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Physiotherapy in the comprehensive treatment of obesity

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Abstract

Background: World Health Organization considers obesity as the most serious health condition in the world today. This concerns not only adults but also children and young people. Obesity is the leading cause of increased morbidity, disabilities, mortality rates and deteriorated quality of life in society. Higher death risk due to cardiovascular diseases and certain cancerous conditions are also attributable to obesity. Some 40% adults in the world today are overweight and 13% are obese. These tendencies have also been observed in Poland. Specific components of comprehensive slimming treatments include dietary treatment, nutrition education, habits modification, increased level of physical activity, pharmacological treatment and surgical interventions. The basis in obesity treatment is to induce a negative energy balance. This status is typically achieved through dietary measures and increased energy expenditure. Helping prepare adequate individual therapeutic programs is a key to success in slimming of the obese patients. Mass reduction programs are prepared individually based on FITT formula, which takes into consideration four aspects of physical activity: frequency, intensity, time and type of physical activity. The role of physiotherapists in this process is essential. Individual therapeutic programs help adjust all the aspects of training to the health status of the obese patients, with respect to coexisting diseases.

Keywords: obesity; treatment; physiotherapy; physical activity

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OBESITY

Obesity is a chronic disease characterized by pathological increase in the amount of fatty tissue in human body of over 25% in men and over 30% in women (Zahorska-Markiewicz 2005). In its report published in 2000, the World Health Organization (WHO) emphasized obesity as the most serious health condition affecting not only adults but also children and young people.

The most popular measure of overweight and obesity is Body Mass Index (BMI), calculated by dividing body weight (kg) by squared body height (m^2). According to the WHO classification (2000), BMI standard in adults ranges from 18.5 to 24.9 kg/m^2, overweight is diagnoses at BMI = 25-29.9 kg/m^2, and obesity occurs for BMI $\geq$ 30 kg/m^2. There are three degrees of obesity: BMI of 30-34.9 kg/m^2 (first degree), 35-39.9 kg/m^2 (second degree) and BMI $\geq$ 40 kg/m^2 (third degrees), with the latter termed morbid obesity. It should be noted that using BMI involves an error since body mass is evaluated without taking into account body composition. Muscle tissue is heavier than adipose tissue and, in people with well-developed musculature, BMI is high despite small content of body fat. There are also people with proper body build and increased abdominal fat (Ruderman 1981, 1998).

According to Zahorska-Markiewicz (2005), it is essential for obesity diagnosis to evaluate body composition. In practice, the most often used method is bioelectric impedance analysis (BIA) (analysers: Bodystat, Omron, Maltron, Tanita). Although a study published by Kyle et al. (2004) challenged the usefulness of this method for diagnosis of obese people, many studies have demonstrated that BIA represents a reliable, non-invasive, safe and efficient analysis of body composition in healthy people and patients with diabetes, arterial hypertension, obesity and other diseases (Kotler et al. 1985, Segal et al. 1985, Lewitt et al. 2007, Heyward & Wagner 2004).

The causes of obesity are complex and characterized by many factors (Yanovski & Yanovski 2002, Haslam & James 2005). Regardless of the primary cause of the disease, obesity is accompanied by chronic disturbances in energy balance connected with excessive energy (food) consumption compared to the demands of human body (Zahorska-Markiewicz 2002, 2005, Czech & Bernas 2007).

A fast increase in obesity over the last 30 years has been caused primarily by cultural and environmental factors. High-calorie diets, huge meals, low level of physical activity and sedentary lifestyles and nutritional disturbances are major risk factors in development of obesity (Branca et al. 2007, James 2008). Sedentary lifestyles are the consequence of new civilization and technological advances, leading to spending most of the time in a passive manner. Diets of contemporary people are the second key factor that affects pathogenesis of overweight and obesity. Analysis of the components of contemporary diets reveals the substantial increase in fat content (40-45% *vs* 15-20%), increased consumption of monosacharides and reduced consumption of complex carbohydrates, fibre and mineral salts (Konner & Eaton 2010). Many nutritional mistakes made by contemporary people are caused by insufficient knowledge about healthy diets (early introduction of artificial feeding of infants, imbalanced diets, irregular meals and large intervals between meals, frequent snaking between meals), access to processed food, no time for preparation of meals, marketing activities of food manufacturers (advertising), inadequate spending energy connected with low level of physical activity and sedentary lifestyles and psychoemotional factors such as stress and coping strategies (Komender 1985, Radoszewska 1996).

