











# The occurrence of cardiovascular risk factors and functioning in chronic illness in the Polish population of EUROASPIRE V

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## Abstract

**Background:** *The aim of this study was to assess the impact of cardiovascular risk on the functioning of patients without a history of atherosclerotic cardiovascular disease.*

**Methods:** *Two hundred patients diagnosed with arterial hypertension, hypercholesterolemia, or diabetes were enrolled in the study. The median age was 52.0 years (interquartile range [IQR] 43.0–60.0). The following risk factors were assessed: blood pressure, body mass index, waist circumference, physical activity, smoking, LDL-cholesterol, triglycerides, and fasting plasma glucose concentration. Total cardiovascular risk was determined as the number of uncontrolled risk factors, and with the Systemic Coronary Risk Evaluation Score (SCORE). The Functioning in the Chronic Illness Scale (FCIS) was applied to assess the physical and mental functioning of patients.*

**Results:** *The median number of measures of cardiovascular risk factors was 4.0 (IQR 3.0–5.0). The median of SCORE for the whole study population was 2.0 (IQR 1.0–3.0). Patients with lower total cardiovascular risk as defined by SCORE and number of uncontrolled risk factors had better functioning as reflected by higher FCIS ( $R = -0.315$ ,  $p < 0.0001$ ;  $R = -0.336$ ,  $p < 0.0001$ , respectively). Multivariate logistic regression analysis identified abnormal blood pressure, abnormal waist circumference, tobacco smoking, and lack of regular physical activity to be negative predictors of functioning. Lack of regular physical activity was the only predictor of low FCIS total score (odds ratio 9.26, 95% confidence interval 1.19–71.77,  $p = 0.03$ ).*

**Conclusions:** *The functioning of patients worsens as the total cardiovascular risk increases. Each of the risk factors affects the functioning of subjects without coronary artery disease with different strength, with physical activity being the strongest determinant of patient functioning. (Cardiol J)*

**Key words:** cardiovascular risk factors, functioning of patients

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## Introduction

The occurrence of chronic diseases is a serious social, health, and economic problem in Poland and in other European countries [1, 2]. It has been shown that risk factors such as poor nutrition, obesity, smoking, diabetes, hypertension, and hypercholesterolemia increase the incidence of cardiovascular events [1–3]. Undoubtedly, the occurrence of cardiovascular events in the course of a chronic disease affects multiple areas of human functioning, including physical activity, as well as the emotional and spiritual sphere. The limitations in the functioning of patients with chronic disease result in lower self-value perception, deterioration of well-being, and increased anxiety and uncertainty about the future. The degree of interference is largely dependent on the severity of disease symptoms [4, 5]. However, it is unclear whether the mere presence of risk factors in patients who have not yet experienced cardiovascular events affects their functioning.

Therefore, we assessed the impact of cardiovascular risk on the comprehensive functioning of patients without a history of atherosclerotic cardiovascular disease (CVD) enrolled into the Polish arm of the EUROASPIRE V study.

## Methods

The EUROASPIRE V study is a multicenter, prospective, cross-sectional observational trial carried out in 2016–2018 in 16 European countries to determine whether the 2016 Joint European Societies' guidelines on CVD prevention in people at high cardiovascular risk have been implemented in clinical practice. The Polish arm of the EUROASPIRE V study included 200 adults (aged 18–80 years) diagnosed with arterial hypertension, hypercholesterolemia, or diabetes within 6 to 24 months before enrolment to the study. Patients with a previous cardiovascular event were excluded from the study. Consecutive patients were identified on the basis of medical records in participating healthcare centers and were invited personally to participate in the study. All patients provided written informed consent for participation in the study. The study was approved by the Bioethical Committee of the Nicolaus Copernicus University in Torun, Collegium Medicum in Bydgoszcz (KB 586/2017). The assessment of study participants was carried out by a trained person — a nurse or a doctor during the study visit. Following the EUROASPIRE V protocol, all patients were

assessed on eight different measures of risk factors: arterial blood pressure (BP), body mass index (BMI), waist circumference, physical activity, tobacco smoking status, serum total cholesterol, low-density lipoprotein cholesterol (LDL-C) and triglycerides (TG) concentration, and fasting plasma glucose.

