

Paffenbarger Physical Activity Questionnaire as an additional tool in clinical assessment of patients with coronary artery disease treated with angioplasty

Zbigniew Nowak¹, Michał Plewa¹, Małgorzata Skowron², Andrzej Markiewicz¹, Cezary Kucio¹, Grażyna Osiadło¹

¹ Faculty of Physiotherapy, the Jerzy Kukuczka Academy of Physical Education, Katowice, Poland

² Health Resort Company „Ustroń” SA, Ustroń, Poland

Abstract

Background: The association between frequency, intensity and duration of physical activity and the risk of cardiovascular disease has been investigated in several studies. Out of many methods used for assessment of physical activity, a questionnaire seems to be a simple and affordable method of assessing the risk of coronary artery disease (CAD). However, the number of clinical studies investigating the usefulness of physical activity questionnaires is limited.

Aim: To analyse the usefulness of Paffenbarger Physical Activity Questionnaire (PPAQ) in assessment of the correlation between the magnitude of physical activity-related energy expenditure and physical capacity assessed with treadmill exercise test (ET), risk of early onset of major adverse cardiovascular events (MACE) and selected haemodynamic parameters in patients with CAD.

Methods: The study group consisted of 211 patients aged 34-79 years (mean 59) with CAD, with or without previous myocardial infarction (MI). All patients were surveyed using PPAQ at the time of PCI and then 6 months later together with ET and echocardiography.

Results: There was a significant correlation between the value of activity-related weekly energy expenditure assessed with the PPAQ and selected parameters of ET (duration: $r = 0.2966$, $p < 0.0001$; METs: $r = 0.2221$, $p < 0.001$; VO_{2max} : $r = 0.3075$, $p < 0.0001$; resting HR: $r = 0.1615$, $p < 0.01$ and maximal HR: $r = -0.1475$, $p < 0.01$) and echocardiography (LVESD $r = 0.2346$, $p < 0.0001$). After the PCI procedure, there was a considerable increase in physical capacity (ET duration: 5.82 vs. 7.48 min, $p < 0.0001$; MET: 7.57 vs. 9.18, $p < 0.0001$; VO_{2max} : 29.23 vs. 34.79 ml, $p < 0.0001$; HRmax: 123 vs. 132 beats/min, $p < 0.0001$) and LV function (EF% 51.64 vs. 52.45%, $p < 0.01$). There was an insignificant change in total physical activity-related energy expenditure of low intensity (< 4 MET), not exceeding 2000 kcal/week (from 3120.13 to 3139.18 kcal/week, $p > 0.05$). Thirty-seven patients with MACE had a trend towards a lower value of average weekly energy expenditure than the remaining 174 patients (2690.71 vs. 3206.06 kcal/week, NS).

Conclusions: High values of correlation coefficients between the questionnaire results and some variables of ET and echocardiography examination make the PPAQ a useful tool in clinical studies.

Key words: ischaemic heart disease, angioplasty, physical activity questionnaire, stress test, echocardiography

Kardiologia Polska 2010; 68: 32-39

Introduction

In recent years there have been many papers published on the research methods aimed at measurement of physical activity. Some were based on monitoring of selected physiological parameters such as heart rate, amount of energy expenditure derived from food using direct and indirect calorimetry, kinematic analysis and doubly labelled water method [1, 2]. In epidemiological studies, the application of such methods is limited due to high costs, potential contraindications, advanced age of subjects, their health status and low reliability [3-5]. It seems that

a questionnaire constitutes a simple and inexpensive tool in assessment of physical activity. In some questionnaires only occupational activity is of interest, in others, only leisure time exercise, but many seek information about activity both on and off the job. The questionnaires assess the physical activity over a wide age range for various periods of time – the last 24 h, the previous week, month or even a year. The data obtained in this way allows for calculation of average energy expenditure of an individual, which informs us whether the form, frequency and intensity of physical activity reach the values required for prevention

Address for correspondence:

Prof. Zbigniew Nowak PhD, Akademia Wychowania Fizycznego, ul. Mikołowska 72a, 40-065 Katowice, tel.: +48 32 207 53 01, fax: +48 32 251 68 68, e-mail: zbinow@gmail.com

Received: 18 May 2009. Accepted: 03 September 2009.

and treatment of many so-called civilization diseases. However, the number of studies done on the application of questionnaires for clinical purposes is limited. The majority of studies have been performed on a large number of subjects, both healthy subjects and patients. They aimed to evaluate the general level of physical activity of studied subjects in recent days, weeks, months or even years, and the results were analysed in relation to gender, age and occupational status.

