‘B-FIT’ TRAINING GUIDE

A guide to prescribe aerobic exercise in neuromuscular diseases

PROJECT ORGANIZATION

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Chapter 1

General introduction

1.1 Background.

In neuromuscular diseases (NMD), common symptoms like muscle weakness, fatigue and pain lead to increased difficulty when engaging in physical activity, resulting in reduced physical fitness. This further complicates physical functioning and aggravates symptoms leading to a vicious circle of inactivity. An inactive lifestyle has many negative consequences: reduced physical fitness, unfavorable fat-to-muscle ratio, increased risk of cardiovascular disease, less social participation and a lower quality of life.[1]

An important goal of rehabilitation treatment is to break this vicious circle of inactivity through physical exercise.[2] However, there are currently no clear guidelines available for prescribing, monitoring and evaluating physical exercise in patients with NMD. This hinders the use of physical exercise programs in daily care[3] and partially explains the conflicting results from previous studies.[2] Due to the lack of guidelines, practitioners and patients experience problems with regard to the needs assessment for physical exercise, the design of the exercise program, and the integration of exercise in daily life.[3,4]

The FACTS-2-NMD study (acronym for ***F***itness ***A***nd ***C***ognitive behavioural ***T***herapie***S*** for ***F***atigue and ***ACT***ivitie***S*** in ***N***euro***M***usuclar ***D***iseases) examined the effectiveness of physical exercise in individuals with NMD for reducing fatigue and limitations in daily functioning and improving quality of life[5-7]. The FACTS-2-NMD study included a qualitative assessment of the experiences of patients and practitioners with physical exercise.[8] The results provided insight into how physical exercise, in particular aerobic exercise, can be better tailored to individual patients. Based on these insights, the 'B-FIT' training guide was developed [Dutch acronym for 'Stabilizing or improving the physical fitness in NMD']. The training guide is intended for people with slowly progressive NMD, so it cannot be used for people with rapidly progressive diseases, such as Amyotrophic Lateral Sclerosis (ALS). In this training guide, NMD therefore refers to slowly progressive NMD. The B-FIT training guide focuses specifically on aerobic exercise and does not include aspects such as exercise to improve muscle strength and flexibility.

The training guide was developed by a multidisciplinary working group of experts including researchers, rehabilitation physicians, physical therapists and people with NMD.

1.2 Using the training guide.

The B-FIT training guide consists of a manual for therapists and a patient workbook. The manual for therapists contains background information about the importance of physical activity and exercise, exercise principles and practical instructions for physical therapists and other care professionals when making a needs assessment and for prescription, monitoring and evaluation of aerobic exercise programs for individuals with NMD. Work protocols and the corresponding forms are included for the various steps in the care pathway. Both can be used in the decision-making process for prescription of an exercise program (specified in Chapter 2). The patient workbook contains practical information for the patient, the exercise program and a logbook for tracking progress and adapting the program if necessary (specified in Chapter 3). An abbreviated version of the manual for therapists and an accompanying instructional film can also be found online on the B-FIT website.[a]

[a] https://www.amc.nl/trainingguide

The primary aim of the training guide is to provide practitioners and patients with tools for the needs assessment and for prescription, monitoring and evaluation of physical exercise in NMD. The secondary aim is to create more uniformity in the treatment of this population.

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Chapter 2

Manual for therapists

2.1 Introduction.

The manual for therapists consists of three parts. Part 1 contains theoretical background information on physical activity guidelines, general exercise physiology principles for achieving improved physical fitness and problems related to prescribing aerobic exercise in individuals with NMD. Part 2 provides practical guidance on making a needs assessment for aerobic exercise, determining exercise intensity, designing the exercise program and monitoring and evaluating the program. Part 3 gives a brief overview of the recommendations from Part 2, including clinimetrics and a description of their use.

PART 1

2.2 Guidelines for physical activity.

2.2.1 Physical activity guidelines in the healthy population.

The World Health Organization (WHO) has established guidelines on physical activity and sedentary behaviour.[b] The guidelines define a minimum level of activity that is necessary for maintaining long-term health. According to the guidelines, adults should do at least 150–300 minutes of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week, for substantial health benefits. Additionally, adults should limit the time being sedentary. Scientific evidence, based on self-reported physical activity, has shown that a third of adults worldwide does not reach physical activity guidelines for recommended levels of physical activity, with large differences between countries.[9]

2.2.2 Physical activity guidelines for individuals with NMD

Although there are no specific physical activity guidelines for NMD, there are recommendations for adults living with disability (Fig. 1). These recommendations are mostly similar. If adults with disability are not meeting the recommendations, doing some physical activity is advised. Interestingly, most studies on physical activity in NMD evaluated whether individuals complied with the WHO physical activity guidelines for adults without disabilities. However, individuals with NMD generally have a decreased aerobic capacity due to their muscle weakness, which makes activities relatively more strenuous. Therefore, relative intensity is a better guide for adults with NMD, than absolute intensity (e.g. number of steps per day, or number of minutes per activity). Nevertheless, physical inactivity is a common problem among individuals with disabilities, including NMD.[10] A physical activity program is therefore usually part of their treatment.[11,12]

b https://www.who.int/publications/i/item/9789240015128

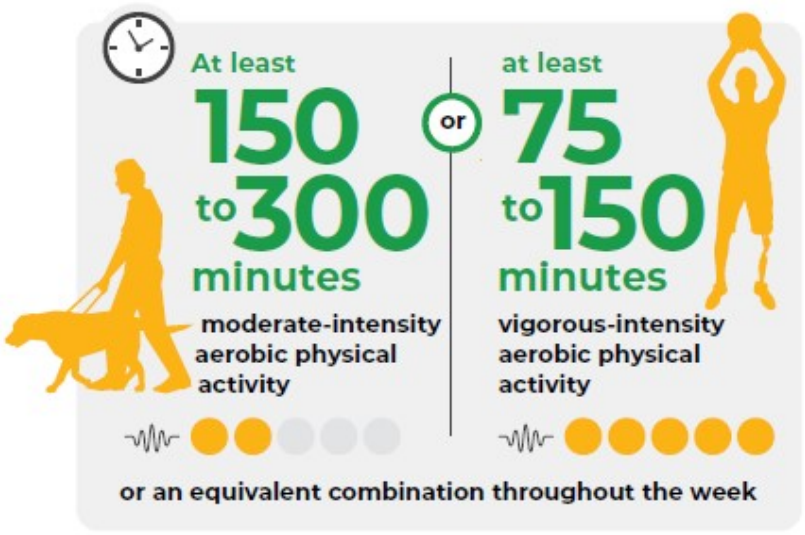

Figure 1. Physical activity guidelines for adults living with disability (WHO, 2020)

2.3 Optimizing health or physical fitness.

When a physical activity program is part of the treatment, it is important to first determine the goal of the program. Is the goal focused on maintaining health or optimizing physical fitness? Although the dividing line is sometimes thin, these different goals also require different treatment plans. This is best explained by the terms physical activity and exercise.

Physical activity is defined as: "*any bodily movement produced by skeletal muscles that requires energy expenditure"*. Exercise is "*a form of physical activity consisting of planned, structured and repeated bodily movement of increasing workload and intensity with the aim of optimizing physical fitness*".[13]

The training guide focuses on optimizing physical fitness (more specifically, the aerobic capacity); maintaining health falls outside the scope of the training guide. The reduced physical fitness in individuals with NMD is partly caused by the disease process, but an inactive lifestyle can also contribute to this. Where the disease process is irreversible, deconditioning as a result of an inactive physical lifestyle can possibly be treated with an aerobic exercise program.[1]

The first important step is therefore to determine to what extent deconditioning has resulted from an inactive lifestyle. To this end, the practitioner determines to what extent there is a discrepancy between the physical capacity of the patient and the actual level of physical activity in daily life: the greater the discrepancy, the greater the potential for improving physical fitness. In some cases, there will be no room for improvement, and the goal of the physical activity program will be to maintain overall health rather than to improve physical fitness. An accurate medical history is the basis for determining to what extent there is deconditioning due to an inactive lifestyle. This is supplemented with activity questionnaires and possibly with tests to determine the physical capacity. This is discussed further in section 2.6.