The secondary character of obesity (10%) is attributable to endocrine disorders (hypothyroidism, Cushing's syndrome, PCOS, growth hormone deficiency, hypogonadism), organic hypothalamic diseases (tumors, inflammations), genetic syndromes (Turner syndrome, Klinefelter syndrome, Prader-Willi syndrome, Dercum's disease), drugs (antidepressants, tranquillizers, glucocorticosteroids), anti-diabetic drugs, certain antiepileptic drugs and antipsychotics (Zahorska-Markiewicz 2002, 2005).

EPIDEMIOLOGY AND HEALTH CONSEQUENCES OF OBESITY

According to the WHO's report published in 2015, there are 40% (5-76%) of overweight adults and 13% of those with obesity. Overweight and obesity is the most widespread in the North American and South American countries and Europe as well as in Africa, Asia and Australia. The highest percentage of obese people was recorded in the United States of America (39%). Morbid obesity is present in nearly 3% of men and 7% of women all over the world. Over 50% of inhabitants of the European countries are overweight and 30% of them are obese. The highest level of this problem is observed in Albania, Greece and Croatia. The countries with the lowest percentage of overweight and obesity are France, Sweden, Denmark and Norway (Tsigos et al. 2009). High percentage of overweight and obesity is also reported in Poland. The survey conducted by the Institute of Food and Nutrition (2000) in Poland demonstrated that 41% of men and 28.7% of women were overweight, whereas obesity was found in 15.7% of men and 19.9% of women (Jarosz 2006, Szponar et al. 2003). In a survey published by WOBASZ (2005) conducted in 2003-2005 among adults aged 20-74 years, prevalence of overweight in men was evaluated at 40.4%, and this percentage in women was 27.9%. Some 21.2% of men and 22.4% of women suffered from obesity. Furthermore, the NATPOL study found overweight in 34% adults (39% of men and 29% of women) and obesity in 19% (Zdrojewski et al. 2002). It should be noted that,

similar to other countries, upward tendencies have been observed for prevalence of overweight and obesity. Furthermore, results of a survey published by IDEA (International Day for Evolution of Abdominal Obesity) showed that Poland is one of the European countries with the dominance of abdominal obesity. This type of obesity concerns 54% of women and 38% of men in Poland (Balkau et al. 2007) and is positively correlated with metabolic disorders and cardiovascular diseases (Zhu et al.2002, Balkau et al. 2007].

According to Banegas et al. (2003), obesity is the leading cause of increased morbidity, disabilities, mortality rates and deteriorated quality of life in society. Many studies have found that obesity increases death risk, both due to cardiovascular diseases and certain tumors, especially in people with high degree of obesity (Adams et al. 2006, Flegal et al. 2007, Renehan et al. 2008, Stevens et al. 2002, Roberts et al. 2003, Linde et al. 2004). A group of European experts on obesity treatment (Tsigos et al. 2009) listed numerous complications of obesity: metabolic disorders (diabetes, insulin resistance, dyslipidemia, metabolic syndrome, hyperuricemia, gout), cardiovascular disorders (arterial hypertension, ischemic heart disease, circulatory collapse, cerebrovascular accidents, venous thrombosis), respiratory diseases (asthma, hypoxia, sleep apnea, Pickwick syndrome), cancer (esophagus, small intestine, colon, rectum, liver, gall bladder, pancreas, kidney), leukemia, myeloma, lymphoma (endometrium, uterine cervix, ovary, postmenopausal breast, prostate), bone and joint conditions (knee joints and hip joints), pain in joints, gastrointestinal diseases (cholelithiasis, steatohepatitis, gastroesophageal reflux disease), urinary incontinence, fertility disorders (irregular menstrual cycles, infertility, hirsutism, polycystic ovarian syndrome, miscarriages, diabetes, hypertension, pre-eclampsia, fetal abnormalities, labor disorders) and many other complications, including psychological and social consequences (low self-esteem, fears, depression, exclusion, discrimination in employment, environmental acceptance and salaries). Elevated health risk translates into the increased demands on the health system. Direct costs of obesity in Europe are estimated at over 7% of total costs of health care, which are comparable with costs of cancers (Branca et al. 2007).

