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№ CB007.2.22.036.

APAS METHODOLOGY FOR FUNCTIONAL TRAININGS AND CARDIO FITNESS FOR SPINE CURVATIONS AND FLAT FOOT

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The project is co-funded by EU through the Interreg-IPA CBC Bulgaria–Serbia Programme;

This publication has been produced with the assistance of the European Union through the Interreg-IPA CBC Bulgaria-Serbia Programme, CCI No 2014TC16I5CB007. The contents of this publication are the sole responsibility of SC "Kaloyan Ladimex" *and can in no way be taken to reflect the views of the European Union or the Managing Authority of the Programme*.

CONTENTS

INTRODUCTION

The methodology for functional training and cardiorespiratory fitness for people with spinal deformities and flat feet is a material designed for teachers of physical education and sports, coaches, recreationists who work with people with spinal deformities and flat feet, as well as for all who want to get additional knowledge in this area. This material includes: basics of functional training and its application in people with spinal deformities and flat feet, functional and physical fitness with special emphasis on cardiorespiratory fitness, muscle strength and flexibility, as well as the ways in which they can be developed through functional training in people with spinal deformities and flat feet, equipment that can be used.

This content is intended for anyone who wants to contribute their knowledge and practical work so that this world is a better place to live. Hoping that the following lines will transmit good vibrations to those who will read them, I just want to add: "The power is in the application."

FUNCTIONAL TRAINING

It can contribute significantly to the entire population, especially to people whose daily functioning is hampered by some kind of injury - spinal deformities and flat feet.

Functional **training** is an **exercise or routine activity**. They serve as preparation for the development of work or for practicing sports. In turn, they are related to a function or designed to effectively perform a goal.

Functional training in this framework is to one who is **goal-oriented**, thus their combinations are designed to achieve the planned goal. It usually consists of a variety of exercises that are conducive to **body** preparation, albeit task-oriented. It can be said that functional training involves planning training according to individual needs and goals. It is based **on intense and short training**, which generally contributes to increasing muscle mass, burning fat and improving balance, mobility and flexibility.

Functional learning can be defined as movement or exercise whose basics are derived from natural movement. It is an effective and easy exercise without risk. In recent years, there has been a trend towards a return to balanced exercise, with an emphasis on improving general health and disease prevention. The purpose of functional training is to "awaken" the body and add enthusiasm to everyday life, which is achieved through: purposeful movements of all body muscles and joints, purposeful movements and activation of the spine, activation of the neurological, nervous and muscular systems.

The functional training program relies on knowledge of sports medicine and physiotherapy. Initially, exercises with the trainer's own weight are used in order to use the body positions that are most suitable for the needs of each individual trainee. Since this type of training exercises are performed, the emphasis is not on the excessive development of the strength of a movement. In order to train a muscle in the way it is used in real movement, it is necessary to close the biomechanical circuit. A larger number of exercises must be performed in an upright position and be multi-joint, while developing the key stabilizer muscles of the hip, back of the shoulders and torso. For the needs of functional training, simple variants of squats, pulling, pushing and thrusting, throwing and bending forward are used.

Always start with exercises in stable positions and body weight and then gradually introduce controlled levels of instability (the trainee must react to restore his stable position).

The characteristics of functional training are:

individuality, diversity and progressivity.

The benefits of this type of training are great: it facilitates the performance of daily duties and activities; increases muscle strength, endurance and speed; improves flexibility and range of motion; strengthens the cardiorespiratory system; helps prevent injuries and rehabilitation; improves posture.

General principles of functional training:

1. Integral - training of complex movements, which means that not a single muscle is isolated, but whole muscle chains are trained in the way they are used in everyday life.

2. Multidimensional range - training of movement patterns of everyday life that require the use of multiple joints at different levels.

3. Use of stabilizer muscles - in the first place is the care for the stability of the torso.

4. Impact on adjustable compensations and dysfunctions.

What functional training can do:

The application of functional training is one of the most important steps towards good general physical shape and health. Training improves not only muscles, but also health and performance. Endurance, properly dosed strength and flexibility are the basis for any movement. The most important positive effects of individualized functional training are: increasing internal strength and endurance, improving and optimizing basic stability and flexibility, improving body awareness and balance, improving quality of life.

Each of these effects is invaluable, functional training makes muscles, tendons and joints stronger and more stable. The upper and lower body are usually trained separately, especially the strength of the torso muscles as a stabilizer. The exercises performed in several planes are much more complex and more accurately mimic the movements in everyday life. With

increasing condition, ie. abilities of the trainees, weights and additional workload can be applied in the functional training.

Depending on which part of the body is trained, the exercises in functional training can be divided into: exercises for the lower part of the body, exercises for the upper part of the body. Different types of exercises can be applied to each of the groups: for strength, endurance and flexibility.

The problem of early detection and limitation of the development of spinal deformities is relevant because it refers to the period of active growth of the human body - children and adolescents. It is not only medical but also socio-economic due to the relatively high frequency of children and adolescents with spinal deformities. The formation of proper posture during standing, sitting, walking and activities of daily living takes place during the period of active growth of the human body (from 3 to 13 years), as the cartilage tissue in the vertebrae has not yet been completely replaced by bone.