2.4 How is an optimal physical fitness achieved?

Exercise is the process in which repeated systematic physical activity leads to functional and morphological changes in body tissues and systems, or to the maintenance of these changes. Aerobic exercise leads to adaptation of the muscles and the cardiorespiratory system. A larger supply of oxygen is achieved, which is due in part to increased heart minute volume and capillary density. In addition, oxygen uptake and processing is improved due to greater numbers of mitochondria, increased size of existing mitochondria and enhanced oxidative enzyme capacity. Aerobic exercise therefore improves energy delivery through the aerobic energy system, i.e. oxidative phosphorylation. For healthy people, these adaptations improve physical fitness and reduce fatigue.[14] This is reflected in the ability to perform submaximal exercise for a longer time and with less effort. A number of general exercise principles have been derived from the changes that result from physical exercise.[14] These principles are important for designing an exercise program and are briefly explained below.

2.4.1 General exercise principles.

Specificity.

The changes that take place in body tissues as a result of systematic physical activity are stimulus-specific. A certain activity can lead to a change in one tissue, but this change may not occur in another tissue. In addition, each tissue can react differently to an exercise stimulus. It is therefore important to train as specifically as possible to achieve a specific goal. For example, if the patient's goal is to improve his or her walking function, then the exercise should preferably focus on walking and not on other activities. Specificity is important for achieving the goal of the exercise and must be tailored to each individual.

Reversibility.

Accumulated exercise effects are partially or completely lost after exercise is stopped. This reversibility is related to the 'use it or lose it' principle; muscle tissue becomes atrophic with insufficient use. The rate of reversibility depends on several factors, including how long the exercise has been stopped. Generally speaking, more exercise effects are reversed as time without exercise increases. In individuals with NMD, it is important to take this into account. Even minimal loss of muscle strength due to stopping exercise may have major functional consequences. This should therefore be prevented as much as possible.

Optimal exercise intensity for effective exercise.

If the exercise intensity is too light or too heavy, the exercise will be less effective. Exercise intensity or frequency that is too low can lead to little or even no progress. On the other hand, excessive exercise intensity or frequency can lead to acute injury or overuse. Therefore, an optimal exercise intensity is especially important in NMD to avoid physical complaints. To determine the optimal intensity for individual patients before starting the exercise program, practitioners must accurately determine their current physical fitness, exercise history and any physical limitations. An exercise program is then designed accordingly.

Diminishing returns.

At the start of an exercise program, participants make rapid progress, but as exercise moves to higher levels, the gains diminish; top athletes make few or no gains with their exercise. They exercise primarily to stay in condition. This may also apply to some individuals with NMD because the physical strain of activities of daily living is relatively high (these patients have to perform these activities with less muscle mass), the muscles involved have already adapted to a large extent.[15] For some individuals with NMD the potential exercise gains will therefore be limited. Nevertheless, a small gain in fitness can lead to a relatively large gain in everyday functioning.

Supercompensation.

In order for adaptation to occur as a result of exercise, the body systems involved must be put under greater load than under normal circumstances. If this extra load is applied over a longer period of time, the systems will adapt to this higher level, which then becomes the new standard. During the adaptation phase (recovery) the body systems will overcompensate or supercompensate to cope with subsequent loads (Fig. 2A). Provided that sufficient recovery time is taken into account and adequate nutrition is provided, exercise in this way can lead to supercompensation, resulting in increased physical fitness (Fig. 2B).

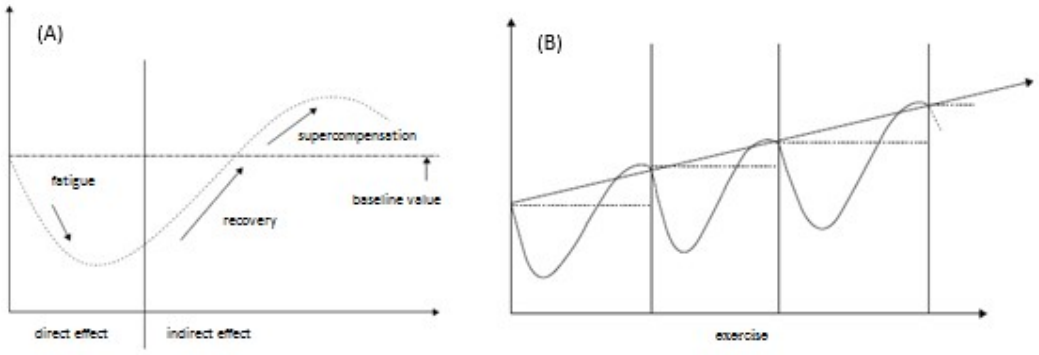

Figure 2. (A) Effect of exercise with optimal intensity. (B) Cumulative effect of multiple exercise sessions.[16]

Overtraining.

Overtraining occurs when someone becomes extremely fatigued due to excessive exercise volume (the combination of frequency, intensity and time). Overtraining may result in loss of physical fitness and a greater risk of injury and fatigue. This must be avoided. Signs of overtraining are: *sharp or acute pain in muscles/joints, fatigue and insomnia, elevated resting heart rate, headache, inability to complete an exercise session, increased susceptibility to disease (including colds and flu)*. To prevent overtraining, it is important to offer a tailored exercise program and to monitor exercise.

2.4.2 The FITT principle.

A tailored exercise program is designed according to the FITT principle.[17] FITT stands for Frequency, Intensity, Time and Type. The FITT factors show strong mutual coherence. The level and type of

coherence differs per individual and depends on the intended goal of the exercise. For example, the FITT factors are different for an aerobic exercise program than for a strength exercise program. The FITT factors will also be different for individuals with NMD than for healthy people. The FITT factors for healthy people are discussed below. Section 2.8.2 describes the recommended FITT factors in NMD.

Frequency.

The frequency is expressed as the number of exercise sessions per week. Due to the interaction between the effects of the intensity and length of each session, the optimum frequency will differ between exercise programs. Guidelines for aerobic exercise for healthy people prescribe an exercise frequency of at least 3 times a week to achieve a positive exercise effect. [17]

Intensity.

According to the principle of supercompensation, there should be a certain minimum threshold intensity. Exercise below this threshold will not provide a sufficient trigger to achieve the desired physiological adaptations. The minimum threshold intensity depends on the physical fitness level. The threshold is high for very well-trained athletes, while there is no minimum threshold for very inactive, untrained people. For the latter group any form of exercise leads to improved physical fitness. [17]

The intensity should not only be described in absolute values, but also in relation to the maximal exercise capacity at that moment. For someone with a maximum oxygen uptake of 1.5 L/min, an activity that requires 1.2 L/min is a much higher load than for someone of the same age with a maximum oxygen uptake of 2.0 L/min. It is therefore recommended to express the intensity of an exercise task as a percentage of the maximal exercise capacity. A commonly used measure for this is the heart rate reserve (HRR), defined as the difference between the maximum heart rate (HR_{max}) and the resting heart rate (HR_{rest}). Guidelines for aerobic exercise for healthy people prescribe moderate (40%–60% HRR) to heavy intensities (60%–90% HRR). Lower intensities (30%–40% HRR) are recommended for people who are deconditioned. [17]

Time.

The time can be expressed in the number of minutes of effort per session, day or week. To improve the aerobic capacity, it is recommended to schedule at least 3 times a week for 25 minutes of high intensity exercise or at least five times a week for at least 30 minutes of moderate intensity, or a combination of moderate and high intensity exercise with an equal volume.

Type.

To improve aerobic capacity, it is recommended to use types of exercise that engage large muscle groups. This is needed to sufficiently load the cardiovascular system. In addition, the principle of *specificity* must be taken into account to achieve the intended goal.

2.5 Aerobic exercise in NMD.

2.5.1 Importance of aerobic exercise.

Individuals with a NMD have long been discouraged from participating in physical exercise programs. This was mainly based on theoretical reasons: already weakened muscles would be more susceptible to overuse injury, because these muscles are often already under relatively heavy load during activities of daily life. Although a number of case reports have shown accelerated muscle weakness due to excessive physical activity, no controlled studies have shown that this is the case. Based in part on the widely acknowledged importance of exercise for good health, increasing attention is being paid to aerobic exercise for individuals with NMD[18] with the aim of counteracting the negative consequences of inactivity and alleviating symptoms such as fatigue.