Blood pressure was measured twice on the right shoulder in a sitting position, with the use of validated semiautomatic sphygmomanometers. The current European Society of Cardiology (ESC) criteria were applied for the diagnosis and classification of hypertension [6].

The following anthropometric measurements were taken: height (cm), weight (kg), BMI ( $\text{kg}/\text{m}^2$ ), and waist circumference (cm).

In order to assess physical activity, the following question was asked: “Which of the following terms best describes your extra-professional activity?”, with four possible answers: 1 — “I do not have any physical activity other than my professional work.”; 2 — “Only light physical activity most of the time.”; 3 — “Intensive physical activity at least 20 minutes 1–2 times a week.”; and 4 — “20 minutes of vigorous physical activity more than twice a week.” Answers 3 and 4 were considered an adequate level of physical activity.

Patients' self-declared smoking status was verified with an objective test measuring the concentration of carbon monoxide in the exhaled air, with results of  $> 10$  parts per million (ppm) being considered indicative of active smoking.

Serum LDL-C and TG concentrations, as well as fasting plasma glucose, were measured in fasting venous blood samples on an Alinity ci analyzer (Abbott, Wiesbaden, Germany).

Appropriate control of the analyzed risk factors was acknowledged when the following criteria were met:

- Blood pressure: systolic BP  $< 140$  mmHg and diastolic BP  $< 90$  mmHg;
- Body weight: BMI of 20.0–24.9  $\text{kg}/\text{m}^2$ ;
- Waist circumference:  $< 80$  cm for women and  $< 94$  cm for men;
- Regular physical activity: intensive exercise for 20 minutes or more at least 1–2 times a week;
- Smoking status: self-reported non-smoker status objectively confirmed by the concentration of carbon monoxide in the exhaled air  $< 10$  ppm;
- LDL-C concentration:  $< 2.6$  mmol/L ( $< 100$  mg/dL);
- TG concentration:  $< 1.7$  mmol/L ( $< 150$  mg/dL);

— Fasting plasma glucose:  $< 100$  mg/dL ( $< 5.6$  mmol/L).

Total cardiovascular risk was determined individually for each study participant, as the number of uncontrolled risk factors, and with Systemic Coronary Risk Evaluation Score (SCORE) introduced in guidelines of the ESC [3] — a version calibrated for the Polish population [7]. The SCORE model predicts the 10-year risk of cardiovascular mortality in apparently healthy individuals based on gender, age, total cholesterol concentration, systolic BP, and smoking status [3, 7, 8]. The actual total cardiovascular risk was defined as follows: very high (SCORE  $\geq 10\%$ ); high (SCORE  $\geq 5\%$  and  $< 10\%$ ); moderate (SCORE  $\geq 1\%$  and  $< 5\%$ ); and low (SCORE  $< 1\%$ ) [9].

We also applied the Functioning in Chronic Illness Scale (FCIS) to assess the physical and mental functioning of each patient. The FCIS is a unique tool developed for comprehensive evaluation of various aspects of patient functioning with chronic disease. It allows the diagnosis of deficit areas in patients and the implementation of appropriate interventions. This scale, consisting of 24 items, is divided into three subscales. The first part of the questionnaire assessing the impact of the disease on the patient (FCIS 1 subscale) mainly refers to the patient's physical efficiency, quality of life, and acceptance of the disease. The second (FCIS 2 subscale) and third (FCIS 3 subscale) assess the patient's beliefs regarding the possible impact on the course of illness and the impact of the disease on the patient's attitudes, respectively. These subscales refer mainly to self-efficacy and the location of health control [10–12]. The FCIS total score  $< 79$  points indicates low functioning, 79–93 points — medium functioning, and  $> 93$  points — high functioning. Respective cut-off points for consecutive FCIS subscales scores were:  $< 24$ , 24–33,  $> 33$  (FCIS 1);  $< 25$ , 25–29,  $> 29$  (FCIS 2); and  $< 28$ , 28–33,  $> 33$  (FCIS 3) [10].

