MINNESOTA LEISURE TIME PHYSICAL ACTIVITY QUESTIONNAIRE AS AN ADDITIONAL TOOL IN CLINICAL ASSESSMENT OF PATIENTS WITH CORONARY ARTERY DISEASE TREATED WITH ANGIOPLASTY

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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 occurrence of coronary insufficiency. However the number of clinical studies done on the application of physical activity questionnaires is limited.

Aim. The objective of the present study was to analyze the suitability of Minnesota Leisure Time Physical Activity Questionnaire (MLTPAQ) in assessment of physical activity in patients after percutaneous coronary intervention (PCI)

Material and methods. Design: prospective analysis — before and 6 months after PCI and correlation between level of physical activity and physical capacity assessed with treadmill exercise test (ET), ejection fraction (LVEF%) Setting: Upper Silesia Medical Center. Department of cardiology. Population: One hundred fiftieth four inpatients (mean of 56 y), among which there were patients with acute myocardial infarction (MI), with history of past MI and with IHD without MI. All subjects underwent coronarography procedure with optional PCI. All patients underwent phase I and II cardiac rehabilitation. The MLTPAQ was administered to all patients at the time of PCI and then 6 months later, so was the treadmill stress test (TST) and echocardiography (ECHO).

Results. Total energy expenditure calculated with the MLTPAQ remained at the same level and was of low intensity (<4 MET, <2000 kcal/week) 6 months after the PCI. There was an increased physical capacity noted 6 months after initial PCI: increased metabolic cost (MET); maximal oxygen consumption (VO_{2max}); maximal heart rate (HR_{max}) obtained during the TST and decreased resting heart rate (HR_{rest}). ECHO examination showed improved LVEF%.

Clinical Rehabilitation Impact: the helpfulness of the research may be used in the work of cardiologists or physiotherapists. The research will allow to estimate the actual level of physical activity and physical endurance of patients that were treated by angioplasty. Moreover, this is the simple and cheap method of estimation.

Conclusion. Despite increased physical capacity and improved heart hemodynamic resulting most likely from PCI procedure, patients presented with similar level of leisure time physical activity 6 months after the PCI.

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Key words: ischemic heart disease, percutaneous coronary intervention, physical activity questionnaire, treadmill stress test, echocardiography.

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CAD — coronary artery disease, ET — exercise test, HA — household activity, IHD — ischemic heart disease, LVEF% — left ventricular ejection fraction, LVESD — left ventricular end-systolic diameter, MET — increased metabolic cost, MI — myocardial infarction, MLTPAQ — Minnesota Leisure Time Physical Activity Questionnaire, PCI — percutaneous coronary intervention, RA — recreational activity, TST — treadmill stress test.

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МИННЕСОТСКИЙ ОПРОСНИК ФИЗИЧЕСКОЙ АКТИВНОСТИ В КАЧЕСТВЕ ДОПОЛНИТЕЛЬНОГО ИНСТРУМЕНТА ДЛЯ КЛИНИЧЕСКОЙ ОЦЕНКИ ПАЦИЕНТОВ С ИШЕМИЧЕСКОЙ БОЛЕЗНЬЮ СЕРДЦА ПОСЛЕ АНГИОПЛАСТИКИ

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Из многих методов, используемых для оценки физической активности, анкеты кажутся простым и недорогим методом оценки риска возникновения коронарной недостаточности. Однако количество клинических исследований, проведенных на применении анкетирования физической активности анкет, ограничено.

Цель. Целью настоящего исследования был анализ пригодности Миннесотского опросника физической активности (MLTPAQ) в оценке физической активности пациентов после чрескожного коронарного вмешательства (ЧКВ)

Материал и методы. Дизайн: перспективное исследование — до и через 6 месяцев после ЧКВ и корреляция между уровнем физической активности и физической способности, оцениваемой с помощью тредмил-теста с физической нагрузкой (ТТ), фракции выброса (ФВ ЛЖ%). Выполнено: в Медицинском центре Верхней Силезии, отделение кардиологии. Пациенты: 154 пациента в стационаре (средний возраст 56 лет), среди которых были пациенты с острым инфарктом миокарда (ИМ), ИМ в анамнезе и с ИБС без ИМ. Все пациенты были подвергнуты коронарографии с возможным ЧКВ. Все пациенты прошли этапы I и II сердечной реабилитации.