2.5.2 Effectiveness of aerobic exercise in NMD.

An important question is the extent to which aerobic exercise has proven to be effective for improving physical fitness and reducing symptoms such as fatigue in individuals with NMD. Although there is insufficient scientific evidence to draw definitive conclusions, more and more studies have demonstrated the positive effects of aerobic exercise in patients with various NMD: motor neuron disorders (including post-polio syndrome [PPS][19]), peripheral nerve disorders (including Charcot Marie Tooth [CMT][20]) and muscle disorders (including mitochondrial myopathy[21] and dystrophy[22]). Aerobic exercise is therefore widely applicable in the patient group. For a more detailed explanation of the effectiveness of aerobic exercise in NMDs, refer to the systematic reviews on this topic, including that of Voet and colleagues.[23]

The extent to which an aerobic exercise program is feasible and effective for individuals with NMD depends on various factors, including the stage and severity of the condition (e.g. the degree of muscle weakness) and the baseline fitness (degree of deconditioning). Effectiveness is also related to the design of the exercise program.

2.5.3 Prescribing aerobic exercise in NMD.

The large heterogeneity of NMD makes it difficult to provide general aerobic exercise guidelines for individuals with NMD. There are approximately 600 different types of NMD, each with its own pathophysiology, and there is a wide variety between individuals in the disease severity and the basic fitness level. It is therefore not surprising that practitioners and patients encounter problems when making a needs assessment and designing an exercise program.[4]

Firstly, there are no guidelines from the scientific literature for making a needs assessment (indication) for physical exercise. Before a program can actually be designed, it must first be determined whether there is an indication for it. There must be a discrepancy between physical capacity and the activities of daily living. The greater this discrepancy, the more deconditioning there is due to inactivity and the greater the potential exercise gain. A good medical history is the basis for determining this degree of deconditioning, and this is supplemented with clinimetrics such as activity questionnaires and functional tests. However, in practice there is no clarity about which clinimetrics should be used and how the information collected contributes to decision making. As a result, practitioners are largely dependent on their own clinical experience and methods.

A second difficulty is how to design the exercise program[3]. This specifically concerns the following: how many sessions per week, with which intensity, how long per session and which type of exercise (the FITT factors)? Due to the lack of guidelines, practitioners are also dependent on their own expertise and experience in this respect. For example, the exercise workload at the start of the exercise program is often estimated based on aspects such as the overall physical capacity of the patient. If the estimate turns out to be inadequate, for example if the 'target heart rate' is not achieved, or if the session cannot be sustained long enough, the intensity and/or duration will be adjusted until an adequate exercise workload is found.

Finally, the integration of the exercise program into the daily life of patients is a point of attention. It is sometimes difficult to give the exercise program an effective follow-up after it has been completed. The question is: how can the positive exercise effects be maintained without intensive counseling from the practitioner?

The following sections provide guidance for making a needs assessment for aerobic exercise (2.6), determining exercise intensity (2.7), designing the exercise program (2.8), general points for attention before starting the exercise program (2.9), monitoring and evaluating exercise (2.10) and the follow-up to the exercise program after completing treatment (2.11).

PART 2

2.6 Needs assessment for aerobic exercise.

To make a needs assessment for an aerobic exercise program, a total picture of the patient must first be obtained. In the first place, there must be a clearly expressed need to optimize physical fitness. A treatment goal can then be formulated to respond to this need. If the need and treatment objective have been established, the feasibility and effectiveness of an aerobic exercise program can be estimated based on medical history, physical examination and additional testing. This analysis focuses primarily on the degree of deconditioning, the personal situation and contraindications. The various aspects of the needs assessment are explained below.

2.6.1 Medical history.

Degree of deconditioning.

The degree of deconditioning is important to determine whether an aerobic exercise program can lead to an improvement in physical fitness. To gain insight into the degree of deconditioning, the activity level of the patient can be measured. In addition to the absolute activity level, such as the number of steps per day, the relative activity level must also be taken into consideration. Appendix 1 describes an activity list, which includes both aspects.

The WHO physical activity guidelines for adults with disability can be used to assess the activity level. Although this recommendation was not developed specifically for individuals with NMD, it provides an indication of the degree of deconditioning, which can be included in the needs assessment.

If a patient is clearly less active than prescribed in the physical activity guidelines, it is important to check whether the physical capacity of the patient is sufficient to meet the standard. If the physical capacity is insufficient to meet the physical activity guidelines, then there may not be deconditioning (Fig. 3). Due to the lack of reference values for physical capacity, for example with

regard to the *'6-minute walk test'*, practitioners are dependent on their own clinical expertise for determining the degree of deconditioning. A needs indication for aerobic exercise requires deconditioning due to inactivity.

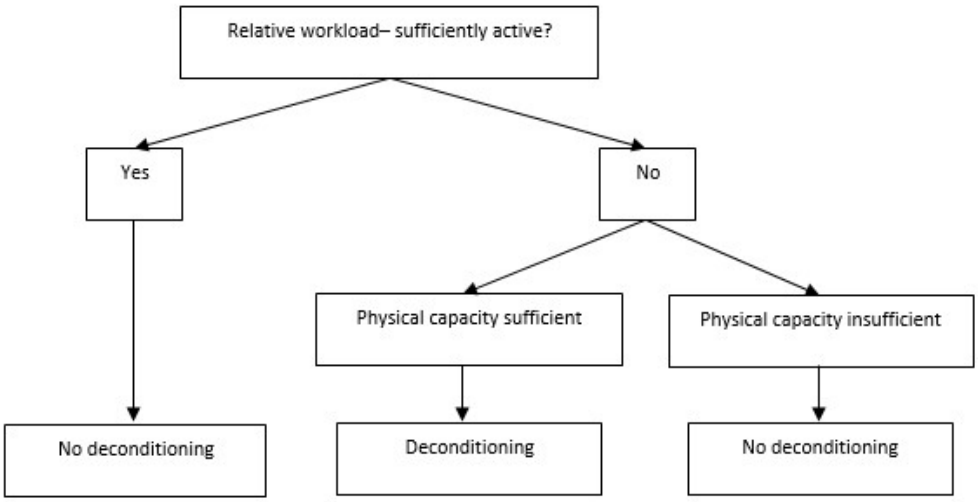

Figure 3. Is there deconditioning due to physical inactivity?

Personal factors and environmental factors.

Personal factors, such as understanding the importance of physical fitness for functioning and intrinsic motivation, are important for the successful completion of an exercise program. Environmental factors, such as transport options and the home situation, also have an impact and must therefore be delineated. For this reason, patients are questioned about their past and current physical activity behavior, previous rehabilitation treatments, and their attitude towards physical activity and exercise.

Contraindications.

Data on the patients overall health status is needed to identify disorders that may influence functioning. This data can also be used to check whether there are absolute or relative contraindications for physical exercise (Table 1).[17] In the case of an *absolute* contraindication, physical exercise can lead to life-threatening situations and should not be undertaken until the symptoms have been resolved. In the case of *relative* contraindications, physical exercise may be undertaken after careful consideration. In this case, a (sports) physician must first be consulted.

Absolute contraindications	Relative contraindications
Recent significant change in resting ECG or recent myocardial infarction	Tachycardia (> 100 beats/minute) and bradycardia (<50 beats/minute)
Unstable angina and unexplained thoracic complaints	Hypertrophic cardiomyopathy and/or other forms of outflow obstruction.
Fever (>38 °C)	Electrolyte disorder (e.g. hypokalemia and hypomagnesemia)
Untreated cardiac arrhythmias, with symptoms and/or hemodynamic consequences	Severe systemic hypertension (>200 mmHg systolic and/or >110 mmHg diastolic)
Symptomatic aortic valve stenosis	Coronary stenosis of left main stem
Untreated severe heart failure	Moderate stenotic valvular heart disease
Acute pulmonary embolism and deep vein thrombosis	Severe symptomatic (2nd and 3rd degree) AV block
Acute myocarditis, pericarditis or endocarditis	Ventricular aneurysm
Aortic dissection	Chronic infection (e.g. hepatitis, AIDS)
Acute systemic infection with fever (>38 °C), muscle pain and/or lymph node swelling	Mental or physical limitations that prevent sufficient physical exercise

Table 1. Absolute and relative contraindications for physical exercise.[17]

2.6.2 Physical examination.

The goal of the physical examination is to determine whether the patient is capable of engaging in the intended type of exercise at a level that is considered sufficient to optimize physical fitness. If this is not the case, the goal of the exercise program will be to maintain overall health rather than to optimize physical fitness.