In line with the EUROASPIRE V protocol, a single study visit was performed, comprising a medical interview including SCORE and FCIS evaluation, anthropometric measurements (height, weight, waist circumference), BP measurements, and measurement of blood and exhaled carbon monoxide.

In the next step the impact of total cardiovascular risk on the functioning of patients according to FCIS was evaluated.

## Statistical methods

The statistical analysis was carried out using Statistica 13.0 (TIBCO Software Inc., California, USA) and MedCalc 15.8 (MedCalc Software, Os-

tend, Belgium). Continuous variables were presented as medians with interquartile range (IQR), and 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. Comparisons between two groups were performed with the Mann-Whitney unpaired rank sum test. For comparisons between more 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. The optimum cut-off point for the association of FCIS and high cardiovascular risk was determined using receiver operator characteristics (ROC) curve analysis. To identify factors predicting high FCIS total score univariate and multivariate logistic regression analysis were performed. The best model was identified using multiple-model backward stepwise regression. The multivariate model was created by including variables with a  $p$  value  $< 0.1$  in univariate analysis and subsequently removing one by one those without significant impact ( $p > 0.05$ ).

## Results

Of 200 patients enrolled in the study, 133 (66.5%) were women. The median age of the study population was 52.0 years (IQR 43.0–60.0). The median BP for the entire population was 125.0 mmHg (IQR 118.0–135.0 mmHg) and 77.5 mmHg (IQR 70.0–82.0 mmHg) for systolic and diastolic BP, respectively. The median BMI for the entire study group was 26.0 kg/m<sup>2</sup> (IQR 23.9–28.7 kg/m<sup>2</sup>). The median waist circumference for the entire study group was 87.0 cm (IQR 80.0–95.5 cm). Regular physical activity according to the adopted definition was declared by 41% of the study participants. The median carbon monoxide concentration measured in the exhaled air was 1.0 ppm (IQR 0.0–2.0). Active smokers ( $n = 30$ ) had a significantly higher carbon monoxide concentration compared with non-smokers (4.5, IQR 2.0–8.0 vs. 1.0, IQR 0.0–1.0;  $p < 0.001$ ). The level of carbon monoxide did not exceed 10 ppm in any of the patients declaring themselves as non-smokers. Median concentrations of LDL-C, TG, and glucose in the venous blood serum were 3.29 mmol/L (IQR 2.68–4.0), 1.21 mmol/L (IQR 0.90–1.55), and 5.4 mmol/L (IQR 5.04–5.90), respectively. The proportions of patients with risk factors identified according to medical records, medical history, or contemporary performed tests are shown in Table 1. The median