The objective of the present study was to assess the utility of the Paffenbarger Physical Activity Questionnaire (PPAQ) in the evaluation of the correlation between physical activity and physical capacity, risk of early onset of major cardiovascular events (combined endpoint) and selected haemodynamic parameters in patients before and after coronary intervention. We attempted to answer the following questions:

1. What is the average weekly amount of physical activity and energy expenditure calculated using the PPAQ in patients with coronary artery disease (CAD) before and after percutaneous coronary intervention (PCI)?
2. Do obtained questionnaire results correlate with the level of physical capacity [assessed with submaximal treadmill exercise test (ET)] and cardiac haemodynamical parameters (evaluated with echocardiography), making it a usable tool in clinical studies?
3. Is there a correlation between the obtained questionnaire results and combined endpoint?

Methods

Study group

The study group consisted of 211 patients, aged 34-79 years (mean age 59 ± 9). Among them there were: 7 patients after an acute uncomplicated myocardial infarction (MI) without ST segment elevation, 125 patients with CAD without previous history of MI; and 79 patients with CAD and a history of MI in the preceding 5 years. All patients were informed about the type and aim of the research and they gave written informed consent before participating in the study. Subjects were instructed that they may withdraw from the study at any time. All patients underwent PCI, during which 145 (68.72%) patients received one stent and 15 (7.10%) had two stents implanted. All patients underwent phase I inpatient cardiac rehabilitation which lasted from 5 to 7 days. After discharge all patients were referred to phase II – a 24-day cardiac rehabilitation in a health resort. The study was approved by the local Ethics Committee.

Desing of the study

All subjects were examined twice: first, at the time of hospitalisation for the PCI procedure, with the exception of 41 patients (including 7 patients after acute MI), who were referred for their ambulatory clinic up to three

months before; then for the second time 6 months after the PCI procedure.

Combined endpoint

One of the criteria used for patients' assessment was the combined endpoint, which included death, MI, unstable CAD, the need for additional PCI or coronary artery bypass grafting (CABG). In order to verify the correlation between the amount of physical activity-related weekly energy expenditure and occurrence of combined endpoints, we compared results obtained from the PPAQ between patients without and with at least one of the combined endpoints.

Treadmill exercise test

The level of physical capacity was assessed using the submaximal ET (7 levels according to Bruce's protocol). The following variables were analysed: test duration (min), metabolic cost (MET), resting and the highest (maximal) recorded value of heart rate (HR) (beats/min), maximal oxygen consumption $VO_2\text{max}$ (ml) and the reason for test termination such as reaching the submaximal value of HR calculated with the formula: $(220 - \text{age}) \times 0.85$, fatigue, angina, changes of ST segment in electrocardiogram (ECG), occurrence of arrhythmias, conduction disorders and excessive increase in arterial blood pressure. The value of $VO_2\text{max}$ was calculated according to the following formula:

$$VO_2\text{max} = 13.3 - 0.03 (t) + 0.297 (t^2) - 0.0077 (t^2) + 4.2 (CHS)$$

where, t – time (min), CHS – cardiac health status, 1 – patients with angina pectoris, after MI, after PCI, 0 – patients without clinical symptoms of angina pectoris, without history of MI or PCI [6].

Echocardiography

Echocardiographic assessment was performed using 2-dimensional echocardiography (HP Sonos 1100) by an experienced investigator. The following parameters were analysed: left ventricular end-diastolic diameter (LVEDD), LV end-systolic diameter (LVESD), LV ejection fraction (LVEF%) and LV mass (LVM) according to established formulas [7-9].

Paffenbarger Physical Activity Questionnaire

The PPAQ results enabled calculation of the level of physical activity during a 6-month period both before and after the PCI procedure [10]. The questionnaire consisted of 8 questions. Questions 1-3 were related to walking, with focus on distance, velocity and pace (casual or strolling, fairly brisk, average or normal and brisk or striding) and the number of asked for stairs climbed up each day. Question 4 asked for any sports or recreation that the patients had actively participated in during the past 6-month period, giving its time and frequency (number of

times during the past week, 6 months or year). In questions 5 and 6, patients described their subjective feelings of fatigue and tiredness during physical activity, while in question 7 they rated their level of exertion on a 10-point scale, while exercising in their usual fashion. In question 8 patients specified how many hours of a 24-hour day they spend doing vigorous, moderate and light activities, and also how many hours they spend doing sitting activities and sleeping, separately for a usual weekday and usual weekend day. On the basis of obtained answers, it was possible to calculate patients' energy expenditure [in kcal].

