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Rehabilitation in Patients after Cardio-Surgical Interventions

by

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The purpose of the present study was to verify the hypothesis: the use of exercises and physical therapy helps patients after cardio-surgical interventions in early return to normal life. The research was based on the diagnosis of physical fitness of cardiological patients. The data was analyzed for 421 cardiological patients: 245 men and 176 women, aged 27-75 years. In the group of patients who were ultimately able to go through the exercise test, the number of male patients reached a significant predominance over female patients. This again confirms higher physical fitness and stronger motivation of men to engage in graded physical exercise. Complex cardiological rehabilitation facilitates improvement of the patient's physical fitness. This has been confirmed by a significant number of patients who have been moved to a higher NYHA Class. Exercise tests performed on a treadmill have shown that, when compared to men, women are characterized by a lower physical work capacity – both before and after cardiological rehabilitation. Thus, the patient's physical fitness should not be the only criterion for grading physical effort.

***Key words**: cardiological rehabilitation, cardio-surgical interventions, physical fitness*

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Introduction

Cardiovascular diseases are among the most common civilization disorders, and account for more than 51.2% of deaths in the middle-aged and the elderly and are predominant arterial hypertension (44.9%) ischaemic heart disease (25.1%), which result in circulatory failure (most often of left ventricular origin) (Oleszczyk 1995).

Coronary heart disease, or *angina pectoris* develops as a result of atherosclerosis, and manifests itself with severe, sudden gripping sternal pain radiating to the neck and upper extremities, and sometimes also to the interscapular area. Coronary heart disease is the main cause of death in men over 45 years, and in women over 65 years of age (Pyörälä et al., 1994). The underlying pathology is most often associated with atherosclerotic lesions within the coronary arteries. The development of the disease is closely related to lifestyle, and a number of risk factors. It has been proved that a change in lifestyle with the elimination of harmful factors may arrest the progression of ischaemic heart disease. The most harmful risk factors for coronary heart disease are smoking and high-fat diet.

Regular engagement in physical activity has preventive as well as therapeutic significance. Physical exercise, if undertaken systematically, exerts positive influence on metabolic rate, helps reduce body weight (mainly adipose tissue), and mental stress. It is important that physical exercise should always be adapted to the age and physical fitness of the patient. In cardio patients exercising should therefore be preceded by electrocardiography and tests evaluating functional work capacity.

Pharmacological treatment and regular life style are not always sufficient to remove the cause of the patient's complaint. Sometimes cardio surgical intervention must be considered, such as, for example, mitral or aortal valve implantation, transcutaneous coronary angioplasty or aortocoronary bypass. After the above-mentioned surgical management, the patients undergo a process of cardiological rehabilitation aimed at improvement of circulatory and respiratory efficiency. Such a process should improve physical fitness to the level that enables the convalescent to engage in a relatively normal family, occupational, and social life. Surgery saves life, and rehabilitation helps regain physical fitness and improve the quality of life. Physical rehabilitation, as a gradual and carefully controlled resumption of physical effort, should be adapted to the condition of the individual rehabilitee and the type of surgical procedure they had undergone. Rehabilitation may prevent the development of some postoperative complications; due to specific methods used in physiotherapy, it may

also have beneficial effect on the course and results of the surgical procedure itself.

When designing the process of rehabilitation for a cardio surgical patient, it is useful to turn to physical fitness classification developed by the American Heart Association (Bruce et al., 1973, Kuch 1989) (Tab. 1), which recommends that the process design should match the sex and age of the particular patient. The patient's physical work capacity diagnosed on the basis of maximum oxygen uptake (ml/kg/min) helps calculate the metabolic equivalent (MET). This should always be the first stage in the process of patient selection for an appropriate rehabilitation model, and proves very helpful in the continuous patient assessment. It is very important to implement the cardiological rehabilitation as soon as the pain and some possible postoperative complications have been controlled.