Опросник предлагался всем пациентам во время проведения ЧКВ и затем через 6 месяцев, как и тредмил-тест (TST) и эхокардиография (ЭХО).

Результаты. Общий расход энергии, рассчитанный с помощью MLTPAQ, остался на прежнем уровне и был низкой интенсивности (<4 MET, <2000 kcal/неделю) в 6 месяцев после ЧКВ. Отмечено увеличение физической работоспособности через 6 месяцев после первоначального ЧКВ: увеличение энергетических затрат (MET); максимального потребления кислорода (VO_{2max}); максимальный сердечный ритм (HR_{max}) был получен в ходе TST, снизилась частота пульса в спокойном состоянии (HRrest). ЭХО исследование показало улучшение ФВ ЛЖ,%.

Клиническое воздействие реабилитации: полезность исследования может быть использована в работе врачей-кардиологов или физиотерапевтов. Исследование позволит определить реальный уровень физической активности и физической выносливости пациентов, которые лечились с помощью ангиопластики. Кроме того, это самый простой и дешевый метод оценки.

Заключение. Несмотря на увеличение физической способности и улучшение сердечной гемодинамики в результате ЧКВ, пациенты показали одинаковый уровень физической активности через 6 месяцев после ЧКВ.

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Ключевые слова: ишемическая болезнь сердца, чрескожное коронарное вмешательство, анкеты физической активности, тредмил-тест, эхокардиография.

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 and whole body movements with the use of accelerometers or pedometers [1–3]. Other were aimed at assessment of energy expenditure derived from food, using direct and indirect calorimetry, kinematic analysis as well as doubly labelled water [4]. 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. It seems that a questionnaire constitutes a simple and inexpensive tool in assessment of physical activity [6–9]. 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 previous 24 hr, the previous week, month or even a year [7, 9].

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 and treatment of many so-called civilization diseases.

Such measurement is of great importance, since the sedentary lifestyle is one of the risk factor responsible for occurrence of IHD and at the same time physical activity constitutes a major factor in treatment and secondary prevention of IHD [10, 11].

However, the number of studies done on the application of questionnaires for clinic purposes in patients with IHD is limited. We attempted to answer the following questions:

1. What is the average weekly amount of physical activity and energy expenditure calculated using the MLTPAQ 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 parameter — Ejection Fraction (evaluated with echocardiography), making it a usable tool in clinical studies?

3. Is there a correlation between the obtained questionnaire results and combined endpoint?

Material and methods

The study group consisted of 211 patients, aged between 32–74 years (mean age of 56±7), among which there were patients with acute MI, with history of past MI and with IHD without MI. Patients with post-MI complications such as cardiogenic shock, circulatory arrest, pericarditis, resting arrhythmias and heart conductivity disorders were excluded from the study. 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 told that they may withdraw from the study at any time. The study was approved by the Senate Ethics Committee of the Academy of Physical Education in Katowice, Poland.

All subjects underwent coronarography procedure with optional percutaneous coronary intervention (PCI). Out of 154 patients 32 (20,77%) did not receive stent implantation, 108 subjects (70.12%) received one stent, while 8 (5,19%) two stents implantation. All patients underwent phase I, inpatient cardiac rehabilitation which lasted from 5 to 7 days. After hospitalization all patients were referred to phase II, 24-day cardiac rehabilitation in health resort (sanatorium). All subjects filled the MLTPAQ twice: first, at the time of hospitalization due to PCI procedure, and then for the second time after the lapse of 6 months. The MLTPAQ results enabled the calculation of the level of recreational physical activity and household activities during leisure time. The results were expressed in a weekly value [kcal/week] after dividing the calculated 6-month energy expenditure by 26 weeks. The following ranges of activity intensity were used: low [< 4 MET], medium [4 — < 6 MET] and high [≥ 6 MET], where 1 MET equals the resting metabolic rate, which is approximately 3.5 ml oxygen kg^{-1} body weight per min^{-1}. 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 repairing). Additional categorization of weekly energy expenditure into 4 ranges was also made: ≤ 999, 1000–1999, 2000–2999, ≥ 3000 [kcal/week]. The MET for a given activity value was calculated according the Compendium of Physical Activities Tracking Guide [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 read the questions of the MLTPAQ and filled in the questionnaires for patients during individual appointments.