By means of observation, passive and active muscle function testing, insight can be gained into aspects such as limb alignment abnormalities, the degree of muscle atrophy, the mobility of the joints and the muscle strength.[24] Although this provides insight into isolated muscle groups and movements, it is difficult to estimate on this basis whether the physical capacity of the patient is sufficient for a certain form of exercise. For a complete assessment, additional testing is therefore required.

2.6.3 Additional testing.

Submaximal exercise test.

To determine whether the intended type of exercise is suitable, an incremental submaximal exercise test is recommended. This test can be used for various types of exercise (including cycling, walking and rowing) and is described in detail in Appendix 2.

A patient is eligible for aerobic exercise with the B-FIT program if at least the level of the anaerobic threshold is achieved during the submaximal exercise test. The anaerobic threshold serves as a starting point for determining the individual exercise zones and can be measured directly using breathing gas analysis equipment or measured indirectly using the RPE scale (6–20) (Appendix 3). If the physical capacity proves insufficient for the intended type of exercise, then other types can be considered for which the functioning is adequate (e.g. cycling instead of walking if the walking function is limited). During this process the principle of specificity must be taken into account.

2.6.4 Analysis.

The information described above forms the basis of the needs assessment for physical exercise for individuals with NMD. The most important criteria for assessing the need for aerobic exercise are the following: *an expressed need for help in optimizing physical fitness, deconditioning due to inactivity, sufficient motivation of the patient, no absolute contraindications for physical exercise, and attainment of the anaerobic threshold (as a minimum) during the submaximal exercise test.*

2.7 Determining the exercise intensity.

When aerobic exercise is indicated, the exercise program is designed. More specifically, the frequency, intensity, time and type (FITT factors) of exercise must be determined. The frequency, intensity and time together are the "exercise volume". Section 2.8 discusses the volume distribution of the exercise program.

2.7.1 Exercise intensity based on the maximal and submaximal exercise capacity.

The intensity for aerobic exercise can be expressed in absolute values (e.g. as heart rate or workload) or in relation to the aerobic capacity (e.g. as a percentage of the maximum oxygen uptake [%VO_{2max}] or as a percentage of the heart rate reserve (%HRR)) (see Section 2.4.2). The best method to determine the maximum heart rate (HR_{max}) and oxygen uptake (VO_{2max}) is a maximal exercise test. However, for many people with NMD, maximal exercise tests are discouraged due to the risk of overuse.[25] In addition, the test is often symptom-limited, meaning that the HR_{max} and VO_{2max} may not be achieved. [25]

Nevertheless, various indirect methods can be used to obtain an indication of aerobic capacity. For example, the HR_{max} can be estimated based on equations. A simple and widely used equation is: HR_{max}=220 – age.[17] Another method is the Åstrand test. By measuring the heart rate (HR) and oxygen uptake (VO_2) during submaximal loads, HR_{max} and VO_{2max} can be estimated by extrapolation. The Åstrand test and the 220-age equation are widely used in NMD. However, because both methods are based on healthy populations, they often result in an underestimation or overestimation of the exercise workload. This underestimation or overestimation has also been shown in scientific research.[26,27] The applicability of these methods in NMD is therefore limited.

Another method, which is based on the anaerobic threshold, can be used for determining the individual intensity zones in individuals with NMD. This is a submaximal, direct indicator of aerobic capacity.

2.7.2 Exercise intensity based on the anaerobic threshold.

The anaerobic threshold is defined as the point at which energy production shifts from being primarily aerobic to being primarily anaerobic. The anaerobic threshold is already widely used to determine the intensity zones for aerobic exercise in healthy people[28] and in patients with other chronic conditions such as multiple sclerosis[29] and obesity.[30]

Recent research in patients with PPS has shown that it is possible to determine the anaerobic threshold by means of a submaximal exercise test with increasing workload.[31] Although further research is needed into the determination of the anaerobic threshold in other slowly progressive

NMDs, this is a promising method for determining the individual intensity zones that are the basis for designing aerobic exercise programs. A disadvantage is that expensive breathing gas analysis equipment is required to determine the anaerobic threshold, which is not available to everyone. However, by using the RPE scale (6–20) during the same submaximal exercise test, a fairly accurate indication of the anaerobic threshold can be obtained. If breathing gas analysis equipment is not available, the RPE scale therefore seems to be a good alternative for determining the anaerobic threshold.[31]

Appendix 3 describes how, based on the anaerobic threshold, the individual exercise zones can be determined that are the basis of the B-FIT training program.

2.8 Designing the exercise program

2.8.1 Polarized training.

The exercise intensity together with the frequency and time, comprise the volume of an exercise program. Conventional exercise programs are characterized as high-volume, high-intensive, i.e. long-term exercise at high intensities. However, there are clear indications that individuals with NMD, including those with PPS[6] and facioscapulohumeral dystrophy (FSHD)[5], are unable to exercise at high intensities for extended, consecutive periods.[26,32]

Recent research revealed that elite endurance athletes completed most of their exercise sessions at either intensities below (75%–80% of the exercise program), or well above (20%–25% of the exercise program) their anaerobic threshold.[33] This method of exercise is called polarized training, and leads to better exercise effects than conventional exercise programs, not only in endurance athletes, but also in patients with various chronic conditions.[34-37]

2.8.2 FITT factors during aerobic exercise with NMD.

A customized exercise program, as discussed in Section 2.4.2, is structured according to the FITT principle[17]. Based on findings from the FACTS-2-NMD study, experiences of therapists and recent insights from the scientific literature, the following FITT factors are recommended in the B-FIT program:

Frequency

According to the guidelines of the American College of Sports Medicine (ACSM)[17], the recommended frequency is three days a week. This is based on guidelines for the general healthy population[38] and other clinical populations – such as stroke patients,[39] patients with high blood pressure[40] and type 2 diabetes patients[41] – that prescribe a frequency of at least three days a week. In addition, in earlier studies that showed positive effects of aerobic exercise, an exercise frequency of three times per week was used in NMDs as well.[42-46] Preferably, exercise should be done on fixed days and with at least one day of rest between consecutive exercise sessions. If three days is not considered feasible, a frequency of two days a week can also be chosen. This may lead to positive exercise effects, but the likelihood of success is smaller[17]

Intensity

The advice for the intensity is to combine low intensity exercise (75%–80% of the total exercise program) with high intensity exercise (20–25% of the total exercise program). The exercise zones are determined based on the individually determined anaerobic threshold. Intensities *below the anaerobic threshold* are considered low intensity exercise zones, intensities *around the anaerobic threshold* are considered moderate intensity exercise zone and intensities *above the anaerobic threshold* are considered high intensity exercise zones (Table 2). The procedures for determining the anaerobic threshold and exercise zones are specified in Appendices 2 and 3.

Exercise zone	Compared to anaerobic threshold	Time in zone (%)
Recovery		
Low intensity	< anaerobic threshold	75 – 80
Moderate intensity	~ anaerobic threshold	0 – 5
High intensity	> anaerobic threshold	20 – 25

Table 2. Classification into exercise zones.

Time

The recommended duration of an exercise session is 10 to 40 minutes (depending on the intensity), with the duration of the exercise bouts increasing during the exercise program. The total duration of the exercise program is 12 to 16 weeks.

Type

The type of exercise depends on the request for help and the treatment goal, but the exercise preferably takes place on an ergometer to reduce the risk of overuse (Section 2.9.1).

Appendix 3 describes how the individual exercise zones and the definitive exercise schedule can be determined based on the anaerobic threshold. Appendix 4 includes a diagram that illustrates aerobic exercise on a bicycle ergometer during a period of 16 weeks with three exercise sessions per week. In addition, alternative schedules are available on the B-FIT website[b] with shorter exercise sessions (e.g. 5 minutes instead of 10 minutes of low intensity exercise at the start of the program), and/or fewer e sessions per week (two sessions instead of three sessions per week). These schemes can be used, for example, for patients with limited exercise capacity.

Note that practitioners are free to make adjustments to the schedules if this is deemed necessary, but that the above-mentioned frameworks should still be taken into account. For example, the duration of the exercise bouts can be adjusted, but the ratio between low-intensity and high-intensity exercise should remain approximately 75%–80%/20%–25%. A calculation tool can be found on the B-FIT website to easily determine the lower and upper limits of the individual intensity zones (i.e. recovery, low, moderate and high intensity) based on the anaerobic threshold obtained during the submaximal exercise test. The calculation tool then generates an exercise program in accordance with the above frameworks (see Appendix 3 for more details).