Table 1

Physical work capacity – classification based on maximum oxygen uptake

Age (years)	Physical work capacity				
	very low	low	average	high	very high
Men					
20-29	x-24	25-33	34-42	43-52	53-x
30-39	x-22	23-30	31-38	39-48	49-x
40-49	x-19	20-26	27-35	36-44	45-x
50-59	x-17	18-24	25-33	34-42	43-x
60-69	x-15	16-22	23-30	31-40	41-x
Women					
20-29	x-23	24-30	31-37	38-48	49-x
30-39	x-19	20-27	28-33	34-44	45-x
40-49	x-16	17-23	24-30	31-41	42-x
50-59	x-14	15-20	21-27	28-37	38-x
60-69	x-12	13-17	18-23	24-34	35-x

A significant therapeutic question is the so-called secondary prevention, i.e.:

- elimination of risk factors such as smoking and obesity,
- initiation or continuing treatment for diabetes and arterial hypertension,
- regulation of lipid metabolism,
- systematic administration of antithrombotic agents,
- avoiding all possible infections,
- development a habit of regular motor activities.

The purpose of the present study was to verify the hypothesis:

1. The use of exercises and physical therapy will help patient in early return to normal life.
2. The rehabilitation should be adapted to the patient's age.
3. As compared to that of men, women will present lower physical fitness – both before and after rehabilitation; the difference should be taken into consideration while supervising the application of motor activity.
4. The sooner the rehabilitation is implemented, the better effects expected for a cardio surgical convalescent.
5. An important element of rehabilitation includes controlled physical activity.
6. The system of management used in the Rehabilitation Center of Upper Silesia should confirm the role of complex cardiological rehabilitation.

Research material

The research was based on the diagnosis of physical fitness of cardiological patients. After carefully reviewing medical records of the patients treated in the Department of Cardiological Rehabilitation from 1995 through 1996, the data was analyzed for 421 cardiological patients: 245 men and 176 women, aged 27-75 years (Tab. 2).

Table 2

Number and age of cardiological patients

Sex	Number	Age	x	SD
Men	245	27-74	54,3	9,9
Women	176	28-75	54,0	9,7
Total	421	27-75	54,2	9,8

For the purpose of the present study, the patients were divided into groups according to the type of surgical intervention they had undergone, i.e., aorto-coronary bypass graft (CABG), mitral valve (MVR) or aortal valve (AVR) replacement, other cardiosurgical operations (OCO) (Fig. 1).

Methods

The methodology of the present study was based on the standard rehabilitation system as applied in „Repty" – the Rehabilitation Center of the Upper Silesia (Oleszczyk et al., 1995 and Wolynska-Slezynska et al., 1992).

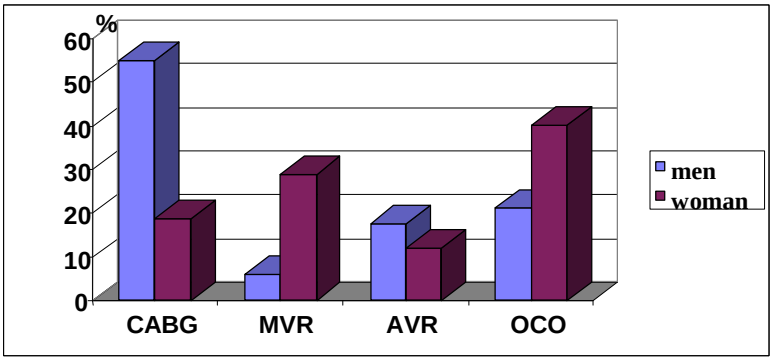


Fig. 1

Cardiosurgical intervention: CABG – aortocoronary bypass graft, MVR – mitral valve replacement, AVR – aortal valve replacement, OCO – other cardiosurgical surgeries

Prior to rehabilitation, on the second day of the in-Center therapy, the patients entered for an exercise test on a treadmill; the test variables were adjusted to the results of subjective and objective examinations as well as to the patient's ECG tracings and blood pressure taken at rest. A similar exercise test was performed after a 23-day rehabilitation process.

Appropriate preparation of the patient was conducted before the exercise test protocol. It was required that the patient should not be taking any medication affecting the function of the circulatory system, e.g. B-blockers, antiarrhythmics, and nitrates. On the test day, the patients were instructed to abstain from drinking coffee, strong tea, and smoking. It was also recommended that they should have a meal two hours before the test.