**Table 1.** Study population characteristics.

The assessed feature		N	Percentage
Age	Median (IQR)	52.0 (43.0–60.0)	
Gender	Male	67	33.5
	Female	133	66.5
Arterial hypertension	Diagnosed	127	63.5
Diabetes mellitus	Diagnosed	38	19.0
Hypercholesterolemia	Diagnosed	90	45.0
Tobacco smoking (active)	Declared	30	15.0
Systolic blood pressure	≥ 140 mmHg	39	19.5
Diastolic blood pressure	≥ 90 mmHg	21	10.5
Systolic/diastolic blood pressure	≥ 140 mmHg and/or ≥ 90 mmHg	45	22.5
Body mass index	Underweight	11	5.5
	Correct weight	72	36.0
	Overweight	84	42.0
	Obesity	33	16.5
Waist circumference	Normal fat distribution	74	37.0
	Moderate central fat accumulation [W ≥ 80 cm, M ≥ 94 cm]	57	28.5
	High central fat accumulation [W ≥ 88 cm, M ≥ 102 cm]	69	34.5
Physical activity	No activity	30	15.0
	Low activity	110	55.0
	Regular activity	60	30.0
Serum LDL-C concentration	≥ 2.6 mmol/L	154	77.0
Serum TG concentration	≥ 1.7 mmol/L	37	18.5
Fasting plasma glucose	≥ 5.56 mmol/L	83	41.5
Number of uncontrolled measures of CV risk factors	0	6	3.0
	1	10	5.0
	2	32	16.0
	3	35	17.5
	4	52	26.0
	5	43	21.5
	6	15	7.5
	7	5	2.5
SCORE	8	2	1.0
	Low: < 1%	35	17.5
	Moderate: ≥ 1%; < 5%	131	65.5
	High: ≥ 5%; < 10%	16	8.0
FCIS total score	Very high: ≥ 10%	18	9.0
	High score	129	64.5
	Medium score	51	25.5
FCIS 1 score	Low score	20	10.0
	High score	126	63.0
	Medium score	60	30.0
FCIS 2 score	Low score	14	7.0
	High score	106	53.0
	Medium score	71	35.5
FCIS 3 score	Low score	23	11.5
	High score	103	51.5
	Medium score	70	35.0
	Low score	27	13.5

IQR — interquartile range; CV — cardiovascular; LDL-C — low-density lipoprotein cholesterol; TG — triglycerides; W — women; M — men



number of measures of cardiovascular risk factors was 4.0 (IQR 3.0–5.0). The median SCORE for the whole study population was 2.0 (IQR 1.0–3.0). Measures of total cardiovascular risk are also presented in Table 1. Functioning levels assessed with the FCIS are shown in Tables 1 and 2.

Mean and median values of the FCIS total score and each subscale reflected a high functioning level (Table 2).

Patients with lower SCORE-defined total cardiovascular risk had better functioning in disease as reflected by higher FCIS total, FCIS 1, and FCIS 2, but not FCIS 3 scores (Fig. 1, 1A). The Spearman correlation between FCIS 1, 2, and 3 scores and SCORE was  $-0.323$ ,  $p < 0.0001$ ;  $-0.273$ ,  $p = 0.0001$ ; and  $-0.197$ ,  $p = 0.005$ , respectively (Fig. 1, 1B). The ROC analysis (area under curve [AUC] 0.658; 95% confidence interval [CI] 0.588–0.724;  $p = 0.0016$ ) revealed that patients with FCIS total score  $\leq 98$  are of high or very high cardiovascular risk according to SCORE, with sensitivity of 76.5% and specificity of 55.4% (Fig. 1, 1C).

In general, these results were confirmed when total cardiovascular risk was calculated as the number of uncontrolled risk factors; however, in this case the effect of total cardiovascular risk was more pronounced and significant for all FCIS subscales (Fig. 1, 2A). Spearman correlation between FCIS 1, 2, and 3 scores and the number of uncontrolled risk factors was  $-0.339$ ,  $p < 0.0001$ ;  $-0.245$ ,  $p < 0.0005$ ; and  $-0.289$ ,  $p < 0.0001$ , respectively (Fig. 1, 2B). According to the ROC analysis (AUC 0.679; 95% CI 0.610–0.743;  $p < 0.0001$ ), patients with an FCIS total score  $\leq 97$  are of high or very high cardiovascular risk as evaluated according to the number of uncontrolled risk factors, with a sensitivity of 58.1% and a specificity of 71.1% (Fig. 1, 2C).