The disease has been known since about 2000 years, but its early detection and treatment is extremely complicated due to its diverse manifestations and polyetiological nature. Under modern conditions, the problem is exacerbated due to reduced physical activity and prolonged standing in front of the computer from an early age, inappropriate diet, increased number of traumatic injuries, congenital spinal anomalies and more. The prevention of spinal deformities is imperative, and for this purpose it is necessary to develop effective methods and technical means.

It is especially important to monitor the duration of the static position of the body, especially in a sitting position (given the increase in intradiscal pressure of the spine compared to that in a standing position) when doing computer work, sitting at a desk, table, desk, in front of the computer and TV, etc. Posture means the habitual posture of a person standing casually, without much muscle tension to keep the body and head upright. Improper posture is one of the first factors that lead to spinal deformities. If the deviation of the spine from its normal shape and function continues for a longer period, gradually, it can turn into a permanent spinal curvature.

It is known that spinal deformities have an adverse effect on the health of children. Due to changes in the chest and changes in the spatial arrangement of the organs in the thoracic cavity and their compression, there are disturbances in breathing and heart activity. Statistics from observations on the development of spinal deformities show that not every incorrect posture

But so far there is no established reliable method to show whether the initial form of a spinal curvature will deepen and become more severe, especially when it is of a habitual nature and is not due to birth defects and diseases. That is why it is necessary to improve the existing preventive and rehabilitation approaches and to develop new effective devices and methods for prevention, early diagnosis and treatment of spinal deformities. The present study is aimed at developing a device, more effective than the existing ones, for body control and self-training to achieve posture correction and limit the development of spinal curvature. The aim is for the device to be comfortable to use, not to cause discomfort and to be affordable for distribution.

Current state of the problem - methods and tools for research and prevention of spinal deformities.

1. Relevance of the topic - spread of various spinal deformities, causes, consequences, prevention and prevention Accurate identification of the frequency and spread of spinal deformities is difficult for several reasons: the data are often contradictory, missing for each country separately, different authors use different research indicators, different methods are used in organizing each study (Sokolov and Markova - Stareishinska, 1991) *.

According to statistics from the National American Scoliosis Foundation, the approximate prevalence of the most common spinal deformities is kyphotic - 1 per 1000 [web1] and scoliotic 2 per 100 [web2] or 2-3% of the total population, with only in the US scoliosis are approximately 6 million. The prevalence of scoliosis among children is higher - 21.7 per 1000, as the effectiveness of conservative treatment of the disease is 70%, and 25-27% of patients require surgery (Rutskii and Volkov, 1995).

According to statistics, the spread of Scheuermann's disease, ie. juvenile structural kyphosis is on average between 4-8% [web4] with only 1% of those affected seeking treatment [web5]. Prevention of scoliosis is difficult because the causes are in most cases unknown. However, its rapid discovery may prevent the consequences of its future development [web3]. The treatment and prevention network in our country had significant experience and implemented in practice effective methods and organizational forms for prevention and treatment of spinal deformities.

Unfortunately, after the changes in health care / in the middle of 2000 / these health problems were ignored. The latest data from the studies of spinal deformities in Bulgaria show a permanent increase not only in the incorrect posture among adolescents, but also in spinal deformities. According to data from the Institute of Physical Education and School Hygiene at the Bulgarian Academy of Sciences from preventive examinations of students in recent decades, spinal deformities are a leading disease. The results are: nearly 1/3 or 30% of the examined children suffer from some kind of spinal curvature (Koleva, 2002). A study of 385 primary school students at the 22nd Secondary School (Chernev and Marinov, 2002) found that 166 students, representing 43.11%, had spinal deformities. 40 students suffer from pre-scoliosis, which is 24.09%.

They are most strongly affected by scoliosis I degree - 82 students (49.40%). Not to be overlooked is the fact that 5 students suffer from scoliosis II degree, which is a disease with serious consequences. 21 students suffer from kyphoscoliosis, or 12.65%, which is no less dangerous disease. The results of the prophylactic and consultative examinations of 384 children and adolescents aged six to eighteen, performed in 2005-2007. have been compared with those from other studies conducted over more than 20 years. Permanently high values of irregular postures were found - 16.83%, and of structural spinal deformities / scoliosis and kyphosis / - 6.81%. The summarized data from the prophylactic examinations, conducted by the personal doctors of the students in the period September - December 2008, show that 91 per 1000 examined children have a deviation in the state of health. The most common problems are overweight, visual disturbances and spinal deformities.

The reasons for the appearance of spinal deformities are usually complex - inconsistent with the height of school furniture, prolonged stay in the wrong position, improper carrying and heavy weight of the school bag. Untimely treatment of kyphotic and scoliotic deformities, which are the most common deformities in childhood and adolescence, can lead to functional problems related to the cardiovascular and respiratory systems - shortness of breath, chest and back pain. Improper posture combined with bone changes can lead to kyphosis. As the kyphotic deformity progresses, pressure can result on pressure on the spinal cord and nerve endings, leading to neurological symptoms such as weakness, loss of sensation, or loss of control. intestines and bladder In order to prevent the negative effects of spinal deformities on the human body, permanent preventive measures are needed. Prevention (from προφύλαξις - protect, protect) of spinal deformities should be the concern not only of health care but also of society as a whole. School conditions are extremely conducive to the occurrence of spinal deformities.