The exercise test was carried out before noon on a treadmill (Quinton 3000) according to Bruce's protocol, which comprises a 5-grade exercise load scale (Bruce 1973).

Table 3

Target heart rate during testing

Maximum heart rate (%)	Age (years)										
	20	25	30	35	40	45	50	55	60	65	70
70	138	136	135	134	132	131	129	127	126	125	123
85	167	166	164	162	161	159	156	155	153	151	150
90	177	175	173	172	170	168	166	162	160	164	162

Maximum	197	195	193	191	189	187	184	182	180	178	176

The test was interrupted at the moment of the patient's pulse reaching the target rate (85%) depending on the age – according to Sheffield (Tab. 3) or if the patient had developed symptoms such as significant fatigue, coronary pain, cyanosis, pallor, dyspnoea, vertigo, intermittent claudication.

In addition to standard testing, special co-operation with the patient was implemented; the latter took his pulse and informed about subjective perception of the intensity of the physical effort, i.e., whether the exercise was easy or difficult to perform. The Borg Scale is helpful in such situations (Tab. 4).

Table 4

Borg's scale – subjective perception of the intensity of physical effort [14]

Scale	Subjective perception of intensity
7	very, very easy
9	Very easy
11	quite easy
13	rather hard
15	Hard
17	Very hard
19	very, very hard

The system of cardiological rehabilitation

In order to verify the study hypotheses, the „Repty" (Rehabilitation Center of the Upper Silesia) system of cardiological rehabilitation was used (Oleszczyk et al., 1995 and Wolynska-Slezynska et al., 1992). The center uses group and individual rehabilitation processes. In case of this study, the physical fitness of the pre-disease period and that observed after active rehabilitation were taken into consideration; the duration of the disease was also noted. The type and intensity of exercise were adapted to the patient's age and his response to graded exercise. Heart rate was taken before and after exercising; the patient's behavior and face expression were carefully examined. During a 3-minute restitution period the heart rate had to return to pre exercise values. The patient selection for cardiological rehabilitation depended on his/her tolerance of submaximal effort; based on this, individual rehabilitation models were employed, i.e., A, B, C, or D (Tab. 5).

Model A corresponds to Class I physical fitness (acc. to NYHA[1]), which means that the patient is capable of performing successfully at II° and possibly also partly at III° of Bruce's protocol; moving treadmill load of about 7 MET[2].

Table 5

Rehabilitation models and physical fitness classification according to NYHA

Model	NYHA Class	Bruce's Protocol	Allowable exercise load	Load (W)	MET * (W)	VO_2max
A	I	II/III	15-30 minute exercise session 3 times a day (morning gymnastics; group respiratory exercises; I° circulatory exercises, possibly also II° exercises). A 30-minute relaxation exercise session at the swimming-pool. Three 30-45 minute cycloergometer training sessions a week at 60-80% of submax effort	100	<7	<20
B	II	I/II	15-30 minute exercise session 3 times a day (morning gymnastics; group respiratory exercises; I° circulatory exercises). Possibly also a 30-minute relaxation exercise session at the swimming-pool. A 20-minute cycloergometer training session daily (intervals adjusted as follows: 3-minute exercise period, 2-minute rest, 3-minute exercise period) at 60-80% of submax effort.	50-70	5-6	16-20
C	III	I and less	20-30 minute group respiratory exercise sessions or 10-15 minute individual sessions; in the case of some patients morning gymnastics or I° circulatory exercises. Allowable cycloergometer training (simulated intervals: 4-minute exercise period, 3-minute rest) with up to 25% increase of resting heart rate.	25	2-4	10-15
D	III/IV	Contrain dications	individual respiratory exercises, walks with intensity up to 10-15% above resting heart rate.	-	1	>9

*Exercise intensity varied depending on the group (patients with low physical fitness were exercising less intensively)

Model B corresponds to Class II physical fitness; the patient is expected to be capable of performing successfully at I° and possibly also partly at II° of Bruce's protocol; moving treadmill load of about 5-6 MET.