TREATMENT: PHYSIOTHERAPY

The main goal in treatment of obesity is to ensure body weight reduction to limit health risks, and, to maintain proper body weight and prevent renewed gaining weight. Treatment of obesity is aimed at decreasing body weight by ca. 5 to 15% of initial weight over a period of 6 months (Porier et al. 2006), and, in people with BMI over 35, reduction by 20%. A negative energy balance is obtained by decreasing energy intake from food (limitation of calorie intake with food) and/or increasing of energy expenditure through muscular work (physical activity). It is also possible to lose weight through increased thermogenesis (Zahorska-Markiewicz 2002, Salvador et al. 2002, Bray & Tartaglia 2000, Deters 1990). Slimming therapy is a process that takes very long, and cooperation of various experts is needed. Specific components of comprehensive slimming treatments are dietary treatment, nutrition education, habits modification, increased level of physical activity and pharmacological treatment (Pupek-Musialik 2006, Bray & Tartaglia 2000, Zahorska-Markiewicz 2002). Treatment of obesity can also involve surgical interventions (Stanowski & Paśnik 2008).

In the comprehensive approach to treatment of obesity presented in this study, physiotherapy plays an important role and, if properly planned and combined with proper diet, is a key for success.

A study by Wing (1999) demonstrated that treatment of obesity is the most effective for combination of low-calorie diets and increased levels of physical activity. These findings were consistent with results obtained by other authors (Zając & Waśkiewicz 2001). The use of diet alone causes body weight reduction, but it results from losing both adipose and muscle tissues. A very unfavorable phenomenon observed during low-calorie diets used alone is reduction of the metabolic rate (20-30%) (Benedict et al. 1915, 1919, Krotkiewski 1994). On the other hand, using physical exercise alone does not involve similar threats, but is very difficult in patients with obesity and, as demonstrated in studies, leads more often only to beneficial changes in body composition (Cieślińska et al. 2002) rather than to weight reduction and it even may increase the weight of the person through increased muscular mass (Krotkiewski 2004). A number of studies have demonstrated that people who exercise regularly after completion of a slimming therapy achieve better results of treatment compared to those who are not involved in physical activity (Van Dale et al. 1990, Holden et al. 1992, Svendsen et al. 1994, De Pue et al. 1995, Hensrud et al. 1995, Saris et al. 2004).

Obese patients involved in physical activity can also enjoy many health benefits, including (Zahorska-Markiewicz 2000, Van Baak & Saris 1999, Brownell & Wadden 1999, Jakicic 2003, Ross et al. 2004, Jakicic & Otto 2005, Kay & Fiatarone Singh 2006, Stallmann-Jorgensen et al. 2007):

- increased energy expenditure and accelerated body weight reduction,
- reduced abdominal fat,
- increase in fat free mass (muscles and bones)
- reduction in undesired diet-induced energy expenditure at rest,
- lower insulin levels, improved glucose tolerance and lipid profile,
- lower blood pressure and heart rate at rest and during exercise,
- improved physical fitness,
- reduction of lower limb and spinal pains,
- long-term following a dietary regimen,
- improved mood and mental health,

– improved emotional states (less serious anxiety states and depression)