Statistics show that the percentage of scoliosis and kyphosis increases sharply when children go to school. The child changes his lifestyle, remaining for a long time in a static position, often in awkward and inappropriate positions. Electromyographic and tonometric studies of the back muscles in different postures (sitting, standing and sideways), made by Golovinskaya (1950), have established interesting facts. In a relaxed correct posture (sitting) the back muscles have shown bioelectrical activity with a symmetrical character, ie. the muscles of both halves are equally involved in maintaining the carcass.

In the wrong position (sitting, standing or carrying a bag in one hand), the back muscles showed uneven bioelectrical activity, expressed more on the convex side of the back, ie where the tension of one half of the back muscles increases, which is seeks to return the corpse to the correct position. The often repeated incorrect posture when sitting on a chair, at work, when lying on the side, when walking, etc., creates prerequisites for improper posture, which in turn leads to muscle imbalance, and later to spinal deformities (Chernogorova, 1955).

Spinal deformities - types, causes, consequences

In orthopedics, there is no greater diagnostic, therapeutic and curative problem than that associated with spinal deformities. This stems from the various etiological factors causing the three main pathological deformities of the spine - scoliosis, kyphosis and lordosis.

Scoliosis - as a term derived from the Greek skolios, which means curvature. It is considered as scoliosis to determine the deformation of the spine in the frontal plane. From a biomechanical point of view, however, scoliosis should be understood as a deformation of the spine in all three planes, more clearly in the frontal and transverse (Popov, 2009). Scoliosis can be functional or structural. Functional scoliosis can be corrected with active posture correction. Structural scoliosis is a fixed deformity of the spine that cannot be completely corrected with active posture correction. Approximately 80% - 90% of all cases of structural scoliosis are defined as idiopathic - that is, with an unclear cause.

Kyphosis (Greek hump kyphos) - was defined as a term in 1958 by G. Guntz (Guntz, 1957), as a prolonged and permanent condition of the spine with an abnormal increase in physiological kyphosis above 40 ° Cobb, involving the entire spine pillar or segment thereof. Kyphosis is

functional (postural) or structural. Postural kyphosis corrects itself when lying on a flat surface or when the spine is hyperextended. X-ray examination revealed no vertebral abnormalities. Structural kyphosis is caused by abnormal effects on the bones and intervertebral discs, causing a tilt in the forward direction of the spine. Examples of structural kyphosis are: congenital kyphosis, Schoerman's kyphosis - Scheuermann's disease and others. Both postural kyphosis and Schoerman's kyphosis occur during the growth period, often between 10 and 15 years of age, and usually occur in boys. Shoerman's kyphosis can lead to the appearance of wedge-shaped vertebrae (Saluja et al., 1986) also known as shmorlov nodes.

Lordotic deformities of the spine (Lordosis) - - according to Hauberg (Hauberg, 1950) are divided into two main groups: primary and secondary. Primary lordotic deformities are associated with spinal malformations, and secondary. X-ray of right thoracic and left lumbar S-shaped scoliosis. Kyphosis - comparison of a kyphotic back with a normal back with a back 9 have a lumbar localization and are the result of compensatory curvature, kyphotic deformation, extreme forward movement of the pelvis with luxation of both hip joints, etc. 1.4. Technical means for prevention and rehabilitation of spinal deformities - advantages and disadvantages The main devices for prevention of various types of spinal deformities are mainly devices using the feedback principle. Their function consists in measuring and controlling the deviations of the spine from the initially set position, in order to provide feedback between the patient and the device, and hence the correction of the spine.

The main elements of these devices are: a sensor (or other measuring device) measuring the angle of deviation of the spine and a signaling element providing light, sound, speech, vibrating or other signaling to the subject under certain conditions. Known feedback devices related to posture correction are: 1. Posture-training device - is the oldest known posture-training device and was proposed by Dworkin (Dworkin, et al., 1985; Dworkin, 1982). It includes a digital recording and analysis system that calculates the total time of the wrong position of the body according to the criteria for correct posture, signaling module (buzzer) and timer. The signal strength from the signaling module of the device increases every 20 sec. When maintaining an incorrect posture. When the stand is adjusted, the sound stops. The choice of the operating range of the device is achieved by changing its length by means of loops, individually adjustable for each patient

2. SpiderMed I Generation - used to correct posture in incorrect body position only in the sagittal plane - in flexion of the shoulder girdle (when the shoulders protrude forward) Biological feedback device for posture training. SpiderMed I Generation device 10 3 Smart garment for trunk posture monitoring - clothing for tracking the position of the torso.

According to data that are not only from Bulgaria, but also from the European Union and the American Association, 94% of the population suffers from some form of flat feet - milder or more severe. As the last few years have seen an increase in the age limit, some call it a condition, others a disease. It occurs in more and more young children, which entails quite serious consequences. Untreated, untreated flat feet can even lead to spinal curvature in childhood.

Degrees of flatfoot

There are different degrees of disease depending on the angle of the arch of the foot. Each class is characterized by separate clinical signs.

The first degree reveals mild clinical signs. Sometimes the patient simply does not feel uncomfortable while walking. Disorders in the lower part of the musculoskeletal system are often invisible. Patients are able to "normally" use their own feet.

The second degree is periodic or moderate flat feet. The pathologies are visible "by eye". As the disease progresses, patients experience joint, muscle, and gait changes. Sometimes patients have flat feet.

Third degree - pronounced flat feet. There is a complete deformation of the foot. At this stage of the disease are found pronounced disorders of gait, curvature of the spine. There is a high risk of disability of the patient, with flat legs with a pronounced degree of progressive destruction of the musculoskeletal system with subsequent sad consequences.

