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Evaluation of the Usability of Selected Questionnaires Assessing Physical Activity in the Prophylaxis of Cardiovascular Diseases*

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation;
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Abstract

Background. The main health problem of the Polish population is posed by cardiovascular diseases (CDVD), coronary artery disease (CAD) in particular. Respectively higher physical activity linked with energy expenditure of at least 1000 kcal/week may significantly reduce the risk of CAD development. The protective effect of exercise applies not only to persons from high-risk groups and with diagnosed chronic diseases that increase the risk of the incidence of atherosclerosis and its complications, but also to healthy individuals.

Objectives. The aim of this study was to evaluate the usability of the Seven-Day Physical Activity Recall (SDPAR) and International Physical Activity Questionnaire (IPAQ) in research on the correlation between physical activity and risk factors of cardiovascular diseases.

Material and Methods. A screening survey, conducted in 2012, included students ($n = 340$) of the Division of the Academy of Physical Education in Białą Podlaska, aged 18–29 years. Total cholesterol, triglycerides and glucose levels were analyzed, and arterial blood pressure and heart rate were measured. The physical activity of the students was estimated using IPAQ and SDPAR questionnaires. The effect of physical activity on the biochemical blood markers, arterial blood pressure and heart rate was analyzed in groups differing in weekly energy expenditure (WEE).

Results. Along with increasing WEE values, calculated with IPAQ and SDPAR questionnaires, tangible descending tendencies were observed in cholesterol concentration in both genders. Significant differences were demonstrated in mean values of the resting heart rate between terciles of women ranked according to the increasing WEE values calculated using IPAQ ($p < 0.05$) and SDPAR ($p < 0.01$). Significant ($p < 0.05$) negative correlations were demonstrated only between the heart rate of women and WEE value calculated with IPAQ ($r = -0.223$) and SDPAR ($r = -0.238$).

Conclusions. Beneficial changes were observed in the blood lipid profile and in mean resting heart rate values as affected by the higher energy expenditure. The IPAQ and SDPAR may be applied to assess the level of physical activity; however the SDPAR seems to be a more useful tool in CDVD prevention screening (*Adv Clin Exp Med* 2016, 25, 1, 69–67).

Key words: students, cardiovascular diseases, physical activity, IPAQ, SDPAR.

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Cardiovascular diseases (CDVD) are the main health issue of the Polish population [1]. CDVD preventive measures should, apart from pharmacological therapy and treatment of co-existing diseases, include such a modification of lifestyle that would make it possible to expose the patient to the increasingly better-recognized and valued health benefits resulting from physical activity.

Among CDVD, the leading candidate is coronary artery disease (CAD), also referred to as coronary heart disease or ischemic heart disease. The underlying cause of its clinical symptoms is atherosclerosis. The development of this disease is determined by many factors, most of which are susceptible to preventive intervention. These include increased levels of lipids and lipoproteins and a reduced level of HDL-cholesterol fraction. Factors that may be minimized or eliminated also include obesity, arterial hypertension, improper nutrition and low physical activity, whereas factors that cannot be modified include: age over 40, male gender and genetic determinants [2]. According to McGill and McMahan [3], a synergy exists between the risk factors, hence even a small reduction of one or a few of them at an early stage of disease development lowers the risk of atherosclerosis.

More physical activity, linked to an energy expenditure of at least 1000 kcal/week, may significantly reduce the risk of CAD development [5]. For instance, a study by Leon et al. [6] demonstrated that even a little daily recreational physical activity (10–30 min) coupled with single energy expenditure of 200–300 kcal significantly reduces the risk of mortality of coronary heart disease (CAD). The protective effect of exercise applies not only to persons from high risk groups and to those with diagnosed chronic diseases that increase the risk of incidence of atherosclerosis and its complications (arterial hypertension, obesity diabetes, metabolic syndrome), but also to healthy individuals [7, 8].