Certain conditions have to be met in order for physical activity to be effective in treatment of obesity. Both in prevention and slimming therapies, physical activity should have a character of general fitness aerobic exercise that helps consume energy stored in adipose tissues. This type of activity engages biochemical processes where fat, and, more specifically, fatty acids, might be entirely consumed. The precondition for this process is unlimited availability of oxygen to the muscles used. According to Van Baak & Saris (1999) and Brownell & Wadden (1999), aerobic exercise is characterized by medium or even low intensity, effective consumption of oxygen by working muscles (also cardiac muscle), involvement of major muscle groups that work continuously during the exercise, cyclic work and opportunity for performing the effort without breaks, characteristics of endurance conditioning of the cardiovascular and respiratory systems. Aerobic exercises represent the basis in body weight reduction training, which should be carefully planned, adjusted to patient's physical capacity and constantly monitored and modified. Furthermore, patients should be advised to increase their daily physical activities such as walking, stairs climbing instead of using lifts, manual car washing, manual changing TV channels instead of using remote control, conscious using body wherever it can be involved in movements (Zahorska-Markiewicz 2002).

The recommendations concerning using physical activity (body weight reduction training) should be consistent with the FITT formula that includes 4 basic aspects **(**Brownell & Wadden 1999, McKenzie & Sallis 1996, Sharkey 1997, Corbin et al. 2007):

- Frequency of physical activities per time unit e.g. a week, month;
- Intensity measured in METs;
- Time of a physical activity;
- Type of physical activity.

DURATION AND FREQUENCY OF EXERCISE

Until recently, a popular formula used for determination of physical activity was Brownell & Wadden (1999): 3 x 30 x 130, which denoted frequency, time and intensity of exercise (3 times, 30 minutes of exercise with heart rate of 130 bpm). However, the rule has become outdated. Exercising 3 times a week for 30 minutes is insufficient for the person who needs to lose weight. According to the First Mike Stock Conference in 2002, thirty-minute additional moderate exercise performed every day in leisure time is sufficient for prevention of cardiovascular diseases and diabetes, 45-60 minutes are sufficient for prevention of overweight/obesity and 60-90 minutes is needed for prevention of further renewed increase in body weight in obese people. Moderate exercise is understood to mean the exercise at the level of 40-60% VO_2 max or 2.8-4.3 MET, leading to the consumption of 150-200 kcal within 30 minutes (Saris et al. 2003). These recommendations were supported by the European project of principles for treatment of obesity in basic health care (2004). The subchapter concerning physical activity defined general recommendations for increasing of daily physical activity. Additional moderate intensity physical exercise was recommended, possibly every day, for at least 30 minutes, regardless of age. These requirements of physical activity are likely to be insufficient for children. Negative tendencies have also been observed among children and young people. The most recent studies showed that time for physical activity is being replaced by watching TV and using computers (Tounian 2008, Mazur 2010). According to Portman (2007), only 24% of children reach the recommended level of physical activity.

INTENSITY

Intensity of recommended exercise for people without cardiovascular complications is usually determined based on heart rate (HR). The most popular formula for evaluation of maximal heart rate HRmax is HRmax = 220 - age. The value calculated from this formula is used for determination of heart rate zones for workouts. According to Coyle (1995), processes of fat burning observed during physical activity occur optimally at the heart rate of 70% to 75% of HRmax. The most of studies have recommended the training heart rate of 60% to 70% for obese people (Van Baak & Saris 1999, Brownell & Wadden 1999).

The process of reduction of excess fat requires using both less intensive aerobic exercise and the exercise with higher intensity. The former takes part directly in burning fatty acids whereas the latter helps extend mitochondrial structures in muscles, which cause that the burning process may be more intensive (Zając et al. 2010).

In the case of coexisting cardiovascular conditions, it is recommended to perform an exercise test before planning the training in order to evaluate exercise capacity of a patient and use the highest heart rate obtained during the test for determination of heart rate zone at the level of 60-70% of this value (Bromboszcz & Dylewicz 2005).

Another method to determine exercise intensity for obese patients with coexisting cardiovascular diseases is to calculate heart rate reserve (HRR), where HRR = HR*peak* - HR*rest*, (HR*peak* - peak heart rate measured during the exercise test, HR*rest* - heart rate at rest). HRR of 40% to 70% is used for determination of exercise intensity by calculation of the training zone according to the formula: 40-70% × [HR*peak* – HR*rest*] + HR*rest* .