Definition. Deformation of the foot, which is expressed in a strong reduction to the complete disappearance of the transverse and longitudinal arch of the foot. The altered shape of the arches leads to a change in the static position of the lower leg, thigh, pelvis, spine, affecting the function of their muscles. Flat feet can be congenital or acquired. Congenital flat feet account for about 5% of all cases and are due to various congenital malformations of the foot. The remaining 95% is acquired later, occurring at all ages. Ten percent of them are due to various diseases such as rickets, paralysis and trauma. In all other cases it is the so-called static flat foot. In it, the load that acts on the feet exceeds the ability of the musculoskeletal system to support the arches. Reasons for this can be overweight, frequent overload of the foot in occupations that require prolonged standing, as well as the choice of inappropriate shoes. A normal foot has two arches - longitudinal (the largest curve in the middle of the inner edge) and transverse, which is less pronounced (the highest point is the second anterior and cuneiform bone). Most often the medial arch or all together falls, but it is not excluded that only the transverse arch suffers. The latter is referred to as the transverse flatfoot (pes planus transversus) and is usually caused by tight and uncomfortable shoes, especially if they have high heels. Some genetic factors also contribute to the development of flat feet. The most important of these are weakness of the ligaments and joint laziness, which are more characteristic of the fairer sex, which is why women suffer more often. There is also the so-called false flatfoot (pceudo pes planus). There is no real fall of the arches, although the whole foot is in contact with the earth's surface. It occurs mainly in professional athletes (mostly sprinters). In children up to 3 years of age they have a physiologically flat foot due to the incomplete physiological process in the position of the lower leg and the muscles of the foot.

Clinical picture:

Flat feet occur at different ages. Initially, there are complaints of easier fatigue and a feeling of heaviness in the feet after exercise. The fall of the arches is often seen visually, as the foot is visibly widened and extended. The gait is more clumsy and insecure. The shoes wear mainly

on the inside of the foot, as well as the heels. Subsequently, swelling occurs in the area of the ankle and foot, and may reach the knee. Over time, the pain spreads to the hip joint and spine.

Diagnosis:

An examination of the feet is performed for the presence of deformation. Measurement is performed by taking an imprint of Chizhin's plantogram, diagnostics of a plantograph device and by the latest methods for computer diagnostics of the feet and complete postural analysis. 6.5. Complications. The center of gravity and statics of all the links up the chain of the human body - the lower legs, thighs, pelvis, spine - also changes. This condition, together with altered gait and a lack of cushioning function of the foot, contributes to excessive overload of the knees, hips and spine. In these structures, a joint and muscle overstrain occurs, which leads to dull pain when walking and other forms of motor activity.

DESIGN OF A FUNCTIONAL TRAINING PROGRAM

The following principles must be observed for the proper design of a functional training program:

• The basic patterns of movement must first be learned. It is always necessary to first improve the basic movement with your own weight before introducing additional load.

• Training begins with simple exercises with your own weight. In some exercises to strengthen the muscles of the upper body, such as pulling (pulling, rowing), body weight can be a problem and therefore it is advisable to use help at the beginning of the exercise.

• Advances from simple to complex. Increasing the complexity of the exercises is accompanied by functional progress, so if necessary, higher levels of load are added at the appropriate time.

• The concept of progressive loading is used. Increasing the load is the key to the success of functional training, so the number of repetitions or load should increase each week.

Usually progress can be made from the fourth week by performing a more difficult version of the exercise or by adding external resistance (dumbbells, push-ups, sandbags, medicine ball). When implementing the functional training program for people with spinal deformities, the individual progress of each trainee must be taken into account.

PERIODIZATION

Periodization is perhaps the most studied segment of education. Periodization can be defined as the strategic application of specific phases of learning. It includes the proper manipulation of all variables in training - frequency, intensity, range, type of exercise, recovery periods. According to the traditional approach to periodization, periods of short duration and high intensity should be replaced by periods of long duration and low intensity of exercise. The most important aspect of the periodization of training is the proper planning of the recovery period, which is especially important in the training of people with spinal deformities and flat feet.

Periodization is considered through three types of cycles that must be properly designed: **the macrocycle** refers to the entire training program or season; **the mesocycle** represents a small whole throughout the training program (for example, the developmental phase of

cardiorespiratory fitness), while **the microcycle** refers to the smallest unit of the mesocycle - usually one week.

ELEMENTS OF PHYSICAL FITNESS

Functional training, among other things, develops elements of physical fitness. When we say physical fitness, we mean the abilities needed to improve daily functioning through the patterns of movement that people use in their daily lives. Physical fitness refers to the preparation for successful performance of daily activities. For example, squatting or grabbing objects from a high shelf are daily activities that involve a large number of muscle groups. When achieving physical fitness, it is important to know that not every exercise is for everyone, as each person has their own goals, needs and level of fitness. However, for most people, exercises such as stepping, plank, pushing and pulling are useful - exercises that require performance in several planes. A large number of exercises to achieve physical fitness are performed with your own weight, but you can also use different equipment and external loads (dumbbells, elastic bands, medical balls ...).