The level of work capacity was assessed with the use of submaximal treadmill stress test (according to Bruce's protocol) performed 1–3 months before the initial PCI procedure and 6 months after. The following variables of stress test were subjected to statistical analysis: test duration [min], metabolic cost [MET], resting and the highest recorded value of heart rate [beats/min], maximal oxygen consumption VO_2max [ml] and the reason for stress test termination: submaximal value of HRmax (85%) calculated with formula: HR max = 208–07 x age, fatigue, stenocardia, changes of S-T segment in electrocardiogram (ECG), occurrence of arrhythmias, heart conductivity disorders and excessive increase in arterial blood pressure. The value of VO_2max was calculated according to the following formula [13]:

$VO_2max = 13,3–0,03\ (t) + 0,297\ (t^2) — 0,0077\ (t.^2) + 4,2\ (CHS)$,

where, t — time [minutes], CHS — cardiac health status, 1- patients with angina pectoris, after MI, after

Table 1

Results of treadmill stress test at the time of PCI and 6 months after

Parametr	at the time of PCI, N = 154	6 months after PCI, N = 150	P
Stress test time [min]	4,24±2,22	6,32±3,12	<0,001
MET	6,52±1,26	8,21±2,86	<0,001
VO_2max [ml]	28,23±5,94	32,52±8,25	<0,001
Resting HR [beats/min]	72±4,23	70±6,22	<0,001
HR_{max} at the test [beats/min]	118±14,52	129±16,47	<0,001

Abbreviations: PCI — percutaneous coronary intervention, MET — metabolic cost, VO_2max — maximal oxygen consumption, HR_{rest}.— resting heart rate, HR_{max} — maximal heart rate.

Table 2

Indications for treadmill stress test termination

Indications for stress test termination	at the time of PCI		6 months after PCI	
	N	%	N	%
Reaching submaximal HR	19	12,33	118	78,66
Other†	135	87,67	32	21,34
Total	154	100	150	100
	P <0,001			

Abbreviations: PCI — percutaneous coronary intervention, HR — heart rate. † stenocardia, S-T segment changes in ECG, occurrence of arrhythmias and heart conductivity disorders, excessive increase in arterial blood pressure.

Table 3

Echocardiography results

Parametr	at the time of PCI, N = 154	6 months after PCI, N = 150	P
LVEF%	50,45±7,21	51,36±6,12	<0,02

Abbreviations: PCI — percutaneous coronary intervention, LVEF% — left ventricular ejection fraction.

PCI, 0 — patients without clinical symptoms of angina pectoris, without history of MI or PCI.

Left ventricular ejection fraction (LVEF%) was analyzed. The assessment of heart structure was done with 2-dimennsional echocardiography (HP Sonos 1100) by a physician, cardiology specialist, after completion of echocardiography training.

All statistical analyses were performed using Statistica (v. 7.1) software, Statsoft USA and MedCalc software (v.8.0.0.1) by F. Schoonjans and included the calculation of means and standard deviations (SD) of variables. The distribution of means was evaluated with Wilk-Shapiro test for normality. A criterion of $p<.05$ defined statistical significance. Student's t-test for independent variables with normal distribution was used. This test was preceded by the Fisher's test for verification of the homogeneity of variance. In case the variance was not equal, Sattherwaite's test was used. Student's t-test for dependent variables was also used, as well as one-way variance analysis proceeded by Bartlett's test for verification of variance homogeneity. For variables with non-normal distribution, U Mann-Whitney test, Kruskall-Wallis ANOVA test and Sperman's rang correlation test were used.