In practice, heart rate measurement through palpation turns out to be difficult for patients. It is recommended to use heart rate monitors instead. The patients can use heart rate monitors with sensor

attached in the location of the heart (chest) which might turn out to be parametrically maladjusted or, heart rate monitors with the sensor near the radial artery, which is more reliable. The most of stationary exercise devices such as treadmills, cycle ergometers or elliptical trainers are equipped in heart rate monitors.

The most basic principle that helps control exercise intensity is the principle of *walk and talk*. This principle assumes that ability to talk during the exercise indicates the aerobic character of the exercise (Plewa & Markiewicz 2006).

TYPE OF EXERCISE

Type of exercise recommended for patients is a matter of individual preferences of the obese person. The characteristics of general fitness exercise are found in the following forms of sport and recreation: vigorous walking, alternate walking and running, cycling, swimming and exercises in water, aerobics, team sports (e.g. volleyball), badminton, gymnastics, cross-country skiing, tennis, stairs climbing, dancing and many other. These exercises involve major muscle groups, especially antigravity muscles (extensors) which are characterized by the dominance of slow-twitch fibers, which are activated through aerobic metabolism (Kubica 1994).

Walking is undoubtedly the most basic and the most available form of anaerobic exercise and allows for easy dosing adequate for age and exercise tolerance of the person. However, it cannot be recommended to all obese people due to the likelihood of degenerative changes in lower limb joints. It should be emphasized that walking causes burning the amount of calories similar to running over the same distance. Recently, the level of physical activity has been measured with foot pods that count daily number of steps made by a person (Plewa 2008). The recommended number of steps for body weight reduction is 12,000 to 15,000 per day **(**Leermakers et al. 2000).

Nordic walking, which means fast walking with special poles, is becoming popular in Europe. This form of activity is adequate for both women and men at various level of physical fitness. The benefits of Nordic walking include improved endurance and physical fitness, maintaining proper body posture, weight reduction, improved stability and balance during walking. This type of activity involves most of the muscles. The muscles work quite differently than it is the case of normal gait. Shoulder muscles are more intensively involved, and, as a result of regular workouts, become stronger and can work for a longer time. Nordic walking helps burn more calories than during normal gait. Therefore, it can be considered as a good form of losing weight. The main benefits of Nordic walking are also improved health status, improved circulatory performance and providing more oxygen to the body (Strycharska-Gać 2007, Zabłocka 2007) .

Cycling improves circulatory system performance and helps develop leg muscle strength. This type of exercise belongs to low-intensity exercise, offers freedom and ensures that training environment can be changed for each training session. Cycling is a form of activity where body weight is loaded to the bicycle, which helps protect the ankle, knee and hip joints from dangerous load. Aerobic training can also be performed on cycle ergometers. This form of motor activity allows for combination of the exercise with music, watching TV and causes that physical activity is possible regardless of the weather conditions. Similar to other stationary training equipment, it also allows for monitoring of heart rate by means of in-build sensors. Two variations of stationary ergometers are used: adjusted to vertical and reclined position. The latter are more convenient for people who suffer from lower back and neck pains (Peters 2000).

Another form of physical activity for the obese people is **aerobics** or **group exercises.** Aerobics is a set of physical exercises that involve all muscle groups in a single training session (usually 45-60 minutes) performed to the rhythm of the music. It represents a very good form of training for the obese patients if exercises are properly selected by a professional trainer. Aerobics for obese people should exclude dynamic jumping, load to one limb and should minimize standing position. Training intensity should be adjusted to fitness level of the group members. It is recommended that the exercises should be performed in isolated positions: sitting, lying back, lying prone, lying on the side, kneeling on all fours in order to minimize the load to joints of the lower limbs. An attractive form to enrich training is to use additional accessories, such as balls, light weights or elastic bands. This form has usually the character of the group training, which additionally motivates patients to regular exercise and contributes to improved effects of the treatment.