In order to achieve physical fitness, one of the three levels of functional training can be applied, depending on the applied intensity of the exercises. Regardless of the part of the body that is exercised, all exercises can be divided according to the intensity and the applied load, as follows:

1. Basic exercises are a common starting point for training. Depending on them, the following exercises are defined as progression or regression. The basic exercises are usually performed for three weeks and then progression is applied. However, if the trainee has difficulty performing basic exercises, either due to injury or due to technical problems, a regression is performed immediately, ie. reducing the intensity. This system of progression and regression is crucial for the proper implementation and application of functional training.
2. Progression is a step forward in terms of basic exercises, as the exercises are performed one after the other according to the principle from easier to harder. Progression is achieved by performing exercises with your own body weight or by applying an appropriate external load.
3. Regression - the exercises are performed in reverse order to the progression, ie. from easy through easier to easiest.

With the correct application of selected exercises and loads, muscle balance is achieved and the possibility of injuries is reduced.

Physical fitness refers to the ability of all body systems to work together effectively so that a person is healthy and able to perform their daily activities without hindrance. Physical fitness consists of a total of 11 components, six of which are healthy, while the other five are related to abilities. All are important for physical activity. Special attention is paid to the health components here. They are:

1. Cardiorespiratory endurance - the body's ability to exercise for a long time without rest. This requires a strong heart muscle, healthy lungs and permeable blood vessels in order for oxygen to be delivered to muscle tissue without any problems.

2. force - represents the amount of force that muscles can produce. It is usually measured by the weight that the trainee can lift or by the resistance that he can overcome.

3. muscular endurance - the ability of a muscle to perform movement several times without the appearance of fatigue.

4. flexibility - the ability to make full use of the joints in a large number of movements without injury. The muscles should be long enough and the joints free enough to allow the necessary movement.

5. body composition - refers to the various types of tissues that make up the human body such as fat, muscle, bone and organ. The level or amount of body fat is usually used as a health-related component of body composition.

6. explosive force - the ability to quickly use muscle strength.

The components of physical fitness related to abilities are: balance, coordination, speed, reaction time.1. Cardiorespiratory endurance - the body's ability to exercise for a long time without rest. This requires a strong heart muscle, healthy lungs and permeable blood vessels in order for oxygen to be delivered to muscle tissue without any problems.

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GENERAL PRINCIPLES FOR DESIGNING AN EXERCISE PROGRAM

Although the recommended or prescribed exercises are individual for each trainee, the main elements of the exercise program are always common. Table 1 below shows the types of workouts and sample exercise patterns that optimize the improvement of each of the components of physical fitness. The intensity of exercise dictates specific physiological and metabolic changes in the body during exercise. The initial intensity, which is set for a specific exercise, depends on the trainee himself: what are his goals, age, abilities, limitations, level of

training. The initial intensity should stimulate but not overload the cardiovascular and musculoskeletal systems.

Duration and intensity are inversely proportional. The duration of training depends not only on the intensity, but also on the individual components of health, the initial level of fitness, functional abilities and goals. The recommendation of the ACSM (American College of Sports Medicine),

that each person should have 150 minutes of moderate-intensity or 75 minutes of intense aerobic exercise per week. As the trainee adapts to the workout, its duration can be gradually increased by 5-10 minutes with an interval of a week or two. For older people with a lower level of fitness, ACSM (2014) recommends increasing the duration rather than the intensity of the workout, which can also be applied to some people with spinal deformities and flat feet.

The frequency includes the total number of workouts per week. Training three times a week is enough to improve the various components of physical fitness.

Table1. Types of workouts to improve the components of physical fitness

A component of physical fitness	**Type of training**	**Type of exercise**
Cardiorespiratory endurance	Aerobic training	Walking, jogging, rowing, cycling, climbing stairs, aerobic dance, step aerobics
Muscle strength and endurance	Workouts with load or resistance	Exercises with own weight, exercises on devices, exercises with free weights, exercises with elastic bands
Flexibility	Stretching workouts	Static stretching, dynamic stretching, yoga, Pilates, partner stretching (PNF stretching)

In order to create a quality functional training program of any kind, it is necessary to understand the eight basic principles that apply when exercises are recommended:

1) frequency - how many times a week you need to train;

2) intensity - a measure of the effort invested in training;

3) duration (time) - refers to the duration of a training or interval;

4) type - refers to the type of exercise that is performed during training (running, swimming, cycling ...);

5) overload - increased involvement of the muscular system;

6) specificity - can be twofold: metabolic specificity and specificity of muscle contraction. Specificity refers to the selection of the appropriate type of stress for the metabolic and musculoskeletal systems;

7) reversibility - refers to the loss of any type of acquired condition. The time required to lose fitness depends on the type (aerobic fitness for 10 days, muscle for about 30 days);

8) maintenance - current condition of the condition, which requires less effort and work than to improve it.

CARDIOR RESPIRATORY FITNESS

One of the most important elements of physical fitness is cardiorespiratory fitness. Cardiorespiratory fitness is the ability to perform dynamic exercises of moderate to high intensity, which involve large muscle groups for long periods. Any assessment of physical fitness should include an assessment of cardiorespiratory function during rest and exercise. Depending on the initial level of fitness, adequate aerobic endurance develops in a period of 4 to 20 weeks (16-20 weeks for beginners, 12-16 weeks for people with intermediate fitness and 4-12 weeks for exercisers with good condition). To continuously improve the cardiovascular and musculoskeletal systems should be gradually overloaded by periodically increasing the frequency, intensity or duration of exercise, always only one element. Simultaneous increases in frequency, intensity and duration can overload the physiological system and increase the risk of injury.