Model C comprises patients with Class III physical fitness who are not able to attain I° load of Bruce's protocol; moving treadmill load < 5 MET.

In models A and B, heart rate, as recorded during rehabilitation procedures, should increase up to 60-80% (for model A even up to 90%) of the value recorded during testing. For model C heart rate should increase up to 25% of the value.

Model D groups patients with Class III/IV physical fitness which have contraindications for exercise tests; age – men over 65, women over 60. Allowed are only individual breathing exercises with resting heart rate increase of 10-15%, and walks.

Morning gymnastics

Everyday rehabilitation started with a 15-minute session of morning gymnastics.

Cycloergometer training

An important element of the rehabilitation scheme was monitored cycloergometer training (Monark) with the intervals adjusted as follows: 3-minute exercise period, 2-minute rest, 3-minute exercise period).

Respiratory exercises

Respiratory exercise sessions were also carried out, especially for the patients with Class III physical fitness (acc. to NYHA).

Circulatory exercises

The purpose of the exercises is to improve circulatory function, breathing mechanics, and movement coordination.

Swimming

Relaxation training at a swimming-pool was also applied, especially in the patients with NYHA physical fitness class I and II.

Results

The duration of rehabilitation period was most often 28 days. Most patients presented with sinus rhythm, which was, however, more frequently diagnosed in men (92.6%) than in women (68.7%). Atrial fibrillation was found predominantly in women (30.7%) as compared to men (6.9%). Thus, women seem more predisposed to the disorder. Only two patients were admitted with a pacemaker (0.5%)

A significant relationship emerges between age and physical fitness – as determined by the exercise test (Fig. 2).

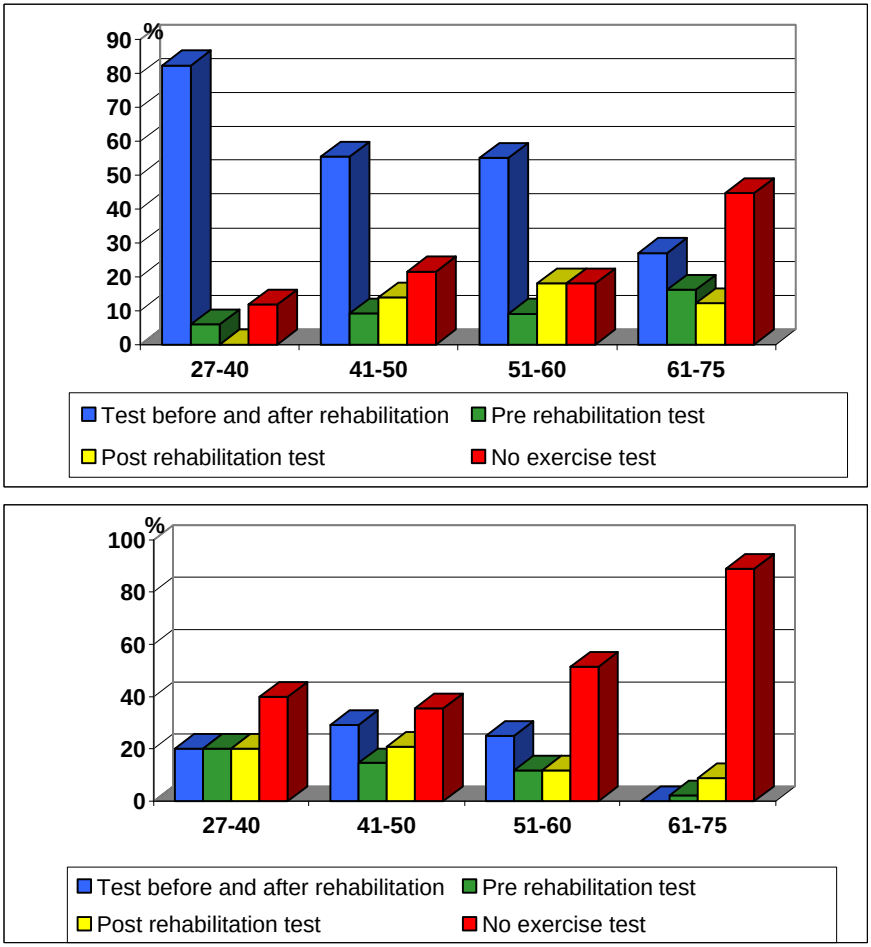


Fig. 2

Age and capability of entering for exercise test men (above) and women (below)

Age does seem to be a factor that limits the patient's capability of entering for an exercise test independent of his/her medical history.