[b] https://www.amc.nl/trainingguide

2.9 Points for attention at the start of the exercise program.

There are a number of points for attention to minimize any unwanted side effects of aerobic exercise.

2.9.1. Points for attention with regard to overuse.

- The patient trains on fixed days (determined in advance in consultation with the practitioner) with at least one day of rest after each day of exercise.
- If exercise sessions are skipped due to circumstances, the program will be restarted at the exercise session following the last completed exercise session.
- During the first few weeks of exercise, the patient includes a number of rest periods during the days on which the exercise is scheduled.
- After each exercise week, the patient records in the *patient workbook* whether the predetermined exercise schedule has been achieved and whether any physical problems have occurred.
- The practitioner periodically reviews the *patient workbook* so adjustments can be made if necessary.
- The patient preferably trains on an ergometer. This is because the exercise workload is easier to standardize than when walking or cycling outdoors. This can reduce the risk of overuse.
- The patient is instructed to contact the practitioner in the event of:
  (1) increased fatigue (i.e. there are problems with activities of daily living after exercise).
  (2) increased muscle weakness.
  (3) increased pain. Muscle pain is an exception; this is normal and can last two to three days. If the muscle pain lasts longer, the practitioner should be contacted.
  (4) repeated muscle cramps.
  (5) other complaints that may be related to physical exercise.

2.9.2. Focus areas with regard to other undesirable side effects.

- The patient is screened for contraindications (Section 2.6) prior to the first exercise session and is instructed in detail on the use of the bicycle ergometer/arm ergometer/ treadmill/rowing ergometer and on exercising according to the training guide.
- The patient is instructed not to train in case of flu or fever.
- The patient is instructed to immediately stop exercise and to contact the practitioner in case of:
  (1) chest pain.
  (2) dizziness.

2.10 Monitoring and evaluating the exercise program.

2.10.1. Monitoring exercise.

Monitoring can provide insight into the number and intensity of exercise sessions followed, the perceived exertion of exercise sessions and the occurrence of physical complaints after the end of an exercise session. This information should be registered in the exercise log in the patient workbook, which is described in Chapter 3. It is also recommended to register the heart rate during the exercise sessions, so that it can be checked regularly whether participants execute the program correctly (frequency, duration and intensity) and so the program can be adjusted promptly if necessary.

Before starting the exercise program, it is important to explicitly discuss the use of the exercise log with the patient. During the start-up phase of the exercise program it is necessary to check regularly whether the patient is able to keep up with the exercise schedule. This can be done, for example, by means of brief weekly contact, by telephone or by e-mail. The frequency of supervision can then be reduced if desired. Experience in practice has shown that patients are reluctant to ask for help, so this is an important responsibility for the practitioner.

2.10.2. Evaluating exercise.

Physical fitness

The submaximal exercise test can be used to determine the effect of the aerobic exercise program on physical fitness. For this purpose, the same exercise test must be used before the start of the exercise program and after its completion (Fig. 4). Appendix 5 contains an evaluation form and instructions on how to use it. Indicators of improved physical fitness after the exercise program include the following:[15]

- A lower heart rate at similar submaximal exercise workloads.
- A lower score on the RPE scale at similar submaximal exercise workloads.
- The anaerobic threshold occurs at a higher exercise workload.
- The stop criterion is reached at a higher exercise workload.
- A faster recovery in heart rate occurs after the end of the exercise test.
- A faster recovery on the RPE scale occurs after the end of the exercise test.

Interim evaluation

In addition to an evaluation at the end of the exercise program, it is also recommended to perform a submaximal exercise test halfway through the exercise program (at 6 or 8 weeks after the start of a program of 12 to 16 weeks, respectively) in order to re-establish the exercise zones based on the anaerobic threshold (Appendix 3). This makes it possible to adjust the exercise program promptly if necessary.

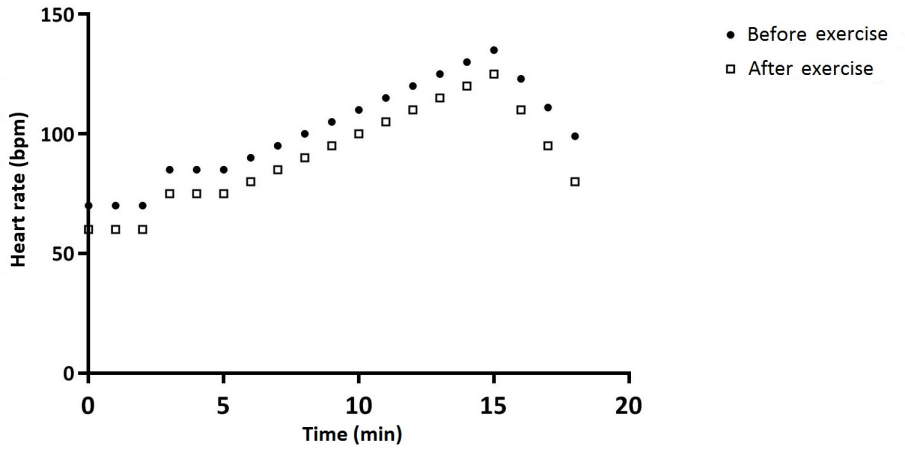

Figure 4. A lower heart rate with the same exercise workload during the submaximal exercise test and a faster heart rate recovery are both indicative of improved aerobic capacity.

2.11 Continuation of exercise after the exercise program.

Because it is difficult for many people to complete an exercise program, an important question is "Should the same exercise volume be continued after the exercise program has been completed in order to maintain the exercise effects achieved?" Although more research is needed, there are clear indications that more effort is needed to improve physical fitness than to sustain this improvement. Eliminating one exercise session per week does not appear to have a negative effect on the exercise effects achieved.[47] It is therefore recommended to continue with two exercise sessions per week. The exercise workload of the final weeks of the exercise program is sufficient.

2.12 Results of a pilot study

We conducted a pilot study.[48] In this study, 31 individuals with 15 different slowly progressive NMD who were referred for exercise training as part of their rehabilitation treatment in 2 university hospitals in the Netherlands that implemented the B-FIT training guide participated. Diagnoses included slowly progressive NMD affecting the motor neurons (e.g. PPS), neuromuscular transmission diseases (e.g. myestenia gravis), peripheral neuropathies (e.g. CMT) and muscle diseases (e.g. FSHD, congential myopathy). The completion rate (84%) and proportion of followed sessions of >75% as well as the number of adverse events (n=3) indicated the feasibility of the B-FIT exercise program. Regarding satisfaction, patients reported that the exercise program benefited them, and they felt fitter. Physical therapists especially appreciated that the use of B-FIT provides a clear, well-grounded guidance, enhances uniformity among care professionals, and improves the quality of care.

Results from the submaximal incremental exercise tests that were performed before and after the exercise program demonstrated the potential to improve physical fitness (Fig. 5). We assessed changes in submaximal heart rate (HR_{submax}), submaximal ratings of perceived exertion (RPE_{submax}) and

peak workload (W_{peak}). The mean (SD) HR_{submax} reduced significantly with -6.5 beats per minute (95% confidence interval [CI], -11.8 to -1.2), from baseline 121.7 (16.5) to post-intervention 115.2 (14.3). A significant reduction was also found for RPE_{submax} (-1.5 points on the Borg Scale, 95%CI -2.4 to -0.6) and a significant increase was found for W_{peak} (15.4 Watts, 95%CI 8.5 to 22.3).

The outcomes of this study suggest that individualized aerobic exercise according to B-FIT is feasible and has the potential to improve physical fitness in a wide variety of slowly progressive NMD.

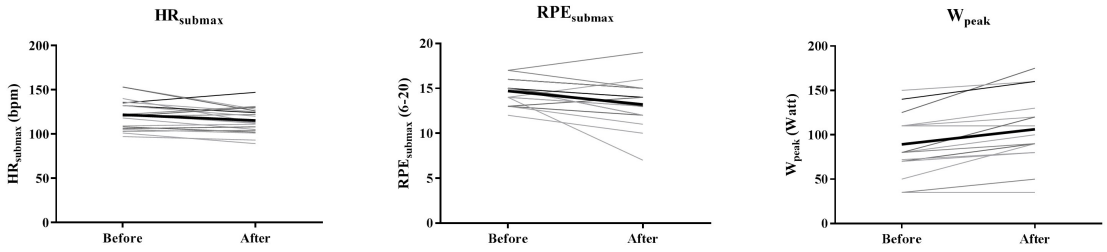

Figure 5: Submaximal heart rate (HR_{submax}), submaximal ratings of perceived exertion (RPE_{submax}) and peak workload (W_{peak}), directly before and after the B-FIT exercise program. Thin grey lines indicate individual scores; thick black line indicates the group mean.