Cardiorespiratory elements of training

Each workout in the aerobic exercise program should contain the following phases:

• Warm-up (5–15 minutes): The purpose of the warm-up is to increase blood flow to the working skeletal muscles and the heart muscle, to raise the body temperature, to reduce the possibility of injury to the muscles and joints and to reduce the chance of abnormal heart rhythms. During the warm-up, the pace of the workout is gradually increased so that the body can prepare for the higher intensity of the workout during the exercise.

• Endurance exercises (25-60 minutes): During the endurance training phase, aerobic exercises are performed according to the rules of training according to the FITT-VP principle (ie F = frequency; I = intensity; T = time, duration ; T = type, mode of activity; V = volume, range, quantity; P = progression). This phase usually lasts from 20 to 60 minutes, depending on the intensity of the exercise.

• Cooling (3-10 minutes): The previous phase is followed by the cooling phase. This phase is necessary immediately after endurance training to reduce the risk of cardiovascular complications caused by abrupt cessation of exercise. During cooling, the trainee continues to exercise (for example, walking, running or cycling) at low intensity for 3 to 7 minutes.

• Stretching (≥10 minutes): The stretching phase lasts at least 10 minutes and takes place after the heating or cooling phase. Static exercises to stretch the legs, waist, abdomen, thighs, groin and shoulders are usually included. Stretching exercises after the cooling phase can help reduce the risk of muscle cramps or pain.

MUSCLE STRENGTH AND ENDURANCE

Muscle strength and endurance are two important components of muscle fitness. Adequate levels of muscle condition reduce the risk of low back problems, osteoporotic fractures and musculoskeletal injuries. Muscle strength is defined as the ability of a muscle group to develop maximum contractile strength against resistance to a single contraction. The force created by a muscle or muscle group largely depends on the speed of movement. Maximum force occurs when the limb does not move (ie at zero speed). As the speed of rotation of the joint increases, muscle strength decreases. Therefore, the force for dynamic movements is defined as the

maximum force generated by a contraction at a certain speed. Muscle endurance is the ability of a muscle group to exert submaximal strength over an extended period of time.

Muscle ability can be improved by using different types of resistance exercises - isometric (static), dynamic (concentric and eccentric) and isokinetic. Although there are general guidelines for designing programs for isometric, dynamic and isokinetic resistance exercises, each regulation (recommendation) for exercise should be individualized according to the specific needs and goals of the trainee. One of the most important areas that needs to be strengthened by applying strength training is the torso area, more specifically the torso muscles need to be strengthened.

Training to strengthen the muscles of the torso

A large number of daily activities require the use of multiple joints in different planes. These activities include dynamic patterns of movement that require the transfer of force between the limbs. The muscles of the torso play a key role in transmitting this force. Insufficiently strong torso muscles increase the risk of lower back injuries during dynamic and ballistic exercises. In contrast, a strong torso: increases the efficiency of movements; improves balance and muscle coordination; improves posture and gait; increases strength and flexibility in the lumbar and pelvic area, as well as the sacroiliac joint; minimizes energy losses and improves power transmission.

Any workout that affects the abdominal muscles, pelvis and shoulder stabilizers can be considered a torso strength workout. The word "core" has a broad meaning and reflects the intention to cover all the muscles in the middle part of the body. The main function of certain muscles and muscle groups is **stabilization.** Functional training for these muscles refers to preparing them to be better stabilizers by performing simple exercises through short-range movements. As a guideline, the information is used that the three muscle groups requiring stabilization exercises are: **deep abdominal muscles, abductors (leads) and rotators in the hip joint and stabilizers of the shoulders (shoulders).** These muscles are the vital link between the strength of the upper and lower body. Therefore, these muscles should be considered anti-rotators, anti-extensors and anti-lateral flexors, not extensors and flexors. It is wrong, for example, to develop a larger volume of rotating movement in the lumbar spine, to perform rotational stretching and rotational exercises for dynamic warm-up. It has been scientifically proven that a large percentage of lower back pain problems occur because the abdominal muscles are unable to maintain strict control over the rotation between the pelvis and the spine (at the level of L5-C1). It is important in parallel with the development of the muscles of the torso as a stabilizer to develop the range of motion in the hip joint in both internal and external rotation.

The connection between strengthening the muscles of the torso as a stabilizer and breathing is interesting. The deep abdominal muscles, whose antagonist is the diaphragm, play an important role in stabilizing the torso. The key to the proper use of breathing in training to strengthen the muscles of the torso is to understand that the respiratory process is not passive but active. With proper breathing, there is an interaction between the eccentric and concentric contractions of the diaphragm and the deep abdominal muscles.

When designing functional workouts, especially for people with disabilities, it is important not to start with strength training until the torso muscles are strong enough to provide stability when performing movements. This improves the health and basic functionality of the body.

Stabilization training usually begins with three sets of 30 s, divided into five exercises of 6 s. It is necessary to follow the concept that if effective training of stabilizers is required, then they must be given time to stabilize. Time may be used instead of number of repetitions to determine the length of the series. Five repetitions last approximately 30 to 60 s. These are general guidelines and can be adjusted based on age, experience and type of disability.