The following types of activity intensity were used: low (< 4 MET), moderate (4 – < 6 MET) and high ($\geq$ 6 MET). The value of total averaged weekly energy expenditure was calculated separately for recreational activity (RA) and household activity (HA) (shopping, cleaning, gardening, house remodelling and repairs). Additional categorisation of weekly energy expenditure into 4 ranges was also made: $\leq$ 999, 1000-1999, 2000-2999, $\geq$ 3000 (kcal/week). The MET for a given activity value was calculated according to the University of South Carolina standards [10-12]. In order to increase reliability of the questionnaire calculations (avoiding possible misunderstanding of some questions, especially those concerning the time of activity), the authors of this study red the questions of the PPAQ and filled in the form for patients during individual appointments.

Statistical analysis

All statistical analyses were performed using Statistica (v. 7.1) software, StatSoft USA and MedCalc software (v. 8.0.0.1). Initially it included the calculation of means and standard deviations (SD) of variables. The distribution of values of all variables was evaluated with the Wilk-Shapiro test for normality. A p value < 0.05 was considered significant. Student's t -test for independent variables with normal distribution was used. This test was preceded by Fisher's test for verification of the homogeneity of variance. If the variance was not equal, Satterthwaite's test was used. Student's t -test for dependent variables was also used, as well as one-way variance analysis preceded by Bartlett's test for verification of variance homogeneity. For variables with non-normal distribution, Mann-Whitney U test, Kruskal-Wallis ANOVA test and Spearman's rank correlation test were used.

Results

Out of 211 patients who initially underwent PCI, 207 were subjected to the second questionnaire (2 patients died due to CAD in the second and fifth month after PCI, and 2 patients resigned from the study due to general discomfort). Compared with the baseline examination results, during the following 6 months we did not observe any increase in total energy expenditure of physical activity, even when we analysed separately the activities

of low, moderate and high intensity. Similarly, the comparison between 4 different ranges of weekly energy expenditure did not show any difference either, though we observed a favourable tendency towards increase in recreational activities of low intensity < 4 MET (in ranges of 1000-1999 and 2000-2999 kcal/week) and of moderate intensity 4-6 MET (for ranges lower than 2000 kcal/week). Detailed results are shown in Table I.

Compared to the results of the initial examination, an improvement in patients' physical capacity was noted during ET performed 6 months later. It was especially pronounced in those patients whose recreational activity exceeded the level of 2000 kcal/week (Table II).

The echocardiography examination performed 6 months after PCI showed an improvement of some echocardiographic parameters. Significant changes were observed in the LVESD and LVEF% values (Table III).

A significant correlation was found between PPAQ results and MET, VO₂max, HR rest and HR max as well as LVESD (Table IV).

Combined endpoint occurred in 37 (17.53%) patients. During the 6-month period 2 (0.94%) patients died due to CAD, 4 (1.89%) patients underwent CABG, and 31 (14.69%) needed another PCI procedure with stent implantation due to recurrence of unstable CAD.

Weekly energy expenditure of physical activity in patients without combined endpoint was higher, though the difference did not reach statistical significance (3206.06 ± 2018.63 vs. 2690.71 ± 1740.20 kcal/week, NS). The comparison of activities of different intensity (low < 4 MET, moderate 4 – < 6 MET and high $\geq$ 6 MET) and various type (RA, HA) did not show significant differences.

Discussion

The average amount of weekly energy expenditure related to recreational activity, and therefore the one which is of great importance for prevention of cardiovascular diseases [13-15], did not exceed in our study the value of 2000 kcal/week before the first PCI and was mainly of low intensity – < 4 MET (morning warm-up exercises, walking, fishing), or of moderate intensity, 4-6 MET (cycling, including stationary cycling, general conditioning exercises). The range of physical activity remained below the level of 1000 kcal/week. Such a low level of physical activity may result from limitation of exercise tolerance due to CAD or history of MI, but most likely from a sedentary lifestyle [15]. The majority of patients did not engage in any form of sport or recreational physical activity and even if they did, such activity was short-lasting and sporadic. There were however a few patients who systematically participated in various forms of recreation (skiing, jogging, swimming); their weekly energy expenditure resulting from such activities very often exceeded the level of 2000 and sometimes even 3000 kcal per week. That small group of patients included individuals

Table I. Comparison of energy expenditure of physical activity before and 6 months after PCI calculated using the PPAQ