The effective use of physical activity in CDVD prevention is a difficult task. Most often, it is based on the kinematic analysis and assays of selected physiological and biochemical parameters. The application of these methods in epidemiological surveys of large populations has, however, some limitations linked to high costs, with potential contraindications regarding the age and health condition of the surveyed, as well as with not always sufficient reliability [9–11]. Most of these limitations may, however, be eliminated through the application of a method of physical activity assessment based on diagnostic polling with the use of questionnaires that are the simplest and cheapest tools not requiring any sophisticated technical facilities. Data collected from these questionnaires makes it possible to estimate the energy expenditure of the

body, which is especially significant in establishing whether the type, frequency and intensity of physical activity reached levels sufficient to preventing most of the modern lifestyle-related diseases, including cardiovascular diseases. The majority of studies, usually conducted on large populations of both healthy and ill individuals, include mainly statistical analyses aimed at demonstrating the level of physical activity of the selected population, and the results presented as relative frequencies expressed in percentages are mainly related to gender, age and socio-economic status.

The scant number of studies on the application of physical activity questionnaires in preventive screening, prompted us to evaluate the usability of the Seven-Day Physical Activity Recall (SDPAR) and International Physical Activity Questionnaire (IPAQ) in studies on the correlation between physical activity and risk factors of cardiovascular diseases.

Material and Methods

A screening survey was conducted in 2012 and included students (165 women and 175 men) of the Faculty of Physical Education and Sport at the Division of the Academy of Physical Education in Biała Podlaska, aged 18–29 years.

The values of somatic features were evaluated based on measurements of body height and body mass as well as skinfold thickness on arm triceps (TST), under scapula (SCTS) and on the abdomen (AST). Body height was measured with an accuracy of 0.1 cm using an anthropometer by Swiss company Sieber Hegner & Co. AG, whereas body mass – with an accuracy of 0.1 kg, was measured using a CAS medical electronic scale by Inter Commerce company (Poland). Skinfold thickness was measured with an accuracy of 0.1 mm on the right side of the body using a Herpenden skinfold caliper by Sieber Hegner & Co. AG. Based on the above measurements, BMI and the sum of TST, SCTS and AST skinfolds (mm) were calculated. The characteristics of the surveyed population are presented in Table 1.

Standard measurements of systolic blood pressure (SBP), diastolic blood pressure (DBP) and resting heart rate in the sitting position were performed using the oscillometric method with an i-Q142 upper arm blood pressure monitor by Japanese company OMRON, following the current recommendations of the Polish Society of Arterial Hypertension (PTNT) [12].

Measurements of the concentrations of total cholesterol (TC), triglycerides (TG) and glucose were conducted using the reflective photometry

Table 1. Characteristics of the surveyed population

Parameters	Women (n = 165)		Men (n = 175)	
	mean $\pm$ SD	range min–max	mean $\pm$ SD	range min–max
Age (years)	20.6 $\pm$ 0.9	18.1–25.7	21.0 $\pm$ 1.2	19.7–29.4
Body height (cm)	166.7 $\pm$ 5.9	152.1–181.8	180.7 $\pm$ 7.1	163.1–201.9
Body mass (kg)	59.7 $\pm$ 9.5	41.5–90.5	77.7 $\pm$ 10.5	57.7–119.4
BMI (kg/m ²)	21.5 $\pm$ 2.8	15.6–29.6	23.8 $\pm$ 2.7	18.4–35.3
Triceps (TST) (mm)	15.6 $\pm$ 4.5	5.9–30.8	9.7 $\pm$ 4.0	3.2–27.4
Subscapular (SCST) (mm)	13.4 $\pm$ 5.3	5.7–34.2	11.3 $\pm$ 4.9	5.0–43.0
Abdominal (AST) (mm)	17.0 $\pm$ 5.5	5.6–35.4	13.0 $\pm$ 7.0	3.7–50.2
Σ TST, SCTS, AST (mm)	46.0 $\pm$ 13.0	18.7–90.3	34.0 $\pm$ 14.4	12.3–111.7