For each exercise that uses body weight, progression or progression over a period of three weeks is performed as follows: first week: 3 × 8 (three sets of eight repetitions); second week: 3 × 10 (three sets of ten repetitions) and third week: 3 × 12 (three sets of twelve repetitions). After the third week, you move on to a more difficult version of the workout (usually called progression 1), the number of repetitions decreases, and the same progression begins again. Trainers should dedicate themselves to training to strengthen the torso muscles at least as well or better than any other aspect of the training program. Properly performed training program for torso muscle strength ("core") helps to reduce injuries, increase strength and improve speed, as well as functional movements in everyday life, especially for people with disabilities.

FLEXIBILITY

Flexibility is the ability of a joint to use its full range of motion (ROM). Flexibility is important not only for sports performance (eg ballet, gymnastics), but also for daily activities. Maintaining the flexibility of all joints facilitates movement. Flexibility depends on a number of specific variables, including joint capsule extensibility, proper warm-up, and muscle viscosity. In addition, flexibility depends on the alignment (i.e., tightening) of other tissues, such as ligaments and tendons, that affect the ROM. Poor flexibility of the lower back and pelvis, along with insufficient strength and endurance of the abdominal muscles or other causative factors, can contribute to the development of pain in the muscles of the lower back.

Flexibility training

The goal of any flexibility training program is to develop the range of motion of major muscle groups and tendons. It is considered through the characteristics presented by the FITT concept:

• **frequency:** three times a week (it is most effective to exercise daily);

• **intensity:** to perform stretching to a feeling of tightness or slight discomfort;

• **duration:** in static stretching the position should be maintained for 10-30 s, in the elderly 30-60 s; during PNF stretching for 3-6 s a slight to medium strong contraction is performed (20-75% of the maximum voluntary contraction), followed by 10-30 s stretching with assistance;

• **type:** each type of stretching is effective, it is important to stretch all major muscle groups and tendons;

• **range:** it is reasonable to perform each flexibility exercise for up to 60 s;

• **model (shape):** flexibility exercises are most effective when performed with warmed muscles after light to moderate aerobic activity or after warming up with external methods such as wet and warm packages or baths; each flexibility exercise should be repeated 2-4 times;

• **progression:** there is no known method for best progress, it is individual.

RECOMMENDATIONS FOR EXERCISE OF PEOPLE WITH DIFFERENT TYPES OF SPINE DISTORTIONS

Remedies for spinal deformities are active and passive. The active agents are widely used as a prophylactic and therapeutic agent in prescoliosis, first and second degree scoliosis, as well as to support surgical and orthostatic treatment of third and fourth degree distortions.

Objective: Restoration of proper posture and stimulation of the psycho-physical development of children.

Tasks: 1. General strengthening of the organism; 2. Psycho-emotional impact; 3. Restoration of normal relations between the vertebrae; 4. Overcoming muscle imbalance; 5. Creating a healthy muscular corset; 6. Restoring the correct habit of posture.

Means: General developmental tools: • General developmental exercises; • Elements of sports - swimming and sports that stimulate balance reactions. 22 Targeted (special) means - active means of CT: Corrective exercises Exercises for pulling the spine: • through active mobilization of the GS - are performed from different starting positions; • through the key position of the head; • by pulling the spine along the longitudinal axis from a loaded position. Exercises to improve muscle strength: • isometric exercises for weak muscles; • symmetrical and asymmetrical - in the first degree of scoliosis the exercises are symmetrical, and in the second and third degree the asymmetrical exercises prevail; • exercises against dosed resistance with the help of dumbbells, weights and rubber bands.

Exercises to overcome muscle imbalance: • PIR for shortened muscles; • stretching exercises; • stretching exercises by F. Mezieres. Exercises to create proper posture: • wearing objects on the head; • placing hands behind the head; • combining the exercises with manual correction. Balance and coordination exercises from different starting positions. Breathing exercises: • dynamic and static breathing exercises are applied; • diaphragmatic breathing; • chest breathing. The number of breathing exercises increases in second and third degree scoliosis. 23 Passive means of CT: • therapeutic massage; • manual hypercorrection; • different types of extensions; • corsets; • autohypercorrection; • physiotherapeutic agents. Contraindicated are: • exercises for flexion of the spine; • relaxing exercises; • heavy strength exercises; • running and shaking. Table 1. Example complex of kinesitherapy in thoracic scoliosis first degree № Starting position Contents Number of repetitions Methodically indicated

For better daily functioning, training for people should include three segments of exercises to develop cardiorespiratory fitness, strength and flexibility. The purpose of the exercise of each trainee included in the training program is taken into account. This directly affects the frequency, intensity, duration, type, form and development of the prescribed program. The following 4 tables provide exercise recommendations for certain forms of disability.

FITT recommendation	Exercises to develop aerobic capacity
Frequency	1-2 times a week at the beginning, three times a week later
Intensity	> 60% of maximum heart rate or 46-90% VO2max (as a measure of cardiorespiratory fitness)
Duration	≥20 minutes over a period of 8 to 16 weeks depending on the weekly frequency;
Type	rhythmic activities, including large muscle groups, exercises on a hand or foot ergometer, treadmill or bicycle
FITT recommendation	**Strength development exercises**
Frequency	2-4 workouts per week with a break of at least one day
Intensity	50% -85% of one maximum repetition
Duration	12 to 16 weeks, the number of repetitions of each exercise in one of the three series should be 6-15;
Type	initially exercised with its own weight, strength training devices can be used as well as free weights

FITT: F - Frequency, I - Intensity, D – Duration, T – Type

Stretching exercises for spastic muscles and non-spastic muscles are recommended to develop flexibility. Stretching exercises should be performed before and after aerobic exercise. The aim is to increase the range of movements that are directly related to the easier performance of daily activities.