Parameter		< 999 kcal		1000-1999 kcal		2000-2999 kcal		> 3000 kcal		Total	
		before PCI	6 months after PCI	before PCI	6 months after PCI	before PCI	6 months after PCI	before PCI	6 months after PCI	before PCI	6 months after PCI
Low intensity < 4 MET											
RA	mean	532.62	468.15	1530.35	1531.26	2486.12	2501.41	3909.34	3687.48*	1780.28	1907.14
	SD	241.90	226.74	258.53	281.05	306.69	260.64	919.69	738.66	1299.75	1171.07
	N	72	45	66	82	33	38	39	41	210	206
HA	mean	263.95	431.33	1218.46		2492.30	2603.93	4216.90	4043.07	1570.43	1370.94
	SD	132.66	215.10	47.97				457.30	197.11	1705.82	1534.13
	N	8	14	3	0	1	2	4	4	16	20
Total	mean	547.95	511.62	1513.77	1518.17	2468.36	2501.19	4139.65	3974.37	1899.93	2030.38
	SD	239.55	242.67	252.46	292.00	317.51	256.36	1111.84	1018.73	1452.16	1330.66
	N	71	45	61	77	33	39	45	46	210	207
Moderate intensity 4 – < 6 MET											
RA	mean	411.28	414.31	1416.51	1467.45	2470.76	2369.85	3415.15	5483.07	639.99	650.51
	SD	269.96	259.59	322.69	341.88	197.19	291.27	391.94		632.47	708.93
	N	106	98	17	14	3	4	2	1	128	117
HA	mean	372.40	506.12*	1398.24	1460.64	2367.56	2384.60	4450.70	3874.73	1156.22	1095.53
	SD	249.74	288.14	278.60	306.17	99.96	412.87	1329.05	531.09	1415.28	1043.98
	N	78	77	22	27	8	6	14	10	122	120
Total	mean	462.20	542.82	1425.12	1388.96	2420.16	2411.50	4221.67	4182.71	1303.97	1221.02
	SD	265.71	269.12	302.47	300.86	193.83	279.38	1327.42	688.86	1318.68	1087.48
	N	92	96	47	45	12	16	20	13	171	170
High intensity ≥ 6 MET											
RA	mean	390.21	335.95	1126.15	1661.53		2035.00	3246.92	5386.14	694.88	687.02
	SD	310.68	241.05	31.97				107.70		836.11	1136.53
	N	21	20	3	1	0	1	2	1	26	23
HA	mean	341.15	253.40	1419.22	1246.15	2215.38		4984.61		770.74	283.48
	SD	230.96	193.60							1220.53	257.25
	N	26	32	2	1	1	0	2	0	31	33
Total	mean	355.10	292.68	1354.15	1396.15	2215.38	2118.45	4337.30	5386.14	777.03	493.26
	SD	257.56	215.45	307.81	230.48			1311.49		1154.65	813.30
	N	31	46	5	3	1	1	4	1	54	51
Total energy expenditure	mean	557.64	563.71	1522.59	1541.39	2496.24	2502.98	4914.73	4573.00	3120.13	3139.18
	SD	201.70	259.43	258.00	271.61	322.38	278.82	1545.59	1258.57	1978.82	1731.65
	N	22	19	52	40	44	48	93	100	211	207

Abbreviations: RA – recreational activity, HA – household activity, Total – energy expenditure includes either one or both types of physical activity (RA, HA, RA + HA)

* $p < 0.05$

who used to do sports in the past or who were really enjoying such activities.

After the angioplasty procedure the increase of the level of physical activity as well as energy expenditure was anticipated. We assumed that one factor which would favourably affect patients' attitude to physical activity was

the cardiac rehabilitation programme, both in hospital and in the health resort. There was, however, no increase in total weekly energy expenditure noted after the PCI procedure; nor was there in the intensity or type of performed activities. During the 6-month period preceding the second PCI, patients engaged mainly in recreational

Table II. Comparison of exercise test parameters in relation to ranges of physical activity assessed using the PPAQ before and 6 months after PCI