Univariate logistic regression analysis identified abnormal BP ( $p = 0.002$ ), abnormal waist circumference ( $p = 0.0003$ ), tobacco smoking ( $p = 0.003$ ), and lack of regular physical activity to be negative predictors of high FCIS total score (Fig. 2). These findings were confirmed in multivariate regression analysis (Table 3). For low FCIS total score, the univariate logistic regression analysis identified only a single predictor — the lack of regular physical activity (odds ratio 9.26, 95% CI 1.19–71.77,  $p = 0.03$ ); therefore, the multivariate logistic regression analysis was abandoned.

## Discussion

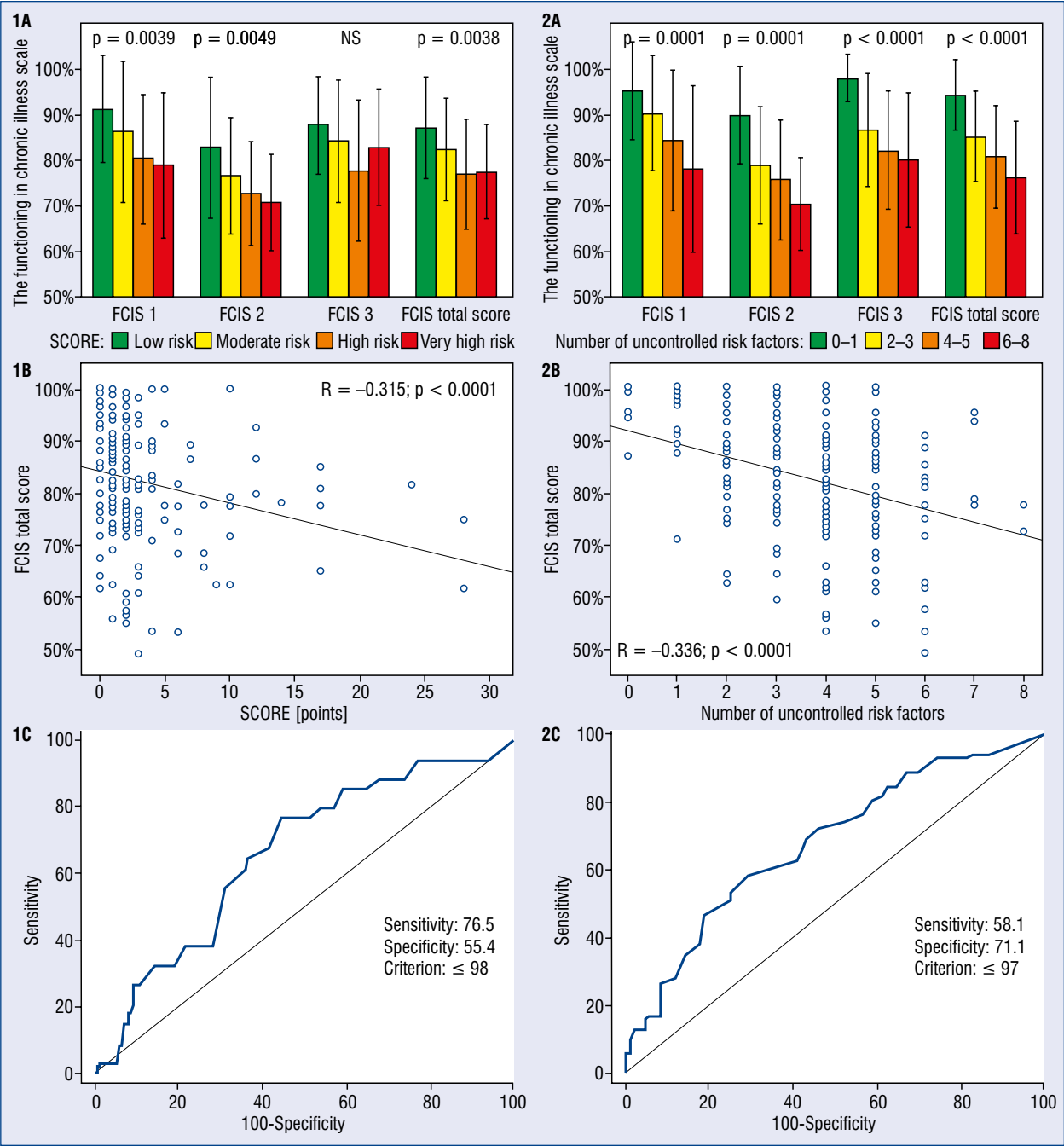
Coronary artery disease (CAD) affects multiple aspects of patients' lives in many ways,