PART 3

2.13 Overview of key points and recommendations.

Physical activity guidelines (2.2).

The level of physical activity in healthy people is determined on the basis of the WHO physical activity guidelines. These guidelines describe the minimum activity level that provides health benefits. For adults the recommendation for aerobic physical activity is: "*30 minutes of moderate intensity aerobic physical activity for at least 5 days per week, or 25 minutes of high intensity aerobic physical activity for at least 3 days per week, or an equivalent combined amount of moderate and high intensity aerobic physical activity"*

Although there are no specific physical activity guidelines for NMD, there are recommendations for adults living with disability. These recommendations are mostly similar to recommendations for healthy adults. If adults with disability are not meeting the recommendations, doing some physical activity is advised. Caution is advised when applying physical activity guidelines to NMD. Generally individuals with NMD have a decreased aerobic capacity due to their muscle weakness, which makes activities relatively more strenuous. Therefore, relative intensity is a better guide for adults with NMD, than absolute intensity (e.g. number of steps per day, or number of minutes per activity).

Optimizing physical fitness (2.3).

With an exercise program, a distinction can be made between maintaining health or optimizing physical fitness. Maintaining health requires physical activities that can be integrated into daily life,

while optimizing fitness requires physical exercise. The training guide focuses on optimizing physical fitness through aerobic exercise.

It is not possible to improve physical fitness by means of physical exercise for all individuals with NMD. However, if there is deconditioning due to a sedentary lifestyle, the expectation is that fitness can be improved with physical exercise.

The first important step is therefore to determine whether there is deconditioning due to a sedentary lifestyle, because this partly determines how much room there is for improving fitness. A complete medical history is the basis for this, supplemented with activity questionnaires and possibly with tests to determine the physical capacity (see Section 2.6).

How is improved physical fitness achieved (2.4)?

A number of general exercise principles have been derived from the changes resulting from physical exercise, and these principles also apply to individuals with NMD. The following general exercise principles must be taken into account when designing a physical exercise program: specificity, reversibility, optimal exercise workload, diminishing returns, supercompensation and overtraining.

An effective, individually designed exercise program is designed according to the FITT principle. FITT stands for Frequency, Intensity, Time and Type.

Aerobic exercise for individuals with NMD (2.5).

Although there is still insufficient evidence from high quality randomized controlled studies to draw definitive conclusions, there is increasing evidence that physical exercise is effective for individuals with NMD.

Important problems for practitioners with regard to aerobic exercise in individuals with NMD relate to the needs assessment, the design of the exercise program and the integration of the exercise program into the daily lives of the patients.

Needs assessment for aerobic exercise (2.6).

The needs assessment for physical exercise is based on the medical history, the physical examination and additional testing.

While reviewing the medical history, the need for help is specified and it is determined whether deconditioning due to inactivity underlies the need for help and the functional problems that the patient experiences. With an activity list that takes the relative workload into account (Appendix 1), insight can be gained into the activity level of the patient in relation to current physical activity guidelines. Personal and environmental factors are also specified (including motivation) and whether there are absolute or relative contraindications for aerobic exercise (Table 1).

The aim of the physical examination is to estimate whether the physical capacity of the patient is sufficient to achieve the desired positive exercise effects. Through observation, passive and active measurement of joint mobility and muscle strength testing, insight can be gained into isolated muscle groups and movements. Additional testing is needed for a more complete assessment.

To determine whether the patient is capable of engaging in the intended type of exercise, an incremental submaximal exercise test (Appendix 2) is recommended. A patient is eligible for aerobic exercise based on the B-FIT program if at least the anaerobic threshold is achieved during the submaximal exercise test (Appendix 3).

The most important criteria for making a needs assessment for physical exercise in individuals with NMD are the following:

- There is a specific need for help in optimizing physical fitness.
- There is deconditioning due to inactivity, determined on the basis of the medical history and physical examination.
- The patient is sufficiently motivated.
- There are no contraindications for physical exercise.
- During the submaximal exercise test, at least the level of the anaerobic threshold is achieved.

Determining the exercise intensity (2.7).

If physical exercise is indicated, the exercise program is designed based on the FITT factors. The frequency (F), intensity (I) and time (T) together comprise the exercise volume.

For determining the individual exercise zones, it is recommended to use a submaximal exercise test with increasing load (Appendix 2) in which the anaerobic threshold is determined with breathing gas analysis equipment (directly) and/or the RPE scale (indirectly) (Appendix 3).

Based on the anaerobic threshold, the individual exercise zones can be determined. These are the basis for the exercise program (Appendix 3). Intensities below the anaerobic threshold are considered low intensity exercise zones, intensities around the anaerobic threshold are considered moderate intensity exercise zone and intensities above the anaerobic threshold are considered high intensity exercise zones.

Designing the exercise program (2.8).

Polarized training programs are characterized by exercising at low intensities for longer periods combined with exercising at high intensities for shorter periods. Although the effectiveness has not yet been demonstrated in individuals with NMD, there are clear indications that such programs are more suitable for the target group than conventional exercise programs, which are characterized by exercise at moderate or high intensities for longer periods.

To design an aerobic exercise program for individuals with slowly progressive NMD, the following FITT factors are recommended:

- *Frequency*: three days a week. Preferably on set days with at least one day of rest between consecutive exercise sessions. If three days is not considered feasible, a frequency of two days a week can also be chosen.
- *Intensity*: low intensity exercise (75%–80% of the total exercise program) combined with high intensity exercise (20%–25% of the total exercise program).
- *Time*: 15 to 40 minutes, depending on the intensity, per session. Increase the duration of the exercise bouts during the exercise program. The total duration of the exercise program is 12 to 16 weeks.
- *Type*: depends on the need for help and the treatment goal. Exercising on an ergometer is preferable.

A calculation tool can be found on the B-FIT website to easily determine the lower and upper limits of the individual intensity zones (i.e. recovery, low, moderate and high intensity) based on the anaerobic threshold obtained during the submaximal exercise test. The calculation tool then generates an exercise program in accordance with the above frameworks.

Points for attention at the start of the exercise program (2.9).

To minimize any unwanted side effects of aerobic exercise, there are a number of points to consider, including the following:

- exercise on fixed days;
- at least one day of rest after every day of exercise;
- keeping an accurate exercise log;
- instructing the patient to contact the practitioner immediately in the event of increased complaints, chest pain and dizziness.

Monitoring and evaluating the exercise program (2.10).

It is important to monitor the following aspects during the exercise program, and to register in the in the exercise log in the patient workbook (Chapter 3):

- the number of exercise sessions followed;
- the perceived exertion of exercise sessions;
- the occurrence of physical complaints after exercise;
- the actual heart rate/RPE score, so that timely adjustments to the program can be made if necessary.

By performing the same submaximal exercise test before and after the exercise program, the effect on physical fitness can be determined (Appendix 5). In addition to an evaluation at the end of the exercise program, it is also recommended to perform a submaximal exercise test halfway through the exercise program (Appendix 2) in order to re-establish the exercise zones based on the anaerobic threshold (Appendix 3), and to modify the exercise program if necessary.

Continuation of exercise after the exercise program (2.11).

Although more research is needed, there are clear indications that more effort is needed to improve physical fitness than is needed to sustain this improvement. It is therefore recommended to continue with two exercise sessions per week. The exercise workload of the final weeks of the exercise program is sufficient.

2.13.1 Overview of care pathway.

The above-mentioned points are included in the flow chart shown below (Fig. 6), which indicates point-by-point which steps must be taken in the care pathway. An ***accompanying instructional film*** is also available on the B-FIT website (https://www.amc.nl/trainingguide) that explains these steps. Five steps are described during the care pathway (from medical history to completion). It is recommended to schedule a contact moment with the patient at every step. If this is not feasible, then steps 1, 2 and 3 can also be combined into 1 or 2 contact moments.

1. Medical history

Goal: mapping out the need for help, treatment goal, degree of deconditioning, personal factors, environmental factors and contraindications.