Parameter		< 999 kcal		1000-1999 kcal		2000-2999 kcal		> 3000 kcal		Total	
		before PCI	6 months after PCI	before PCI	6 months after PCI	before PCI	6 months after PCI	before PCI	6 months after PCI	before PCI	6 months after PCI
Test duration [min]	mean	5.35	6.50**	5.96	6.53*	5.62	7.14***	5.95	8.15***	5.82	7.48***
	SD	2.91	2.43	2.58	2.23	2.35	2.66	2.84	2.32	2.68	2.48
	N	22	12	52	37	44	41	93	90	211	180
Energy expenditure [MET]	mean	6.99	8.66***	7.91	8.40*	7.35	8.77***	7.61	9.76***	7.57	9.18***
	SD	2.83	2.30	2.91	2.71	2.31	2.81	2.63	2.40	2.66	2.61
	N	22	12	52	37	44	41	93	90	211	180
VO ₂ max [ml/kg/min]	mean	27.94	29.94*	29.61	30.76	28.19	33.48***	29.82	37.69***	29.23	34.79***
	SD	9.66	7.34	8.95	8.37	8.64	10.72	11.19	10.78	9.98	10.51
	N	22	12	52	37	44	41	93	90	211	180
Resting HR [beats/min]	75.91	76.58	77.02	73.46***	77.82	73.56***	77.72	73.04***	77.38	73.48***	
	SD	10.28	7.65	8.06	10.13	10.46	10.00	9.26	10.04	9.31	9.87
	N	22	12	52	37	44	41	93	90	211	180
HRmax [beats/min]	119.42	134.00***	122.28	134.40***	121.56	131.78***	126.63	130.76**	123.60	132.19***	
	SD	16.06	11.37	19.44	14.67	17.10	14.73	16.44	15.07	17.32	14.57
	N	22	12	52	37	44	41	93	90	211	180
HRsubmax not reached	N/Σ	14/22	4/12***	36/52	15/37***	31/44	17/41***	52/93	27/90**	133/211	63/180***
	[%]	63.64	33.33	69.23	40.54	70.45	41.46	55.91	30.00	63.03	35.00
Positive result of test	N/Σ	20/22	6/12**	47/52	16/37***	39/44	16/41***	80/93	19/90***	186/211	57/180***
	[%]	90.91	50.00	90.38	43.24	88.64	39.02	86.02	21.11	88.15	31.67

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ **Table III.** Comparison of echocardiographic parameters in relation to ranges of physical activity assessed using the PPAQ before and 6 months after PCI

Parameter		Below < 999 kcal		1000-1999 kcal		2000-2999 kcal		> 3000 kcal		Total	
		before PCI	6 months after PCI	before PCI	6 months after PCI	before PCI	6 months after PCI	before PCI	6 months after PCI	before PCI	6 months after PCI
LVEDD [mm]	mean	49.86	51.83*	49.38	50.45*	52.95	51.24*	51.47	51.82	51.10	51.35
	SD	6.88	6.90	7.69	5.18	5.98	7.71	5.54	5.26	6.44	6.08
	N	22	18	52	40	44	46	93	99	211	203
LVESD [mm]	mean	33.59	34.56***	32.65	33.40***	35.68	34.11**	36.17	34.80***	34.93	34.33***
	SD	7.42	9.82	5.58	5.08	6.90	5.78	7.09	7.26	6.87	6.80
	N	22	18	52	40	44	46	93	99	211	203
LVEF% [%]	mean	52.14	48.83**	53.12	54.30*	49.70	52.41**	51.60	52.45**	51.64	52.45**
	SD	9.60	10.76	8.83	7.53	7.97	8.09	9.65	8.19	9.13	8.34
	N	22	18	52	40	44	46	93	99	211	203
LVM [g]	mean	221.40	227.91*	197.43	192.25*	219.03	216.63	211.70	206.87*	210.64	207.86
	SD	70.74	67.94	51.86	41.43	67.46	60.68	54.60	51.39	58.70	54.01
	N	22	18	52	40	44	46	93	99	211	203
LVMI [g/m ²]	mean	116.31	118.76	103.58	101.24	113.52	115.92	112.37	109.09*	110.82	109.86
	SD	29.01	28.05	28.30	20.92	34.90	31.25	27.21	26.18	29.50	27.01
	N	22	18	52	40	44	46	93	99	211	203

Abbreviations: LVEDD – left ventricular end-diastolic diameter, LVESD – left ventricular end-systolic diameter, LVEF – left ventricular ejection fraction, LVM – left ventricular mass, LVMI – left ventricular mass index

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table IV. Correlation coefficients of weekly energy expenditure assessed using the PPAQ and exercise test as well as echocardiographic parameters

Exercise test		r	p	Echocardiography		p
PPAQ 1	duration 1	0.0620	0.3700	LVEDD 1	0.1289	0.0616
PPAQ 2	duration 2	0.2966	0.0001	LVEDD 2	0.0349	0.6216
PPAQ Δ	duration Δ	0.2073	0.0052	LVEDD Δ	-0.0660	0.3497
PPAQ 1	MET 1	0.0108	0.8761	LVESD 1	0.2346	0.0006
PPAQ 2	MET 2	0.2221	0.0027	LVESD 2	0.0353	0.6173
PPAQ Δ	MET Δ	0.1477	0.0478	LVESD Δ	0.0735	0.2975
PPAQ 1	VO ₂ max 1	0.0530	0.4435	EF% 1	-0.0488	0.4809
PPAQ 2	VO ₂ max 2	0.3075	0.0001	EF% 2	0.0211	0.7656
PPAQ Δ	VO ₂ max Δ	0.2312	0.0018	EF% Δ	0.0369	0.6013
PPAQ 1	resting HR 1	0.0405	0.5587	LVM 1	0.0469	0.5033
PPAQ 2	resting HR 2	-0.0025	0.9735	LVM 2	-0.0348	0.6217
PPAQ Δ	resting HR Δ	0.1615	0.0303	LVM Δ	-0.0615	0.3835
PPAQ 1	HRmax 1	-0.0268	0.6989	LVMI 1	0.0485	0.4887
PPAQ 2	HRmax 2	-0.1475	0.0481	LVMI 2	-0.0448	0.5252
PPAQ Δ	HRmax Δ	-0.0075	0.9204	LVMI Δ	-0.0736	0.2967