Table 2. Distribution of the surveyed population depending on the value of weekly energy expenditure (WEE) in kcal

Terciles	Women (n = 165)						Men (n = 175)					
	IPAQ			SDPAR			IPAQ			SDPAR		
	tercile ranges of energy expenditure	tercile distribution		tercile ranges of energy expenditure	tercile distribution		tercile ranges of energy expenditure	tercile distribution		tercile ranges of energy expenditure	tercile distribution	
		%	n		%	n		%	n		%	n
T1	< 1784	34	57	< 3788	34	57	< 5195	33	58	< 5286	33	58
T2	1785–3802	33	54	3789–7603	33	54	5196–9465	33	58	5287–9726	33	58
T3	> 3803	33	54	> 7604	33	54	> 9466	34	59	> 9727	34	59

method in fresh capillary blood using test strips and a CardioChek analyzer by Polymer Technology Systems Inc. (USA). The concentration of TC and TG was assayed in the range of 100–400 and 50–500 mg/dL, respectively, and that of glucose in the range of 20–600 mg/dL.

The physical activity of the surveyed students was estimated using the diagnostic survey method with a short version of the International Physical Activity Questionnaire (IPAQ) [13] and Seven-Day Physical Activity Recall Questionnaire (SDPAR) [14]. Both questionnaires were aimed at collecting data concerning the time spent within a week (7 days) on various activities which, depending on their intensity, were ascribed a specified value of MET equivalent (metabolic equivalent), being an equivalent of 1 kcal/kg/h. The SDPAR makes it possible to collect data on the number of hours of physical activity with low (1.5 MET), moderate (4 MET), high (6 MET) and very high (10 MET) intensity, and additionally takes an account of the energy expenditure during sleep (1 MET). The short version of the IPAQ considers moderate (4 MET) and intensive (8 MET) physical activity as well as walking (3.3 MET).

Afterwards, the activities with similar energy expenditure were aggregated: in the case of IPAQ – intensive and moderate ones, and in the case of SDPAR – moderate or those with high and very high intensity. The data gathered from the questionnaires was used to calculate the weekly energy expenditure (WEE) expressed in kcal/week.

In order to determine the effect of physical activity on biochemical blood parameters, arterial blood pressure and heart rate, the surveyed population (separately women and men) was ordered according to the increasing WEE values and then divided into 3 groups (T1, T2, T3) corresponding to tercile ranges (Table 2).

The distribution of the selected somatic traits, biochemical parameters, arterial blood pressure and physical activity was analyzed graphically by comparing the cumulative distribution functions of particular variables (crude and transformed values) with the cumulative distribution function of normal distribution. The variables for which the cumulative distribution function of the transformed values was closer to normal distribution than to crude values were subjected to logarithmic transformation, which made it possible to

obtain distributions closer to the normal distribution. The transformed values were used in further calculations.

The differences between the groups regarding the concentration of total cholesterol (TC), triglycerides (TG), and glucose as well as systolic and diastolic blood pressure and heart rate, were evaluated with the one-way analysis of variance (ANOVA) and *post-hoc* Newman-Keuls test. Correlations between biochemical blood markers, arterial blood pressure, heart rate and the WEE values were determined by calculating simple correlation coefficients. The significance of the statistical tests was assumed at the level of $p \leq 0.05$ or higher.

Results

The characteristics of the surveyed population are presented in Table 1. The mean body height and body mass of women were 166.7 ± 5.9 cm and 59.7 ± 9.5 kg, and of men were 180.7 ± 7.1 cm and 77.7 ± 10.5 kg, respectively. Adiposity expressed by the sum of skinfolds was at 46.0 ± 13.0 mm in women and at 34.0 ± 14.5 mm in men. The mean BMI values calculated for women and men based on individual measurements of body height and body mass were normal and were calculated at 21.5 ± 2.8 kg/m² and 23.8 ± 2.7 kg/m², respectively.