Results

Out of 211 patients who initially underwent PCI procedure, there were 207 subjected to the second questionnaire administration (2 patients died due to coronary insufficiency in second and fifth month after the PCI, 2 patients resigned from the study due to general discomfort). Compared to the stress test performed at the time of the initial PCI procedure, the improvement of patients' physical capacity was noted during the treadmill stress test: increased metabolic cost (MET); maximal oxygen consumption (VO_{2max}); maximal heart rate (HR_{max}) obtained during the test and decreased resting heart rate (HR_{rest}) (Table 1). The number of patients who terminated the stress test due to pathological reasons reduced (Table 2).

After the 6-month period, there was a favourable tendency noted in the changes of heart hemodynamic, though only in the case of EF% statistical significance was observed (Table 3).

The total energy expenditure from the leisure time activities calculated with the MLTPAQ was higher 6 months after the angioplasty procedure (2829,52 vs 2799,92kcal/week). As far as physical activity of low intensity was concerned, there was an increase noted (1759,30 vs 1811,06 kcal/week). The values of activity of medium and high intensity dropped from 1300,99 to 1190,46 and from 714,63 to 491,73 kcal/week, respectively. Nevertheless, none of the above changes were statistically significant. The value of recreational activity was higher 6 months after the angioplasty for the range of low intensity (<4 MET) and in majority of patients did not exceed 3000 kcal/week. For the range of medium intensity (4–6 MET) it stayed under 2000 kcal/week in majority of patients. In the range of high intensity (>6MET) it did not exceed 1000 kcal/week in those few patients who presented with that level of intensity. In case of household activity, there was an increase noted in medium range of intensity (4–6MET) which did not exceed 3000 kcal/week in majority of patients. For the household activities of high intensity

Table 4

Types and ranges of physical activity energy expenditure calculated with the MLTPAQ

Parameter		below 999 kcal		1000–1999 kcal		2000–2999 kcal		over 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.	P
		Low intensity < 4 MET										
RA	Mean	498,18	521,75	1333,52	1451,66	2445,65	2512,62	4186,59	4105,97	1619,94	1707,99	<0,24
	SD	270,17	212,64	216,62	220,38	329,21	312,40	875,31	601,03	1232,93	1104,06	
	N	51	52	54	65	20	20	7	6	132	143	
HA	Mean	191,46	429,11	1210,46	—	2312,30	2403,93	4116,90	4000,07	1632,29	1320,53	<0,34
	SD	45,54	201,79	33,97	—	—	152,60	427,10	187,11	1611,22	1481,89	
	N	5	10	3	0	1	2	4	4	13	16	
Total	Mean	435,65	501,51	1235,39	1366,11	2568,12	2489,92	4452,98	4481,01	1729,10	1801,14	<0,31
	SD	292,09	232,50	233,37	222,51	307,08	309,43	1076,02	900,03	1421,13	1291,56	
	N	56	51	23	35	40	7	19	3	131	138	
		Medium intensity 4 — >6 MET										
RA	Mean	309,90	420,33	1318,01	1501,26	2500,76	2401,10	3048,04	4623,12	545,12	601,18	<0,11
	SD	253,55	261,49	324,92	223,30	190,19	288,27	—	—	534,81	641,21	
	N	84	85	22	10	9	4	4	2	119	101	
HA	Mean	371,91	524,22	1418,24	1495,28	2417,56	2484,60	4410,14	3765,73	1064,42	1011,12	<0,45
	SD	245,38	290,29	278,60	302,84	99,96	412,87	1295,59	531,09	1529,76	1129,48	
	N	65	66	21	28	5	5	13	11	104	110	
Total	Mean	415,37	515,90	1541,89	1352,59	2320,16	2355,92	4221,67	4112,71	1289,85	1088,42	<0,71
	SD	111,00	207,23	292,12	296,89	125,83	283,95	1007,42	568,86	1326,26	1198,55	
	N	74	81	34	29	12	15	12	8	132	133	
High intensity >6 MET												
RA	Mean	372,70	321,41	1226,15	1561,54	—	2225,00	3113,01	5226,14	511,94	643,90	<0,6
	SD	224,21	232,07	22,12	—	—	—	—	—	621,73	1005,01	
	N	24	21	3	1	0	1	1	1	28	24	
HA	Mean	332,15	231,94	1409,01	1206,15	2015,38	—	4644,61	—	723,74	195,34	<0,6
	SD	180,21	181,79	—	—	—	—	—	—	1220,53	252,87	
	N	18	25	2	2	1	0	5	0	26	28	
Total	Mean	361,61	281,26	1354,15	1396,15	2195,38	2068,45	4126,15	5106,14	700,63	391,73	<0,9
	SD	272,61	219,48	307,81	230,48	—	—	1293,36	—	1092,74	806,73	
	N	34	39	6	3	2	1	3	1	45	44	
Total energy expenditure	Mean	581,11	589,29	1449,74	1530,92	2477,41	2499,81	4796,96	4536,78	2363,11	2412,53	<0,6
	SD	292,31	199,13	154,43	110,69	100,83	154,70	1327,55	1107,28	1647,09	1599,55	
	N	28	23	45	42	37	48	44	37	154	150	