Swimming is another form of physical activity that can be recommended to people who need to lose weight. It has a lot of benefits of preventing motor system disorders and is also used in slimming therapies for general fitness conditioning. A great benefit of water environments is elimination of load to the joint, which is particularly important for obese patients. Water also represents resistance during exercise (Piotrowska-Całka 2004). If a patient can swim, they can use any swimming stroke for a time period recommended for aerobic exercise (45-60 minutes). Patients can also perform **water exercises** (or aqua aerobics), which involve all muscle groups. This type of programs is used in numerous centres. Intensity of exercise during water exercises should be adjusted to water temperature. Optimum water temperature for the obese people is around 31-32°C. Due to faster heat transfer, lower water temperatures need greater exercise intensity, whereas higher water temperatures

deteriorate release of heat from human body, which caused that exercise intensity should be lower (Plewa & Markiewicz 2006).

Skating. Skating involves the respiratory and circulatory systems similar to running, but the load to the joints is much lower. This form of physical activity is very effective, involving many muscles, especially gluteal, lower limb and abdominal muscles. Due to joint protection, this sport can be recommended for overweight people. However, greater injury risk (compared to running) should be taken into consideration, especially in the first phase of this discipline.

Dancing is a very popular form of physical activity among obese people and it allows for releasing the energy through involvement of many muscles during a dancing session and allows for relax. Group classes at different levels are often organized, although the intensity of the exercise can be modified at any time.

Cross-country skiing is a form of physical activity that can be practiced during winter. It involves many muscle groups and helps use the substantial amount of energy. The environment of low temperature accelerates the metabolic rate. This sport requires learning a technique of cross-country skiing and proper use of the poles. The beginner cross-country skiers should consult skiing instructors before they start workouts.

Due to a substantial load to the joint surfaces and the spinal column, people with excessive body weight (BMI>35) are recommended to start exercises first without load (water exercises, cycling, exercises in low positions or exercises on a ball). These forms of physical activity are safer for these people as the load to joint surfaces in lower limbs is reduced. Jumping, fast running, Alpine skiing or climbing are not recommended for obese patients (Plewa 2011).

Regardless of the type of physical activity preferred by a patient, each training session should take into consideration 3 phases. The first phase is warm-up, which should take from 5 to 15 minutes. The warm-up is aimed at preparation of the respiratory and circulatory systems as well as the nervous and muscular systems for elevated physical work. This phase is also essential for prevention of injuries (Kubica 1995). Low impact stretching exercises are recommended in order to improve joint mobility and muscle flexibility. The exercises should also be dynamic. Then, the main general fitness exercise should be performed slowly. If running is adopted as a general fitness exercise, the warm-up should be performed at a pace slower than in the main phase (Brownell & Wadden 1999).

The second phase, which is the main phase, should take from 20 to 60 minutes. This phase involved the main exercises (walking, cycling, swimming, gymnastics). The aim is to reach the specific training heart rate in the patient and to maintain this value. In the beginning of the slimming program, the main phase should be shorter, with the duration of 10 to 20 minutes, and gradually extended over the therapy. The session ends with a cool down phase that should take from 5 to 15 minutes. In this phase, exercises from the main phase are continued, but at lower intensity. The aim of this phase is to slow down the breathing and heart rate and allow for gradual return of blood to the heart and brain in order to prevent from the risk of losing consciousness or heart rate disturbances. Static stretching of the muscles is also recommended after the main part, especially after resistance training.

Strength training in treatment of obesity

Strength training plays an important role in the slimming program of the obese patient and, as demonstrated in a study by Kussel (1991), the resistance training is as essential as aerobic exercise to reduction of adipose tissue in obese patients. First of all, this training prevents reduction of skeletal muscle mass, which can be observed for diets and aerobic training. It can also cause muscle mass growth, and, consequently increase metabolism. Strength conditioning also strengthens the postural muscles which are often very weak in obese patients.