Distribution of the surveyed population based on WEE value is presented in Table 2. In the group of women ($n = 165$) and group of men ($n = 175$), respectively, 57 and 58 persons (34 and 33% of each particular group) were counted in the lower tercile (T1), denoting low energy expenditure. The analysis of the WEE values from the lower tercile showed that in the case of IPAQ, the values were lower than 1784 and 5195 kcal/week for women and men, respectively, whereas in the case of the SDPAR questionnaire, they were lower than 3788 and 5286 kcal/week, respectively. The middle tercile (T2) included 54 women and 58 men, which in both cases constituted 33% of the sample. In turn, the upper tercile (T3), with the highest WEE values, included 54 women and 59 men, which corresponded to 33 and 34% of the sample, respectively. In the upper tercile, the WEE values calculated for women and men using IPAQ and SDPAR questionnaires were higher than 3803 and 9466 kcal/week, and than 7604 and 9727 kcal/week, respectively.

Table 3 summarizes the mean values of the blood biochemical parameters, arterial blood pressure and heart rate in the tercile ranges of WEE values. The data presented therein demonstrated that in the case of both women and men the average values of glucose, TC and TG concentrations

in subjects from the lower WEE terciles calculated using IPAQ and SDPAR questionnaires did not differ significantly from the values recorded for those surveyed from the middle and upper terciles. Tangible decreasing tendencies were, however, observed in cholesterol concentration for both genders along with increasing WEE values calculated with the use of both questionnaires. The mean values of systolic blood pressure (SBP) displayed a descending tendency between terciles of the weekly energy expenditure (WEE) calculated with IPAQ only in the group of women. In the case of diastolic blood pressure (DBP), similar tendencies were noted only in men, however they referred to differences between the terciles of WEE calculated using both questionnaires. In addition, significant differences were observed in the mean values of resting heart rate between the terciles of women ordered according to the increasing values of WEE calculated with IPAQ ($p < 0.05$) and SDPAR ($p < 0.01$). In both cases, the mean values were decreasing as follows: 82 ± 13 heartbeats $\times$ min⁻¹ vs. 79 ± 14 heartbeats $\times$ min⁻¹ vs. 75 ± 11 heartbeats $\times$ min⁻¹ and 82 ± 14 heartbeats $\times$ min⁻¹ vs. 77 ± 11 heartbeats $\times$ min⁻¹ vs. 75 ± 12 heartbeats $\times$ min⁻¹. Likewise, a significant ($p < 0.05$) decrease in the mean values of heart rate was noted in the case of men between the terciles of WEE calculated using IPAQ (73 ± 11 heartbeats $\times$ min⁻¹ vs. 71 ± 9 heartbeats $\times$ min⁻¹ vs. 67 ± 12 heartbeats $\times$ min⁻¹).

The results achieved in the study indicate no significant correlations between the selected biochemical blood markers and arterial blood pressure in women and men and the value of weekly energy expenditure calculated using IPAQ and SDPAR (Table 4). Significant ($p < 0.05$) negative correlations were demonstrated only between the heart rate of women and WEE value calculated with IPAQ ($r = -0.223$; Fig. 1) and SDPAR ($r = -0.238$; Fig. 2).