In the group of patients who were ultimately able to go through the exercise test, the number of male patients reached significant predominance over female patients. This again confirms higher physical fitness and stronger motivation of men to engage in graded physical exercise.

Among concomitant diseases, the most frequent were postoperative complications, and osteo-muscular pain within the thorax. These again were more frequent in women.

The patients' rehabilitation process proceeded according to exercise scheme allowable for particular rehabilitation models (see above). The most frequently applied was Model C of cardiological rehabilitation (men 42.5%, women 58.5%). However, men were more often selected for rehabilitation models requiring higher levels of physical fitness (B and B/C) whereas in case of women the selection was most often Model C and C/D; two female patients (0.5%) were selected for Model D. Despite cardiological disorders, men were characterized by a higher level of physical fitness, and showed better motivation for motor activity. There is no doubt that selection of patients for particular rehabilitation models ensures the implementation of appropriate rehabilitation processes as well as correct methodology of movement exercise and all kinesitherapeutic and physiotherapeutic procedures. Special approach should be used in case of women with a low level of physical fitness.

Table 6

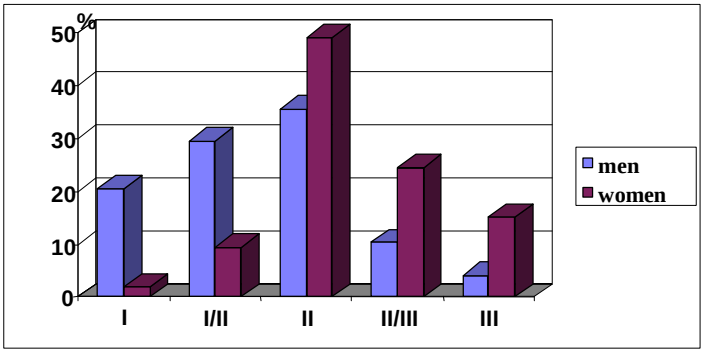
Classification of physical work efficiency in cardiological patients

Class	Patients' characteristics
I	Heart disease does not constrain physical activities of the patient. Everyday activities do not bring on excessive fatigue, palpitations, dyspnoea or coronary pain
II	Heart disease slightly limits physical activities of the patient. No discomfort at rest; everyday activities cause fatigue, palpitations, dyspnoea, and coronary pain
III	Heart disease imposes considerable limitation on physical activities of the patient. No discomfort at rest; however, effort of intensity lower than that of everyday activities cause fatigue, palpitations, dyspnoea, and coronary pain.
IV	Heart disease causes discomfort on performance of even very low intensity physical effort; the symptoms of cardiac insufficiency or coronary disease may be present at rest, and are aggravated by any form of physical activity.

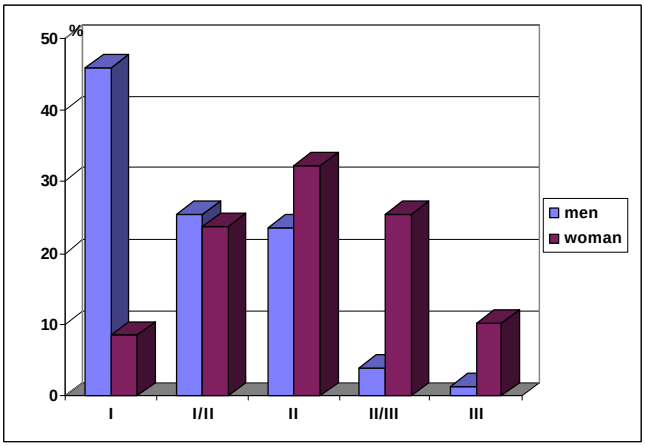
Special classification of functional work capacity (tab. 6) is also helpful – it aids in grouping the patients into teams with similar types of disorders and comparable physical fitness.

