulthood is an informative and practically accessible method for early detection of initial functional disorders of the cardiovascular system and stratification by the level of cardiovascular risk. Statistically significant relationships between the indicators of express risk assessment and functional parameters of the cardiovascular system confirm the prognostic value of this approach for assessing the initial functional state of individuals in the second period of adulthood.

Prospects for further scientific research are related to the implementation of a useful model in rehabilitation centers.

Author's contribution

Larysa Ruban: Conceptualization, Methodology, Data Curation; **Vitalii Kashuba:** Writing – Review and Editing; **Dmytro Demiohin:** Visualization, Investigation; **Mykhailo Sanin:** Supervision; **Nazarii Fedyniak:** Writing – Original draft preparation. All authors have read and agreed with the published version of the manuscript.

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Conflict of Interest

Larisa Ruban, Dmytro Demiohin, Mykhailo Sanin, and Nazarii Fedyniak declared that they have no conflict of interest.

Vitalii Kashuba is the member of Editorial board of *Journal Physical Rehabilitation and Recreational Health Technologies* and a co-author of this article. He was excluded from the editorial decision-making process and peer review related to this manuscript to ensure the independence of the publication process.

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