Discussion

Insufficient physical activity is one of the main risk factors of chronic diseases, cardiovascular diseases (CDVD) in particular [15, 16]. American guidelines concerning CDVD prevention recommend endurance exercises performed with moderate intensity minimally 3 times a week for at least 30 min [17]. European guidelines that assume performing physical exercise every day for 30 min on average seem to be stricter [18]. The preferred activities include a brisk march, riding a bicycle, gymnastics or swimming. Physical activity with intensity below 4–5 MET or is too short, such that it causes energy expenditure to go below

Table 3. Values of biochemical blood markers, arterial blood pressure and heart rate in tercile ranges of weekly energy expenditure estimated with IPAQ and SDPAR questionnaires (mean $\pm$ SD)

Parameter	Total	IPAQ terciles (kcal/week)				SDPAR terciles (kcal/week)			
		Women							
		(T1) (< 1784)	(T2) (1785–3802)	(T3) (> 3803)	ANOVA	(T1) (< 3788)	(T2) (3789–7603)	(T3) (> 7604)	ANOVA
Glucose (mg dL ⁻¹)	63.9 $\pm$ 9.4	64.3 $\pm$ 9.0	63.0 $\pm$ 10.5	64.4 $\pm$ 8.6	0.3558	63.2 $\pm$ 9.8	64.8 $\pm$ 8.9	63.8 $\pm$ 9.5	0.2110
Cholesterol (TC) (mg dL ⁻¹)	130.3 $\pm$ 23.3	133.1 $\pm$ 22.1	129.1 $\pm$ 20.1	126.7 $\pm$ 27.2	0.5816	132.6 $\pm$ 28.3	129.5 $\pm$ 22.7	128.7 $\pm$ 23.5	0.1172
Triglycerides (TG) (mg dL ⁻¹)	94.4 $\pm$ 43.6	94.9 $\pm$ 41.3	91.4 $\pm$ 44.2	96.8 $\pm$ 45.6	0.2156	93.8 $\pm$ 41.7	92.5 $\pm$ 41.4	96.8 $\pm$ 47.8	0.6212
SBP (mm Hg)	122 $\pm$ 11	123 $\pm$ 10	122 $\pm$ 9	120 $\pm$ 14	0.3499	122 $\pm$ 14	122 $\pm$ 9	121 $\pm$ 10	0.5333
DBP (mm Hg)	74 $\pm$ 9	74 $\pm$ 8	74 $\pm$ 10	74 $\pm$ 7	0.0330	75 $\pm$ 9	75 $\pm$ 9	72 $\pm$ 7	2.1214
Heart rate (heartbeats min ⁻¹)	79 $\pm$ 13	82 $\pm$ 13 ^{A#}	79 $\pm$ 14	75 $\pm$ 11 ^A	3.6684*	82 $\pm$ 14 ^A	77 $\pm$ 11	75 $\pm$ 12 ^A	4.7650**
		Men							
		(< 5195)	(5196–9465)	(> 9466)		(< 5286)	(5287–9726)	(> 9727)	
Glucose (mg dL ⁻¹)	65.3 $\pm$ 9.4	66.6 $\pm$ 9.4	65.4 $\pm$ 8.7	63.9 $\pm$ 10.1	1.1264	62.8 $\pm$ 9.7	67.0 $\pm$ 10.1	65.1 $\pm$ 8.7	2.1466
Cholesterol (TC) (mg dL ⁻¹)	113.7 $\pm$ 18.1	116.3 $\pm$ 18.6	114.2 $\pm$ 20.9	110.6 $\pm$ 14.0	1.5948	117.6 $\pm$ 20.7	113.8 $\pm$ 17.3	108.6 $\pm$ 12.6	2.4585
Triglycerides (TG) (mg dL ⁻¹)	78.1 $\pm$ 34.5	81.5 $\pm$ 35.7	75.7 $\pm$ 35.3	77.3 $\pm$ 32.8	0.3879	76.1 $\pm$ 30.7	78.1 $\pm$ 35.5	78.9 $\pm$ 35.5	0.0749
SBP (mm Hg)	132 $\pm$ 12	133 $\pm$ 12	130 $\pm$ 11	132 $\pm$ 13	0.9082	130 $\pm$ 13	132 $\pm$ 12	132 $\pm$ 11	0.3399
DBP (mm Hg)	72 $\pm$ 9	73 $\pm$ 9	72 $\pm$ 10	71 $\pm$ 8	0.6889	73 $\pm$ 8	72 $\pm$ 11	71 $\pm$ 8	0.4219
Heart rate (heartbeats min ⁻¹)	70 $\pm$ 11	73 $\pm$ 11 ^A	71 $\pm$ 9 ^B	67 $\pm$ 12 ^{AB}	3.8422*	71 $\pm$ 12	71 $\pm$ 12	70 $\pm$ 10	0.2186