1 – result obtained before PCI, 2 – result 6 months after PCI, Δ – delta between result 2 and 1. Abbreviations as in Table III

activities of low intensity, in the range of 1000-1999 or 2000-2999 kcal/week, and in household activities of moderate intensity (4-6 MET). The values of these activities however still remained at an unchanged level.

We found an improvement in variables obtained at the second ET. The higher the increase in energy expenditure in relation to the initial examination, the more the improvement in selected ET parameters was noted. Patients who exceeded the value of 2000 kcal/week after the first PCI were able to exercise longer, resulting in higher values of obtained MET, VO₂max and maximal HR. In this group of patients, there was a considerable increase in the number of patients reaching the level of submaximal HR and a decrease in the number of positive ET results. Similar findings were reported by Richardson et al. [16].

The PCI procedure resulted in improvement of LV function (increase in EF%, reduced LVESD), which was also reported by Agirbasli et al. [17], Hu et al. [18], Nechvatal et al. [19] and Zellweger et al. [20]. In the case of other parameters such as LVEDD, LVM and LVMI, there was a favourable trend towards improvement.

We also calculated the range of weekly energy expenditure at which patients obtained the most desirable examination results. Before the PCI procedure the best results were observed in the range below 2000 kcal/week. After a 6-month period, the echocardiography examination and ET revealed the most favourable changes in the group of patients whose level of energy expenditure exceeded 2000 kcal/week.

Correlation analysis showed that there was a weak correlation between the energy expenditure and all ET parameters such as time, MET, VO₂max and resting and maximal HR, mainly when the second test and delta values were taken into consideration. The correlation analysis of energy expenditure with echocardiography results showed only one weak correlation of LVESD dimension in comparison to initial values. Low values of correlation coefficients may result from a drop in physical activity level in some patients due to a fear of recurrence of cardiovascular events or due to slow learning of new behavioural habits concerning more active lifestyle.

We also attempted to determine whether the average value of weekly energy expenditure calculated using a questionnaire may be used in predicting the occurrence of combined endpoint. For this purpose we compared the calculated questionnaire results of 37 patients with combined endpoint with the results of the other 174 patients. Comparison of total weekly energy expenditure and comparison of different intensity activities (low, moderate, high) and their type (recreational and household) showed a favourable trend for patients without the combined endpoint, however, there were no significant differences noted between compared variables. Perhaps, if the study group consisted of more patients with a combined endpoint, it would be possible to prove that the PPAQ could be used for prediction of combined endpoints in patients with CAD. Meanwhile, such a conclusion cannot be made.

The questionnaire used in the present study seems to be a valuable tool in the assessment of long-term QoL. It

also allows to follow the changes in the level of physical activity resulting from PCI and provides motivation for patients to increase their physical activity for the purpose of reducing the risk of reoccurrence of cardiovascular disease. The observed correlation between the questionnaire results and ET as well as echocardiography parameters, as well as its high repeatability, indicate that the PPAQ is a useful tool in clinical studies. Compared with other examination methods, a questionnaire is a simple, affordable and safe diagnostic tool, which enables energy expenditure to be measured regardless of patients' age, gender and health status.

Conclusions

1. According to the questionnaire results it seems that patients with CAD do not change their level of physical activity within 6 months after the angioplasty procedure.
2. The PPAQ results correlate with the majority of ET results and with LVEF, which makes it a valuable tool in clinical studies.
3. Patients with a combined endpoint occurring during 6 months after PCI, seem to have lower weekly energy expenditure than patients without complications.