including physical activity, emotional and spiritual spheres, and social functioning. Limited functioning of a patient with chronic disease results in decreased self-esteem, deteriorated well-being, increased anxiety, and uncertainty about the future [13–16]. Numerous studies [17–34] indicate the need for the combined use of various tools for the overall assessment of various aspects of the functioning of subjects with chronic disease. The tools previously developed to diagnose overall functioning of patients, e.g., WHO-DAS II scale and CIA questionnaire, are dedicated to very specific clinical situations, such as low back pain [17, 18] or nutrition disorders [19, 20]. The FCIS is a unique validated tool allowing the comprehensive assessment of physical and mental functioning dedicated to patients with chronic diseases. The first FCIS subscale mainly refers to the patient's physical efficiency, quality of life, and acceptance of the disease. These aspects of patient functioning were previously evaluated in numerous studies in different clinical settings with several different tools [21–29]. The second and third FCIS subscales refer mainly to the self-efficacy and the location of health control. These aspects were assessed separately with other tools [30–34].

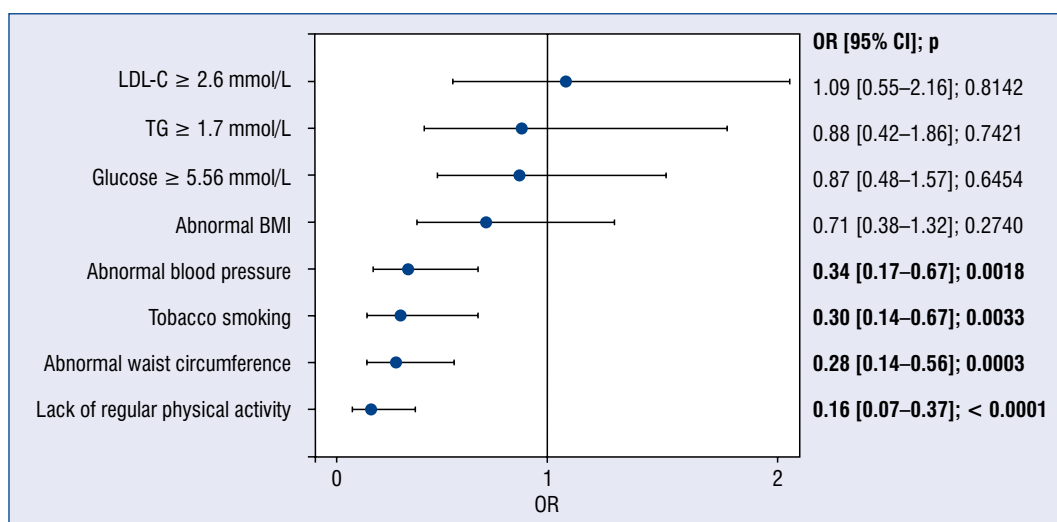
According to our best knowledge, this study is the first to show that the risk factors themselves affect the comprehensive functioning of patients without diagnosed CAD. The increase in total cardiovascular risk determined with the SCORE or expressed by the number of uncontrolled risk factors results in deterioration of functioning of patients as assessed with the FCIS. The scores in the FCIS subscales are generally consistent with each other, with the exception of FCIS 3 reflecting the location of health control, with regard to the SCORE scores. We have also demonstrated that an FCIS total score of 97–98 points is the cut-off for high and very high cardiovascular risk irrespective of whether it is assessed with the SCORE or the number of uncontrolled risk factors. The FCIS questionnaire was previously applied in patients with CAD [35] and in subjects with post-COVID syndrome [36]. The FCIS is currently being used in the ELECTRA-SIRIO2 study — an ongoing large-scale clinical trial scheduled to enroll a total of 4500 acute coronary syndrome patients [37, 38]. The proportion of patients with high FCIS score in our current study (64.5%) is noticeably higher than in our previous studies with CAD patients (31%) [35] and post-COVID patients (30%) [36]. We have shown that lack of regular physical activity (the strongest factor), tobacco smoking, abdominal obe-