In case of cardiological patients, rehabilitation should be effective, and, at the same time, absolutely safe and free of risks. The patient's reaction to kinesitherapeutic and physiotherapeutic procedures should be continuously monitored.

The rehabilitation process in this study resulted in a significant improvement of physical fitness; a lot of cardiological patients were moved from a lower to a higher NYHA Class (Fig. 3). Before the rehabilitation, in the group of male patients predominant were those with Class II (35.6%) and I/II (29.5%). After its termination, the patients' physical fitness was characterized as corresponding to that of Class I (45.8%), and Class I/II (25.5%). However, such a tendency was not found for female patients: before rehabilitation predominant were Class II and II/III (24.5%), and after Class II (32.2%) as well as Class I/II and II/III, comprising 23.7% and 25.4% of female patients, respectively.



A

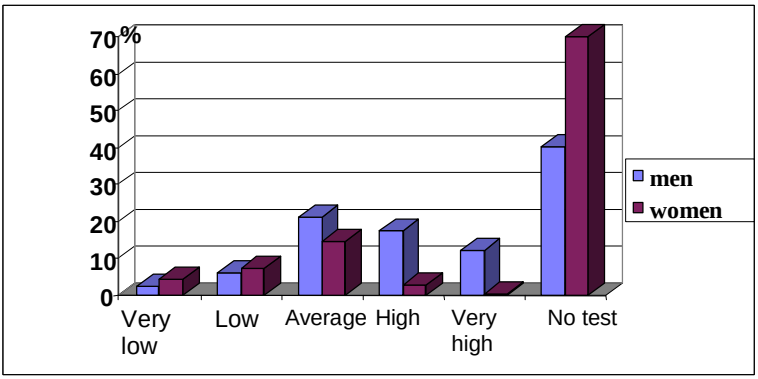


B

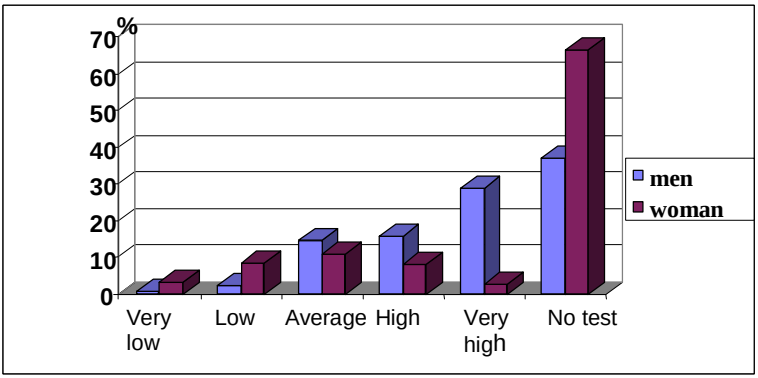
Fig. 3

NYHA Class before (above) and after (below) cardiological rehabilitation

Tolerance of treadmill exercise, as expressed by MET units, also improved (Fig. 4). The rate of patients with very low or low physical fitness was decreasing whereas that of patients with good or very good fitness increased.



A



B

Fig. 4

Physical fitness before (above) and after (below) rehabilitation – based on calculated MET units

It should be pointed out that, after the rehabilitation process, the number of patients capable of entering for an exercise test increased; this means that the fitness of several cardiological rehabilitees improved sufficiently to allow those patients to go through the exercise test at a reduced risk.

Rehabilitees were divided into three groups: short time span between surgery and rehabilitation (the process of cardiological rehabilitation started not later than on day 61 after the operation), medium length delay of the rehabilitation launch (62-122 days after surgery) and long delay of the rehabilitation launch (over 122 days).

Numerical distribution of patients over NYHA Classes, both before and after rehabilitation, was verified using the criterion of χ^2. The procedure did not reveal any significant relationship between NYHA Class and time that had elapsed between surgery and the start of rehabilitation procedures.