References

1. Bonnefoy M, Normand S, Pachiardi C, et al. Simultaneous validation of ten physical activity questionnaires in older men: a doubly labeled water study. *J Am Geriatr Soc* 2001; 49: 28-35.
2. Paffenbarger RS, Blair SN, Lee IM, et al. Measurement of physical activity to assess health effects in free-living populations. *Med Sci Sports Exerc* 1993; 25: 60-70.
3. Aaron DJ, Kriska AM, Dearwater SR, et al. Reproducibility and validity of an epidemiologic questionnaire to assess past year physical activity in adolescents. *Am J Epidemiol* 1995; 142: 191-201.
4. Eaton CB, Nafziger AN, Strogatz DS, et al. Self-reported physical activity in a rural county: A New York County Health Census. *Am J Public Health* 1994; 84: 29-32.
5. Berenstein M, Sloutskis D, Kumanyika S, et al. Data based approach for developing a physical activity frequency questionnaire. *Am J Epidemiol* 1998; 147: 147-54.
6. Foster C, Jackson AS, Pollock ML, et al. Generalized equations for predicting functional capacity from treadmill performance. *Am Heart J* 1984; 107: 1229-34.
7. Juo SH, Di Tullio MR, Lin HF, et al. Heritability of left ventricular mass and other morphologic variables in Caribbean Hispanic subjects: the Northern Manhattan Family Study. *J Am Coll Cardiol* 2005; 46: 735-7.
8. Devereux RB, Alonso DR, Lutas EM. Echocardiographic assessment of left ventricular hypertrophy: comparison to necroscopy findings. *Am J Cardiol* 1986; 57: 450-8.
9. DuBois D, DuBois EF. A formula to estimate the approximate surface area if height and weight be known. *Arch Int Med* 1916; 17: 863-71.
10. Montoye HJ, Kemper HCG, Saris WHM, et al. Measuring physical activity and energy expenditure. *Human Kinetics Publishers, Champaign, IL*; 1996, 139-48.
11. Ainsworth BE. The compendium of physical activities guide. Prevention Research Center, Norman J. Arnold School of Public Health, University of South Carolina 2002. http://prevention.sph.sc.edu/tools/docs/documents_compendium.pdf.
12. Ainsworth BE, Haskell WL, Whitt MC, et al. Compendium of Physical Activities: An update of activity codes and MET intensities. *Med Sci Sports Exerc* 2000; 32 (Suppl. 9): 498-516.
13. Haskell WL, Lee IM, Pate RR, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc* 2007; 39: 1423-1434.
14. Nelson ME, Rejeski WJ, Blair SN, et al. Physical activity and public health in older adults. Recommendation from the American College of Sports Medicine and the American Heart Association. *Circulation* 2007; 116: 1094-105.
15. Steffen LM, Arnett DK, Blackburn H, et al. Population Trends in Leisure-Time Physical Activity: Minnesota Heart Survey, 1980-2000. *Med Sci Sports Exerc* 2006; 38: 1716-23.
16. Richardson MT, Leon AS, Jacobs DR, et al. Comprehensive Minnesota Leisure – Time Physical Activity Questionnaire. *J Clin Epidemiol* 1994; 47: 271-81.
17. Agribasli M, Guler N. Recovery of left ventricular systolic function after left anterior descending coronary artery stenting. *J Interv Cardiol* 2005; 18: 83-8.
18. Hu FB, Tamai H, Kosuga K, et al. Predictors of improvement in left ventricular function after initially successful angioplasty of unprotected left main coronary artery stenoses. *Int J Cardiovasc Intervent* 2004; 6: 119-27.
19. Nechvatal L, Hlinomaz O, Groch L, et al. Serial echocardiographic assessment of left ventricular function after direct PCI. *Kardiol Pol* 2003; 59: 397-401.
20. Zellweger MJ, Tabacek G, Zutter AW, et al. Evidence for left ventricular remodeling after percutaneous coronary intervention: effect of percutaneous coronary intervention on left ventricular ejection fraction and volumes. *Int J Cardiol* 2004; 96: 197-201.

Ocena przydatności kwestionariusza aktywności ruchowej Paffenbargera w badaniach klinicznych u chorych z niewydolnością wieńcową leczonych metodą angioplastyki

Zbigniew Nowak¹, Michał Plewa¹, Małgorzata Skowron², Andrzej Markiewicz¹, Cezary Kucio¹, Grażyna Osiadło¹

¹ Wydział Fizjoterapii, Akademia Wychowania Fizycznego im. Jerzego Kukuczki, Katowice

² Przedsiębiorstwo Uzdrowskie „Ustroń” SA, Ustroń

Streszczenie

Wstęp: Spośród wielu narzędzi badawczych służących pomiarom aktywności ruchowej, istotnej z punktu widzenia ryzyka wystąpienia niewydolności wieńcowej, najprostszymi i najtańszymi są kwestionariusze. Liczba publikacji naukowych na temat ich wykorzystania w badaniach klinicznych jest znikoma.