() – numbers in brackets represent tercile ranges of weekly energy expenditure (kcal/week); # – mean values denoted with the same letters differ significantly at $p < 0.05$ (Newman-Keuls test); * $p < 0.05$; ** $p < 0.01$ statistical significance of one-way analysis of variance (ANOVA); SBP – systolic blood pressure; DBP – diastolic blood pressure.

Table 4. Correlations between biochemical blood markers, arterial blood pressure and heart rate and weekly energy expenditure estimated using IPAQ and SDPAR questionnaires (Pearson's correlation coefficients)

Parameter	IPAQ (kcal/week)		SDPAR (kcal/week)	
	women	men	women	men
Glucose (mg dL ⁻¹)	-0.010	0.064	-0.056	0.057
Cholesterol (TC) (mg dL ⁻¹)	0.092	-0.019	-0.038	-0.004
Triglycerides (TG) (mg dL ⁻¹)	-0.020	-0.003	-0.037	0.067
SBP (mm Hg)	-0.010	-0.004	-0.024	0.070
DBP (mm Hg)	-0.057	-0.043	-0.131	-0.044
Heart rate (heartbeats min ⁻¹)	-0.223*	-0.074	-0.238*	-0.036

* $p < 0.05$; SBP – systolic blood pressure; DBP – diastolic blood pressure.

Fig. 1. Negative correlation between resting heart rate (heartbeats/min) and weekly energy expenditure (WEE) estimated using IPAQ (kcal/week) in the group of women **Fig. 2.** Negative correlation between resting heart rate (heartbeats/min) and weekly energy expenditure (WEE) estimated using SDPAR (kcal/week) in the group of women

500 kcal/week is acknowledged as insufficient [19]. It seems that from the viewpoint of CDVD prophylaxis, the total weekly health-promoting dose of physical exercise and the corresponding total energy expenditure, which has been stipulated at min 1000 kcal/week, is more significant than the form of the training, its duration and frequency [20–22]. It is noteworthy that the optimal dose of physical exercise in CDVD prophylaxis has not been established yet and still remains the object of many studies. The results of this study demonstrate that energy expenditure above 1000 kcal/week may yield specified health benefits, but in turn indicate that the prophylactic dose of physical exercise should be much higher. Kwaśniewska et al. [23] are of the opinion that the discrepancy in the threshold dose of physical activity results mainly from the fact that most of the data originates from cross-sectional surveys or short-term clinical trials. In turn, the prospective study conducted by Lee et al. [24] among students of Harvard University demonstrates that the greatest reduction of atherosclerotic risk in middle-aged men was achieved at energy expenditure above 4000 kcal/week. Similar results were achieved from a 12-year observation of 44,000 men by Tanasescu et al. [25], who demonstrated that the most effective prophylactic strategy was an increase in total exercise volume through an increase in the intensity of aerobic exercise to a value of at least 6–12 MET and training completion with resistance exercises.

The results achieved in this survey (Table 3) confirm that systematic physical exercise with a weekly energy expenditure significantly exceeding 2000 kcal may have remarkable protective effects and may prevent the adverse changes related to cardiovascular risk and CDVD development. This may be indicated by distinct tendencies for TC concentration decrease in both gender groups that occurred along with the increasing WEE calculated using IPAQ and SDPAR questionnaires. A comparative analysis of the TC blood concentrations found in our study with data concerning male students of the West Pomeranian University of Technology [26] and candidates for pilots at the Polish Air Force Academy [27] demonstrated that in the group of students of the Academy of Physical Education in Biała Podlaska it was respectively lower by 49.5 and 44.5 mg·dL⁻¹, on average. Gromadzka-Ostrowska and Dworzynski [28] emphasized that increased physical activity enhances the activity of lipoprotein lipase in both adipose and muscle tissue, which contributes to the increasing rate of triglyceride metabolism in adipocytes and to changes in lipoprotein concentrations in blood plasma.