Action points:

- Medical history, see Section 2.6 for a description of the method.
- Record the need for help and the treatment goal in the training log in the patient workbook (Chapter 3).
- If the activity list is used (Appendix 1), it is recommended to give this to the patient at the end of the first visit and request that it is completed and returned at the next visit.

2. Additional testing: submaximal exercise test

Goal: patient undergoes a submaximal exercise test to 1) determine whether the type of training is suitable, 2) design the training schedule based on the individually determined training zones, and 3) determine the initial level of physical fitness (for training evaluation).

Action points:

- Need for help and treatment goal based on activity list (if provided) and in agreement with patient.
- Physical examination for assessing feasibility of training.
- Identifying any contraindications.
- Patient undergoes submaximal exercise test (Appendix 2).
  - *Complete the **submaximal exercise test score form** (Appendix 5).*

1. Determine whether the type of training (bicycle ergometer, treadmill etc.) is suitable:
   - *See Section 2.6.3. for a description of the method.*
   - *Record the type of training in the **training log** in the patient workbook (Chapter 3)*

2. Filling in the training schedule:
   - *Determine the heart rate at the anaerobic threshold (HR at AT) (Appendix 3).*
   - *Determining the lower and upper limits of the individual training zones and the training schedule:*
     - *The B-FIT website* contains a calculation tool that can automatically generate the lower and upper limits of the training zones and the **training schedule** for the first half of the program (Appendix 3).*
     - *Record the heart rates associated with the various training zones in the training log in the patient workbook (Chapter 3).*

3. Determine initial level of physical fitness:
   - *On the **aerobic training evaluation form** (Appendix 5), enter the values before the start of the training program.*

3. Start training

Goal: to ensure that the patient can start the training program.

Action points:

- *Inform the patient about how to train according to the established training schedule (including the use of the heart rate monitor, ergometer), and the importance of updating the training log in the patient workbook.*
- *Discuss usage and adjustment of the ergometer (if used). Record the ergometer settings in the patient workbook (Chapter 3).*
- *Discuss with the patient how monitoring is taking place. Contact patient especially at the start of the program, preferably weekly, by telephone or by e-mail.*
- *Ensure that the patient updates the **training log** in the patient workbook (Chapter 3), and modify the program if necessary.*
- *Schedule a visit for the interim evaluation (halfway through the training program). **Plan this visit after the training program has actually started**.*

4. Interim evaluation

Goal: Have patient undergo a submaximal exercise test in order to 1) check whether the training zones need to be adjusted and 2) determine the physical fitness (for training evaluation).

Action points:

- Discuss the progress of the training program with the patient.
- Have patient undergo a submaximal exercise test (Appendix 2)

1. <u>Training schedule:</u>
   - *Complete the interim **submaximal exercise test score form** (Appendix 5).*
   - *Re-determine the HF at AT. Based on this, determine the heart rates associated with the various training zones (Appendix 3).*
   - *Use the calculation tool on the B-FIT website to determine the training zones and the **training schedule** for the second half of the program.*

2. <u>Determine the level of physical fitness:</u>
   - *Complete the **aerobic training evaluation form** (Appendix 5).*

5. Final evaluation

Goal: Patient undergoes a submaximal exercise test to determine the effect of the training program on physical fitness; evaluate the training program; discuss the follow-up.

Action points:

- Have patient undergo a submaximal exercise test (Appendix 2)

<u>Determine the effect on physical fitness:</u>
- *Complete the **submaximal exercise test score form** (Appendix 5).*
- *Complete the **aerobic training evaluation form** (Appendix 5).*

<u>Evaluating the training program:</u>
- *Discuss the effect of the training schedule on physical fitness.*
- *Discuss the extent to which the treatment goals have been achieved.*
- *Discuss the continuation of the training program (Section 2.12)*

Figure 6. The steps in the care pathway that must be followed.

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3

Chapter 3

Patient workbook.

CHAPTER 3. PATIENT WORKBOOK.

3.1 Explanation of patient workbook.

In consultation with your physical therapist, an exercise program has been prescribed for you. The main goal of this program is to improve your physical condition so that your symptoms decrease and your well-being improves.

The patient workbook that you are now reading is part of a training guide specially developed for patients with muscle diseases. The exercise program that your therapist has designed is completely tailored to your personal situation. The content of the program is based on the information from the intake interview and the data collected during the exercise test prior to the exercise program.

The patient workbook is an important tool in the supervision of your exercise. Based on your workbook, the physiotherapist will be able to monitor the progress of the exercise program in order to prevent overuse. The exercise workload may need to be adjusted.

This workbook also contains practical instructions about exercise and the contact details for your physical therapist. For the interested reader, more background information can be found about the importance of physical activity and exercise in Chapter 1 of the therapist's manual (this can be consulted via the B-FIT website[c]). You can contact your physical therapist you have any questions about the exercise.

Physical therapist:

Name: ……

Institution: …………..

Telephone number: …………

E-mail: …………

[c] https://www.amc.nl/trainingguide

3.2 Explanation of the exercise schedule.

Your exercise schedule is detailed in the exercise log (beginning with Chapter 3.5). It describes, for example, the type of exercise chosen (cycling, walking, rowing, or similar activities), how often you have to train per week, how long the exercise lasts and at which intensity level you have to train.

Your heart rate will be measured during exercise to ensure that it remains within the values indicated in your exercise schedule. Assuming that the heart rate values are 115–125, then ensure that your heart rate does not fall below 115 or rise above 125 beats per minute during exercise. Your heart rate can be increased by 1) increasing the resistance of your ergometer, or 2) increasing the pace. At the start of the exercise program, your physical therapist will discuss with you which combination of resistance and pace is most suitable for keeping your heart rate between the values indicated in your schedule.

In some cases, you or your physical therapist may not have a heart rate monitor that you can use during exercise. In that case you do not use the heart rate, but the Rating of Perceived Exertion (RPE) scale. The RPE scale is a subjective exercise workload scale to estimate the perceived level of effort on a scale of 6 to 20 (Section 3.4). Your therapist will explain how to use the RPE scale. Assuming that the score on the RPE scale is 11–12, then you should make sure during exercise that your score does not fall below 11, but also does not rise above 12. Similar to the heart rate, your RPE score can be increased by 1) increasing the resistance of your ergometer, or 2) increasing the pace. At the start of the exercise program, your physical therapist will discuss with you which combination of resistance and pace is most suitable for keeping your RPE score between the values indicated in your schedule.

Here are a number of important aspects to keep in mind during the exercise program:

- If you do not reach the values indicated in your exercise schedule, continue to exercise at the highest possible resistance and pace, and try to complete the exercise session. During the next session, try again to stay between the specified values. If you do not reach the values indicated this time, contact your physical therapist.

- During the course of the program you may need to increase the resistance or pace to stay within the values specified in the exercise schedule. This is a positive effect of exercise! Discuss with your therapist which combination of resistance and pace is most suitable for you.

- Halfway through your exercise program you will visit your physical therapist and undergo the same exercise test as before the start of the exercise program. Based on the results of this test, the heart rate values are determined again. The heart rates can therefore deviate in the second half of the exercise program from those in the first half of the exercise program.

- Try to keep the pace as even as possible during exercise.

- As you can see in the exercise log, there are low intensity and high intensity exercise sessions. Make sure that you always start with a warm-up during high intensity exercise sessions (for example, session 2 in week 1).

- Before you start your workout, don't forget to attach the heart rate monitor strap to your chest and put the watch on your wrist. If you or your physical therapist does not have a heart rate monitor, you should use the RPE scale. Make sure it is clearly visible during exercise!

After completing the exercise program:

Because it appears to be difficult for many people to maintain an exercise program, an interesting question is: "To maintain the exercise effects achieved, should the same exercise schedule be continued after completing the program?" Although more research is needed, there are clear indications that more effort is needed to improve fitness than is needed to sustain this improvement. Therefore, discuss with your physical therapist how to continue the exercise program.

3.3 Practical instructions about exercise

Drinking.

When you exercise, it is important to maintain your fluid balance, especially if you train intensively. You can lose 1 to 2 liters of water per hour. Drinking enough is an important precondition for good performance. Make sure you drink enough before, during and after training. For example, fill a half-liter bottle with tap water before the session starts so that you can easily drink during exercise.

Temperature.