Strength workouts should contain 8 to 10 resistance exercises for major muscle groups (lower limbs, gluteal, back, abdominal, shoulder and chest muscles). This can be achieved using body-building methods, where each exercise is performed in sets (recommended number of 3 to 4 sets), with each set containing an individual exercise repeated for 8 to 20 times. The circuit training can also be used, with all the exercises repeated as one set for 2 to 4 times. The external resistance should be adjusted individually, involving 30 to 50% of maximal muscular strength. The main emphasis in slimming therapies is on multiple repetitions of an exercise with resistance rather than the level of resistance. The load can be regarded as adequate if a patient is able to overcome the external resistance for 12 to 15 times. The rests between sets should take 60 seconds. Strength training is recommended twice a week as a supplementation of the slimming program**.** It is important during the resistant training that breathing is controlled and the exhaling should be performed in the resistance phase. The patients should focus on not holding the breath in order to prevent a sudden increase in blood pressure. It is also important to ensure proper technique and a help of a physiotherapist or a coach is recommended.

Energy expenditure during physical activity

According to Celejowa (2008), energy expenditure is a sum of energy expenditure for individual components such as: resting metabolic rate (around 60-70%), nutritional thermogenesis (10%) and physical activity (15% in people not physically active and 40% in those physically active).

Physical activity, which involves skeletal muscles, increases energy expenditure, which is conducive to body weight reduction at the expense of adipose tissue. Adipose tissue represents an energy store for human body and can store up to 75,000 kcal in adipocytes in people with proper body weight and much more in obese patients. In order to lose 1 kg of fat, human has to "burn" 7,000 kcal. Depending on body weight, human body is able to consume from 30 to 150 kcal in 10 minutes under conditions of increased work for a person with normal weight and from 50 to 300 kcal in the same time in the case of people with substantial overweight (Brownell & Wadden 1999).

Table 1 presents energy values of different activities that take 10 minutes for people with various body mass. An important aspect in evaluation of the energy expenditure for physical activity is fitness level. Higher fitness level helps consume more oxygen during a workout, thus leading to greater amount of fat burnt during the exercise. Regular aerobic exercise causes an increase in oxygen uptake. In untrained patients, oxygen consumption is around 1.5 l/muscle gram/hour. Everyday jogging, fast walking (about 5 km every day) are likely to increase oxygen uptake to 2.7 l/muscle gram/hour i.e. by almost 100%. Therefore, progression in training is essential in therapies for people who need to lose weight.

Training plans for obese patients should include consultation with a physician in order to exclude contraindications for exercise. Medical check-ups are also recommended for people older than 50 years and those who has never performed more vigorous exercise before. The diseases that represent contraindication for training include circulatory collapse, acute coronary disease, uncontrolled arterial hypertension, unbalanced diabetes, acute inflammations, cancers, chronic inflammatory diseases and degenerative changes in the motor system that need specific rehabilitation programs. People with cardiovascular diseases are recommended to have exercise tolerance evaluated based on the exercise test.

Helping obese patients requires cooperation of an interdisciplinary team including physicians, dieticians, psychologists and physiotherapists, who should prepare adequate training program with respect to the coexisting diseases. It should also be noted that obesity is a chronic disease and lifelong treatment and medical check-ups of obese patients are needed.

Table 1. Energy expenditure for activities with duration of 10 minutes (in kcal) depending on body weight (Brownell &Wadden 1999).

ACTIVITY	BODY WEIGHT in kg		
	60	80	110
Sleeping	11	14	19
Sitting (talking)	16	21	29
Dressing or toileting	28	37	51
Walking downstairs	59	79	108
Walking upstairs	154	204	279
Slow walk (3 km/h)	31	40	56
Fast walk (6 km/h)	55	73	99
Running (9 km/h)	95	126	173
Running (11 km/h)	125	165	225
Running (19 km/h)	173	230	316
Cycling (9 km/h)	44	58	81
Cycling (21 km/h)	94	125	173
Floor cleaning	40	53	73
Window washing	37	48	67
Snow removing[(with a shovel)	69	90	126
Light garden works	32	42	57
Light office works	26	34	48
Wall decorating	31	40	56
Wood chopping	63	85	117
Swimming (backstroke)	34	45	62
Golf	35	48	66
Dancing (moderate intensity)	37	48	67
Swimming (front crawl)	42	56	78
Badminton	45	65	91
Volleyball	45	65	91
Dancing (high intensity)	51	66	91
Tennis	59	81	112
Bowling	59	79	108
Basketball	61	83	113
Alpine skiing	85	113	155
Cross-country skiing	104	139	188

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