The level of physical activity turned out to be the factor which also differentiated the values of

arterial blood pressure (Table 3). The increasing mean WEE values were accompanied by descending tendencies of SBP and DBP in the group of women and men, respectively. Worthy of emphasis is that these tendencies were observed based on WEE estimation with both the IPAQ and SDPAR questionnaires, which suggests that, irrespectively of the test applied, some threshold of physical exercise intensity needs to be reached to induce the beneficial effect of exercise on arterial blood pressure reduction. Hayashi et al. [29] and Chase et al. [30] demonstrated that a higher level of physical activity reduced the risk of hypertension in healthy subjects with normal SBP and DBP values. Physical activity may help in both hypertension prevention and blood pressure control in hypertensive patients. Intensive aerobic exercises were proved not only to reduce the value of arterial blood pressure in subjects with already diagnosed hypertension, but also to reduce its susceptibility to stress-inducing factors [31]. The greater benefits resulting from high-intensity physical activity occur, probably, due to improved physical efficiency, which is claimed to be an important determinant of atherosclerosis risk.

The intensity of exercise is usually determined as the percentage of maximum oxygen absorption (VO_{2max}), ventilation threshold or lactate threshold, which may be assessed using ergospirometric tests that may be conducted only under laboratory conditions. Hence in practice, the intensity of recommended exercises is usually determined according to the resting heart rate which reaches 60–90 heartbeats/min. in a human. Our survey demonstrated that in the group of women, the increasing values of WEE calculated using both questionnaires were accompanied by a significant decrease in the mean values of resting heart rate. The significant ($p < 0.05$) decrease in heart rate was also observed in the group of men, but concerned only WEE values calculated using IPAQ (Table 3). In addition, it was demonstrated that the increasing WEE values corresponded to decreasing values of resting heart rate (Table 3), which was confirmed by significant correlations (Table 4) between the heart rate of women and WEE estimated using IPAQ ($r = -0.223$, Fig. 1) and SDPAR ($r = -0.238$, Fig. 2). This may be explained by the body's adaptation to higher loads, which also affects the value of the resting heart rate. In addition, healthy and trained individuals may better tolerate exercise with a higher intensity. A healthy man aged 21–30 may perform – without any greater risk – physical exercises that cause acceleration of the heart rate to 115–145 beats per min [21].

To sum up the survey conducted, it is worth emphasizing that higher values of coefficients of

correlation between the biochemical blood markers, arterial blood pressure, resting heart rate and WEE values were achieved in the case of the SDPAR questionnaire (Table 4). Apart from the data on the physical activity, this questionnaire additionally takes account of the energy expenditure during sleep, which makes it possible to estimate the total daily or weekly energy expenditure (kcal/day, kcal/week), including considering body mass (kcal/kg/day, kcal/kg/week).

The authors concluded that beneficial changes were observed in the blood lipid profile and mean values of the resting heart rate as a result of higher

energy expenditure. Systematic physical exercise with weekly energy expenditure significantly exceeding 2000 kcal may have remarkable protective effects and may prevent adverse changes related to cardiovascular risk and CDVD development. Both IPAQ and SDPAR questionnaires may be applied to assess the level of physical activity; however, higher values of coefficients of correlation between the biochemical blood parameters, arterial blood pressure, resting heart rate and WEE values were achieved with the SDPAR questionnaire, which makes it a more useful tool in CDVD preventive screening.

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