Abbreviations: PCI — percutaneous coronary intervention, RA — energy expenditure of recreational activity, HA — energy expenditure of household activity, Total — energy expenditure of either RA, HA or both forms of activity, SD — standard deviation.

(>6 MET) there was a significant drop of the energy expenditure noted in all ranges (Table 4).

There was a significant increase of work tolerance noted during the stress test 6 months after the angioplasty. There were considerable changes in values of all observed parameters. Patients, whose physical activity in leisure time was in the range of 2000–2999 and over 3000 kcal/week, obtained the most significant improvement during the stress test (Table 5).

The echocardiography examination performed 6 months after the angioplasty showed improvement of the heart structure dimensions. Statistically significant changes (within the normal range) considered the LVESD and LVEF% values. In the group of patients whose weekly energy expenditure was below 2000 kcal/week, there was a slight increase of the dimensions in majority of parameters, except for LVEF%, where there was a small decrease (within the normal range) observed in the group of patients with weekly energy expenditure under 999 kcal/week (Table 6).

There were weak correlations observed between total energy expenditure calculated with the MLTPAQ stress test parameters and ECHO results (Table 7 and Table 8).

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

Table 5

Selected parameters of stress test in relation to the intensity ranges of activity calculated with the MLTPAQ

Parameter		below 999 kcal		1000–1999 kcal		2000–2999 kcal		over 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	P
Test duration [min]	Mean	5,70	5,64	5,71	7,16	5,31	7,35	6,15	8,18	4,24	6,32	<0,001
	SD	2,79	2,40	2,44	2,06	2,57	2,70	2,86	2,39	2,22	3,12	
	N	33	18	57	45	37	42	82	73	154	150	
Metabolic cost [MET`s]	Mean	7,51	7,70	7,68	8,95	7,01	9,26	7,73	9,66	6,52	8,21	<0,001
	SD	2,76	2,70	2,71	2,38	2,54	3,02	2,66	2,38	1,26	2,86	
	N	33	18	57	45	37	42	82	73	154	150	
VO2max [ml/kg/min]	Mean	28,93	27,16	28,54	32,90	27,70	34,54	30,49	37,94	28,23	32,52	<0,001
	SD	9,55	7,16	8,32	8,65	9,32	10,95	11,50	11,02	5,94	8,25	
	N	33	18	57	45	37	42	82	73	154	150	
HR resting [beats/min]	Mean	75,55	75,94	77,44	71,82	78,70	73,79	77,10	73,52	72,00	70,00	<0,001
	SD	8,53	8,63	9,40	10,13	9,11	10,46	9,41	9,72	4,23	6,22	
	N	33	18	57	45	37	42	82	73	154	150	
HR max [beats/min]	Mean	120,52	136,50	120,38	132,04	125,65	129,50	125,90	131,78	118,00	129,00	<0,001
	SD	15,56	11,64	18,89	15,02	18,23	15,51	16,09	14,85	14,52	16,47	
	N	33	18	57	45	37	42	82	73	154	150	
HR submax not reached	N/Σ	16/17	6/20	43/51	16/46	24/33	11/41	35/53	15/43	118/154	48/150	<0,001
	%	94,11%	30,00%	84,31%	34,78%	72,72%	26,82%	66,03%	34,88%	76,62%	32,00%	
Positive results of stress test	N/ Σ	21/30	8/23	33/41	11/30	26/32	16/37	41/51	7/60	121/154	42/150	<0,001
	%	70,00%	34,78%	80,48%	36,66%	81,25%	43,24%	80,39%	11,66%	78,57%	28,00%	