In regard to physical fitness estimated on the basis of MET values – significant relationships between the former and rehabilitation delay were only found for the pre-rehabilitation period; after rehabilitation such relationships were no longer observed in any of the subgroups. However the rate of female rehabilitees, who did not participate in the test, was 63.1% and 69.7% before and after rehabilitation, respectively. The corresponding value for male patients was 37% - both before and after rehabilitation.

It should also be pointed out that before rehabilitation male patients presented with better physical efficiency when compared to women. At the termination of therapy, the values were comparable, which, however, does not necessarily suggest proportional decrease of post-rehabilitation physical fitness in male patients – the fact remains that over 60% of female patients did not go through exercise testing at all.

Similarly, MET-unit expression of physical fitness does not show any statistically significant relationships.

Thus, the above-presented figures seem to suggest that the patient's physical fitness does not really depend on prompt referral for therapy in a rehabilitation center. This is not, of course, synonymous with the statement that patients do not benefit from early rehabilitation. Oleszczyk (1995) showed that early therapy provided the patient with better chance of early return to family life, as well as occupational and social activities.

The present study concerning cardiological patients under rehabilitation as well as numerous literature data clearly demonstrate the beneficial effect of physical activity on health condition of patients with circulatory diseases. Thus, in case of imminent heart ischaemia or past cardiosurgical intervention, active lifestyle associated with a rational diet and avoidance of stress should be advertised as an important preventive and therapeutic factor.

Based on the Polish model of Askanas (1971), Mazurek et al.,(1998) and Rudnicki (1989), the system of active rehabilitation as the second stage therapy for cardiosurgical patients proved to a large extent successful. Post-rehabilitation treadmill exercise test demonstrated patient transfer to higher NYHA Class and an increase of MET values. Spontaneous opinions expressed by the patients reveal their subjective feeling of improvement in physical efficiency and general condition (satisfaction).

Conclusions

1. Complex cardiological rehabilitation facilitates improvement of the patient's physical fitness. This has been confirmed by a significant number of patients in this study who have been moved to a higher NYHA Class.
2. Exercise tests performed on a treadmill have shown that, when compared to men, women are characterized by lower physical fitness – both before and after cardiological rehabilitation. Thus, the patient's physical fitness should not be the only criterion for grading physical effort.
3. The rehabilitation activities of older patients with cardiological disorders should be watched very attentively because the tolerance of physical effort decreases with age.
4. These studies indicate that time span between surgery and the launch of rehabilitation is not of particular importance – there were no significant differences between physical fitness of cardiological patients who had been relatively early referred to the rehabilitation center in comparison to patients whose rehabilitation was delayed.
5. Low physical fitness of older cardiological patients may result not only from senile involution and circulatory diseases, but also from postoperative complications and other disorders. While a rehabilitation plan is developed for such patients, heart disease as well as concomitant disorders and complications should all be taken into consideration as they can considerably impair the level of physical fitness.

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Resolution From International Scientific Conference "Aging and Physical Activity: Application to Fitness, Sport and Health" Rydzyna, Poland, 15-17 September 2006

by
Wieslaw Osinski[1]

Participants of the International Scientific Conference organized under the auspices of the International Association of Sport Kinetics and with the support of the Committee of Rehabilitation, Physical Culture and Social Integration of the Polish Academy of Sciences, adopt this resolution with a deep conviction about the growing medical, economic, and social challenges associated with the aging of the population in Poland and throughout the world.

It is estimated that within the next 25 years the total number of people over 60 years will grow from 605 million in 2000 to 1.2 billion in 2025. Today, in many developed and developing countries there are more people aged 60-years and older than children below 15 years. Polish society is also growing older rapidly.

According to the forecasts of demographers, by the year 2020 there will be approximately 2 million additional retired persons (women over 60 years, men over 65 years). By 2030 every fourth Pole will be a pensioner.

An increasing number of older persons will almost inevitably lead to an increase in expenses associated with social security and health care. Many countries throughout Western Europe are already experiencing the economic and social challenges associated with the aging of the population. It is clear that there is a need to focus our attention on the preservation of health and independence in old age. The promotion of regular physical activity will play an important role in the development of a healthy aging strategy.

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