**Table 2.** Results of the Functioning in Chronic Illness Scale (FCIS).

FCIS	N	Median	Quartile 1	Quartile 3	Minimum	Maximum
FCIS total score	200	98.50	91.00	109.00	59.00	120.00
FCIS 1 score	200	36.50	31.00	39.50	12.00	40.00
FCIS 2 score	200	30.00	27.00	35.00	19.00	40.00
FCIS 3 score	200	34.00	31.00	38.00	16.00	40.00



**Figure 1.** Functioning of patients in relation to cardiovascular risk stratified according to the SCORE and the number of uncontrolled risk factors; **A.** Functioning of patients according to the FCIS (subscales and total score) in a subset of patients with increasing total cardiovascular risk assessed with the SCORE (**1A**), expressed as the number of uncontrolled risk factors (**2A**); **B.** Spearman correlation between FCIS total score and the SCORE (**1B**), and the number of uncontrolled risk factors (**2B**); **C.** Discrimination of FCIS score threshold indicating patients with high or very high cardiovascular risk according to the SCORE (**1C**) and to the number of uncontrolled risk factors (**2C**).



**Figure 2.** Impact of single risk factors on the occurrence of high FCIS total score. Univariate regression analysis; OR — odds ratio; CI — confidence interval; LDL-C — low-density lipoprotein cholesterol; TG — triglycerides; BMI — body mass index

**Table 3.** Predictors of high FCIS total score — multivariate logistic regression analysis.

Variable	Odds ratio	95% confidence interval		P
Abnormal blood pressure	0.47	0.22	0.99	0.0485
Abnormal waist circumference	0.37	0.18	0.76	0.0069
Tobacco smoking	0.36	0.15	0.88	0.0243
Lack of regular physical activity	0.19	0.08	0.47	0.0003

sity, and increased BP deteriorate the functioning of patients. Conversely, laboratory cardiovascular risk factors such as increased concentrations of LDL-C, TG, and glucose do not affect the FCIS score in multivariate regression analysis. In line with our study, Spinka et al. [39] found physical activity to be strongly correlated with the functioning and quality of life of CAD patients. Aerobic interval training as well as aerobic continuous training were shown to improve peripheral endothelial function, cardiovascular risk factors, and the quality of life [40]. Moreover, in subjects with normal coronaries, treatment of endothelial dysfunction, reflecting the cardiovascular risk and favorably influencing the quality of life [41]. We have shown increased waist circumference, but not increased BMI, to have a deteriorating impact on patient functioning. On the other hand, Oreopoulos et al. [42] revealed BMI to be inversely associated with the physical functioning and overall health-related quality of life in CAD patients, especially in individuals with severe obesity. Because the assessment of the

quality of life is part of the evaluation of functioning in chronic illness, the results of the cited studies [39–42] should be considered generally consistent with our observations.

### Limitations of the study

The limitation of our study is the relatively low number of enrolled patients. Moreover, the lack of follow-up did not allow for assessment of the influence of the examined risk factors on clinical outcome.

### Conclusions

In conclusion, the functioning of patients worsens as the total cardiovascular risk increases. Each of the risk factors affects the functioning of subjects without CAD with different strength, with physical activity being the strongest determinant of patient functioning.

**Conflict of interest:** None declared

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