Table 3. Training rules for people with muscular dystrophy

FITT recommendation	Exercises to develop aerobic capacity
Frequency	4-6 times a week
Intensity	50% -80% of cardiac reserve
Duration	each workout for 20-40 minutes or until the onset of fatigue in beginners
Type	cycling, treadmill walking, hand ergometry and exercise machine
FITT recommendation	**Strength development exercises**
Frequency	2-3 times a week, a break of 48 hours between two workouts
Intensity	It starts with 50% of a maximum workout with more than 10 reps and over time (it should take weeks and months) you reach 75% of a maximum workout with 10-12 reps in three sets (depending on the ability of each training separately)
Duration	not specified
Type	exercises to develop strength and endurance of the muscles of the lower extremities and daily strengthening of the respiratory muscles, swimming

FITT: F - Frequency, I - Intensity, D – Duration, T – Type

The purpose of flexibility exercises is to increase the range of motion and prevent contractures. They need to be performed daily so that the end position during stretching is maintained for up to 30 s.

Table 4. Training rules for people with multiple sclerosis

FITT recommendation	Exercises to develop aerobic capacity (in order to improve or maintain cardiorespiratory function)

Frequency	3-5 times a week
Intensity	60% -85% of maximum heart rate or 50% -70% of VO2max
Duration	About 30 minutes of each individual workout, with a total program duration of 3 to 6 months
Type	Riding a bike, running on a treadmill with a seat belt and swimming
FITT recommendation	**Strength development exercises**
Frequency	2-3 times a week
Intensity	50% -70% of the maximum voluntary contraction, 8-15 repetitions in one to two series
Duration	For the effectiveness of the program 4-6 months
Type	Isokinetic exercises, exercises with weights, rubber bands and equipment

FITT: F - Frequency, I - Intensity, D – Duration, T – Type

The most effective method for developing flexibility is the daily application of stretching. The final position for each part of the body that is stretched should be maintained for 30 to 60 s with two repetitions. If there are contractures, a longer stretch is needed, which can last more than 20 minutes.

Table 5. Training rules for people with spinal injuries (paraplegia and quadriplegia)

FITT recommendation	**Exercises to develop aerobic capacity**
Frequency	3-5 times a week
Intensity	40% -90% of the reserve for oxygen consumption
Duration	10-20 minutes at the beginning, increase to 30-60 minutes for each workout
Type	Ergometer for manual cycling, wheelchair ergometry, treadmill wheelchair riding, sitting aerobics, swimming, electrical stimulation of leg ergometry with or without hand ergometry
FITT recommendation	**Strength development exercises**
Frequency	2-4 times a week
Intensity	8-12 repetitions in 2 to 3 series
Duration	4-6 months of continuous training
Type	Exercises with strength training devices, exercises with dumbbells or weights with velcro straps that are placed around the joints

FITT: F - Frequency, I - Intensity, D – Duration, T – Type

To develop flexibility, it is best to use one of the stretching methods. These exercises should be practiced before aerobic and strength training. The main goal is to prevent contractures.

Stretching should be used to develop flexibility to maintain the optimal range of motion of the joints. For strength and flexibility training in terms of load dosing, the same mode of operation can be used as for people without amputations (if there are no related diseases).

EQUIPMENT USED IN THE FUNCTIONAL TRAINING OF PEOPLE WITH SPINAL DISTORTIONS

Functional training consists of exercises with body weight and progressive exercises with resistance. First you need to master the exercises with body weight, and then add various external loads. Initially, no additional external resistance is needed, as a person with a disability learns the patterns of movement. It is necessary to master the pattern of movement and then add resistance. For the concept of functional training, it is important to learn the movements before applying the load. Below is a brief overview of some key elements of functional exercise equipment and some basic guidelines on how and when to use them.

Elastic bands and rings. In training for coordination and strength with the help of elastic bands, the intensity can be determined for each trainer. These tapes are versatile and flexible in their use as equipment providing elastic resistance. TRX is the most popular commercial model, but there are many types.

Medical balls. They are made of rubber, with different sizes and weights, they can bounce or not. They can have holders and built-in ropes. Because the whole body is used in the exercises, the medicine ball can activate the whole kinetic chain. They are also used as weights to intensify the exercises. Medical balls are used to create an asymmetrical and unstable training environment.

Pilates balls (for stability). Trainers and trainees should be careful when sitting on Pilates balls during dumbbell exercises or if they use a Pilates ball as a substitute for a push-up bench.

Agility ladders. They provide dynamic warm-up, which emphasizes each component (balance, leg speed, coordination and eccentric force). Agility ladders provide benefits to both the muscular and neuromuscular systems, while raising muscle temperature.

Other equipment. For the needs of functional training other equipment is used: dumbbells, cones, small balls, pudovki with different weight. For training cardiorespiratory fitness are also used: hand and foot ergometers, recumbent bicycles (also used in a supine position), treadmills with a seat belt and heart rate monitors (in order to objectively monitor the intensity of training).

LITERATURE

Posture-training device - by Dworkin (Dworkin, et al., 1985; Dworkin, 1982).

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