Abbreviations: PCI — percutaneous coronary intervention, MET — metabolic cost, VO_2max — maximal oxygen consumption, HR_{rest} — resting heart rate, HR_{max} — maximal heart rate: HR sumbax — HR calculated with formula: (220 — age) x 0,85; SD — standard deviation.

Table 6

Selected echocardiography variables, in relation to the intensity ranges of activity calculated with the MLTPAQ

Parameter		below 999 kcal		1000–1999 kcal		2000–2999 kcal		over 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	P<
LVEF% [%]	Mean	51,33	50,56	53,37	53,45	49,76	52,62	51,12	52,42	50,45	51,36	<0,02
	SD	9,12	9,85	8,03	8,00	7,64	7,21	10,26	8,69	7,21	6,12	
	N	33	27	57	47	37	47	82	81	154	150	

Abbreviations: PCI — percutaneous coronary intervention, LVEF% — left ventricular ejection fraction, SD — standard deviation.

diseases [12, 14, 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 low level of physical activity may result from limitation of exercise tolerance due to atherosclerotic process in coronary vessels or history of MI, but most likely from the sedentary lifestyle [13, 15, 16]. 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 (6) 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 group of few patients included individuals 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 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 Nowak et al [13]. The angioplasty procedure restores proper circulation in coronary arteries, improves work tolerance and thus allows patient to exercise longer and with increased intensity. The procedure resulted in improvement of left ventricle function of studied subjects (increase in EF%) what was also reported by other authors [17–20]. We also evaluated correlation between the delta of energy expenditure assessed in the questionnaire versus the delta of selected parameters of treadmill stress test and echocardiography examination. As far as stress test results were concerned we found weak correlation with the delta of test time and VO2 max. There was however no association with the delta values of echocardiography procedure. This situation may result from patients' fear of ischemic symptoms reproduction associated with considerable chest pain and perhaps from their unwillingness to physical effort in general.

Table 7

Correlation indices between total energy expenditure calculated with MLTPAQ, stress test parameters and ECHO results

	Exercise stress test	r	P
MLTPAQ*Δ†	Time Δ†	0,198	<0,002
MLTPAQ Δ	MET Δ	0,158	<0,057
MLTPAQ Δ	VO_2max Δ	0,255	<0,001
MLTPAQ Δ	Rest.HR Δ	0,159	<0,048
MLTPAQ Δ	HR max Δ	0,134	<0,087

*Minnesota Leisure Time Physical Activity Questionnaire; †Δ: the result of subtraction of the first and second examination and MLTPAQ values.

Table 8

Correlation indices between total energy expenditure calculated with MLTPAQ, and ECHO results (EF%)

	Echocardiography	r	P
MLTPAQ*Δ†	EF% Δ	0,028	<0,624

* Minnesota Leisure Time Physical Activity Questionnaire; †Δ: the result of subtraction of the first and second examination and MLTPAQ values.

Conclusion

Our findings suggest that MLTPAQ may be used as an additional tool in clinical assessment of patients undergoing PCI. The results obtained in this study indicate that the level of leisure time physical activity in studied subjects was below the value recommended for primary and secondary prevention of IHD. We assume that improvement of patients' clinical status 6 months after the PCI resulted from high effectiveness of that procedure and participation in two phases of cardiac rehabilitation.

Clinical Rehabilitation Impact

The helpfulness of the research may be used in the work of cardiologists or physiotherapists. The research will allow to estimate the actual level of physical activity and physical endurance of patients that were treated by angioplasty. Moreover, this is the simple and cheap method of estimation.

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