Cel: Analiza przydatności kwestionariusza aktywności ruchowej *Paffenbarger Physical Activity Questionnaire* (PPAQ) do oceny związku pomiędzy wielkością wydatku energetycznego związanego z aktywnością ruchową a: tolerancją wysiłkową (próba wysiłkowa), ryzykiem wystąpienia powikłań sercowo-naczyniowych (złożony punkt końcowy, ZPK) i parametrami hemodynamicznymi serca (UKG) u pacjentów z chorobą niedokrwienną serca, po przebytym zawale lub bez zawatu w wywiadzie, przed angioplastyką i 6 miesięcy po niej.

Metody: Zbadano 211 chorych w wieku 34–79 lat (średnio 59 ± 9) z ostrym zawalem oraz z rozpoznaną wcześniej chorobą niedokrwienną serca, po przebytym zawale lub bez zawatu w wywiadzie. U wszystkich pacjentów wykonano koronarografię, a następnie angioplastykę naczyń wieńcowych z implantacją stentu lub bez implantacji. Badania wykonano dwukrotnie – podczas hospitalizacji związanej z zabiegiem i 6 miesięcy po zabiegu. Oceniano poziom tolerancji wysiłkowej na podstawie testu wysiłkowego na bieżni (czas testu, MET, $VO_2 \max$, HR spoczynkowe, HR $\max$) i wybrane wskaźniki funkcji lewej komory serca (LVEDD, LVESD, EF%, LVM, LVMI). Oceny poziomu i rodzaju aktywności ruchowej dokonano na podstawie kwestionariusza PPAQ. Oszacowano wartość całkowitego tygodniowego wydatku energetycznego (kcal/tydzień) oraz dokonano jego kategoryzacji: ≤ 999 , 1000–1999, 2000–2999, ≥ 3000 kcal/tydzień. Zbadano zależność pomiędzy wielkością tego wydatku a wystąpieniem ZPK.

Wyniki: Po zabiegu angioplastyki wykazano wzrost tolerancji wysiłkowej (czas testu 5,82 vs 7,48 min, $p < 0,0001$; MET 7,57 vs 9,18, $p < 0,0001$; $VO_2 \max$ 29,23 vs 34,79 ml, $p < 0,0001$; HR $\max$ 123 vs 132 uderzeń/min, $p < 0,0001$), poprawę funkcji lewej komory serca (istotna zmiana jedynie w zakresie EF% – 51,64 vs 52,45%, $p < 0,01$) oraz zwiększenie całkowitego wydatku energetycznego związanego z aktywnością ruchową (3120,13 vs 3139,18 kcal/tydzień, NS), przy czym wydatek energetyczny związany z aktywnością rekreacyjną zarówno przed, jak i po zabiegu mieścił się w obszarze wysiłków lekkich (< 4 MET), nie przekraczając 2000 kcal/tydzień. Wykazano zależności pomiędzy wielkością tygodniowego wydatku kalorycznego a parametrami testu wysiłkowego (czas trwania testu $r = 0,2966$, $p < 0,0001$; MET $r = 0,2221$, $p < 0,001$; $VO_2 \max$ $r = 0,3075$, $p < 0,0001$; HR spoczynkowe $r = 0,1615$, $p < 0,01$; HR $\max$ $r = -0,1475$, $p < 0,01$) i badania UKG (LVESD $r = 0,2346$, $p < 0,0001$). Porównano wyniki 37 chorych, u których wystąpił ZPK, z wynikami 174 chorych, u których nie stwierdzono ZPK. Wyniki analizy porównawczej tygodniowego wydatku kalorycznego i analizy obejmującej rodzaj wysiłku oraz jego charakter okazały się korzystniejsze dla grupy chorych bez ZPK (3206,06 vs 2690,71 kcal/tydzień, $p = 0,1506$).

Wnioski: Kwestionariusz PPAQ wykazuje korelacje ze wskaźnikami próby wysiłkowej i badania echokardiograficznego, co czyni go przydatnym w badaniach klinicznych.

Słowa kluczowe: choroba wieńcowa, angioplastyka, kwestionariusz aktywności ruchowej, test wysiłkowy, badanie echokardiograficzne

Kardiologia Polska 2010; 68: 32-39

Adres do korespondencji:

prof. dr hab. Zbigniew Nowak, Akademia Wychowania Fizycznego, ul. Mikołowska 72a, 40-065 Katowice, tel.: +48 32 207 53 01, faks: +48 32 251 68 68, e-mail: zbinow@gmail.com

Praca wpłynęła: 18.05.2009. Zaakceptowana do druku: 03.09.2009.