As your body temperature rises, more blood vessels open in your skin. The warm blood that flows through the skin releases more heat to the environment. While exercising you should therefore ensure that the temperature in the room where you train is not too high. Otherwise you can become overheated.

Clothing.

It is best to wear sports clothing: if you are exercising indoors, shorts or training pants with a T-shirt and sneakers are all you need. Outside, your clothing must be appropriate for the weather conditions. In warm weather, for example, you should wear light clothing with light colors, while in cold weather it is important to wear several layers of clothing.

Food.

Food eaten before exercise is only useful if the food is also effectively digested and absorbed through the gastrointestinal tract. This means that time is needed to actually use the food as fuel for exercise. The time required for this depends on the type of food. Foods that are high in fat, protein and dietary fiber digest more slowly. If they are not fully digested, they can cause stomach complaints during exercise. A general guideline is to plan your last meal 2 to 4 hours before exercise, while a light snack is still possible until 1 to 2 hours before exercise.

What to do in case of illness?

You should not exercise if you have a fever, i.e. a body temperature above 38 degrees Celsius (100 degrees Fahrenheit). In that case, contact your physical therapist. The telephone number is on page 2 of the workbook. You can start exercising again 2 to 3 days after the last day of fever.

What to do in case of cramps?

If you have cramps, stretch the limb that is cramping. If the cramp does not disappear after 3 minutes, stop exercising. You can resume exercise when the cramp is gone. If the cramp returns, contact your physical therapist. To prevent cramping, you should drink sufficient water and not too much coffee.

What to do in case of muscle pain?

Muscle pain is not a bad sign. The pain is caused by lactic acid in muscles that stimulates the free nerve endings. This is irritating, but fortunately goes away quickly. During recovery, muscle fibers become thicker than they were before, making the muscle bigger and stronger. When you do a good warm-up and cool-down, you reduce the risk of muscle pain. It is normal for the muscle pain to last for 2 to 3 days. Contact your physical therapist if the muscle pain lasts longer.

Dizziness/chest pain.

If you feel dizzy or nauseous, or have chest pain, you should stop exercising and contact your physical therapist.

Fatigued after exercise.

It is normal for you to feel fatigued after exercise. This is a healthy response of the body to physical exertion. However, if you are hindered in your daily activities after exercise, please report this to your physical therapist.

After exercise.

In the first hours after exercise, we advise against performing heavy physical work. Light physical activity is not a problem.

Check-up appointment with the physiotherapist.

Make sure you bring your patient workbook, heart rate monitor (if used), drinks and sportswear to the physical therapist.

Unable to attend appointment

If you are unable to attend the check-up appointment, you must inform your physical therapist about this in advance so a new appointment can be scheduled.

Provide a stimulating environment.

Research and daily clinical practice show that many people find it difficult to maintain an exercise program. It is therefore important that you provide a stimulating environment for yourself. A few examples are: exercise together with others (if possible), exercise with music (make sure that the pace is not influenced too much), and ask your physical therapist to provide regular feedback (positive results are motivating).

3.4 Instructions using the ergometer, heart rate monitor, and RPE scale.

Ergometer.

It is preferable to use an ergometer during exercise. The disadvantage of this method is that your exercise does not take place outdoors. A big advantage, however, is that the ergometer makes it possible to accurately determine the required resistance and the required pace so you can attain the heart rate values indicated in your schedule. Partly in view of the risks of overuse and underuse, it is crucial to train as much as possible between the stated heart rate values.

A number of examples of commonly used ergometers for exercise are the bicycle ergometer (also known as an home trainer), treadmill, rowing ergometer and arm ergometer. You can contact your physical therapist with questions about working with the ergometer and adjusting it. Possible questions are the following: how do I adjust the resistance and the pace so that I am exercising in my exercise zones, and how must the ergometer be adjusted (saddle height, distance, etc.) to exercise as efficiently as possible?

Heart rate monitor.

You have received a heart rate monitor from your physical therapist, or you have one yourself. The heart rate monitor consists of a heart rate monitor strap and a watch. The heart rate monitor strap is worn around your chest and the watch is worn around your wrist. With the watch you can check your heart rate during exercise. Note that during exercise you must ensure that your heart rate remains between the values indicated in your personal schedule (see Section 3.2). You can contact your physical therapist with questions about the type of heart rate monitor that you are using.

RPE scale.

The RPE scale is a subjective scale to determine the perceived level of effort on a scale of 6 to 20. For reliable use, user training is necessary to clarify which score corresponds to which subjective experience. Your physical therapist will instruct you on the correct use of the RPE scale.

RPE SCALE		
6		6
7	Extremely light	7
8		8
9	Very light	9
10		10
11	Light	11
12		12
13	Somewhat hard	13
14		14
15	Hard	15
16		16
17	Very hard	17
18		18
19	Extremely hard	19
20		20

3.5 The exercise log.

You should complete the exercise log in consultation with your physical therapist. The specific need for help and the treatment goal are determined during the intake interview. The details of your exercise schedule are based on the data from the exercise test that you underwent prior to the program.

The schedule is specified for each week of the program. After each exercise session you will be asked to record the actual heart rate achieved during the session. After each exercise week you will also be asked to answer a number of questions. It is important you keep accurate records because your therapist can use your log to check whether the exercise schedule is sufficiently in line with your specific situation or whether adjustments may be necessary to prevent overuse.

The specific need for help:

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The treatment goal:

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Your exercise schedule:

Frequency	
Intensity (zones)	
Recovery	
Low intensity	
Moderate intensity	
High intensity	
Type	
Time	
Exercise method	**Heart rate monitor/RPE scale**

Ergometer settings (if used):

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Week 1:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] *To be completed by the physical therapist based on the exercise test before the start of the exercise program.*

[b] *To be completed by the patient.*

[c] *To be completed in consultation with the physical therapist.*

Week 1:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

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Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

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Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

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……

……

Do you now have muscle pain?

❑ yes ❑ no

Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

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……

……

Week 2:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] *To be completed by the physical therapist based on the exercise test before the start of the exercise program.*

[b] *To be completed by the patient.*

[c] *To be completed in consultation with the physical therapist.*

Week 2:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

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Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

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Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

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Do you now have muscle pain?

❑ yes ❑ no

Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

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……

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Week 3:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] *To be completed by the physical therapist based on the exercise test before the start of the exercise program.*

[b] *To be completed by the patient.*

[c] *To be completed in consultation with the physical therapist.*

Week 3:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

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Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

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Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

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Do you now have muscle pain?

❑ yes ❑ no

Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

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Week 4:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] *To be completed by the physical therapist based on the exercise test before the start of the exercise program.*

[b] *To be completed by the patient.*

[c] *To be completed in consultation with the physical therapist.*

Week 4:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

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Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

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Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

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Do you now have muscle pain?

❑ yes ❑ no

Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

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……

……

Week 5:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] *To be completed by the physical therapist based on the exercise test before the start of the exercise program.*

[b] *To be completed by the patient.*

[c] *To be completed in consultation with the physical therapist.*

Week 5:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

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Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

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Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

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……

Do you now have muscle pain?

❑ yes ❑ no

Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

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……

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Week 6:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] *To be completed by the physical therapist based on the exercise test before the start of the exercise program.*

[b] *To be completed by the patient.*

[c] *To be completed in consultation with the physical therapist.*

Week 6:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

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……

Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

……

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……

Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

……

……

……

Do you now have muscle pain?

❑ yes ❑ no

Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

……

……

……

Week 7:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] *To be completed by the physical therapist based on the exercise test before the start of the exercise program.*

[b] *To be completed by the patient.*

[c] *To be completed in consultation with the physical therapist.*

Week 7:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

……

……

……

Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

……

……

……

Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

……

……

……

Do you now have muscle pain?

❑ yes ❑ no

Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

……

……

……

Week 8:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] *To be completed by the physical therapist based on the exercise test before the start of the exercise program.*

[b] *To be completed by the patient.*

[c] *To be completed in consultation with the physical therapist.*

Week 8:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

……

……

……

Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

……

……

……

Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

……

……

……

Do you now have muscle pain?

❑ yes ❑ no

Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

……

……

……

Week 9:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] *To be completed by the physical therapist based on the exercise test before the start of the exercise program.*

[b] *To be completed by the patient.*

[c] *To be completed in consultation with the physical therapist.*

Week 9:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

……

……

……

Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

……

……

……

Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

……

……

……

Do you now have muscle pain?

❑ yes ❑ no

Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

……

……

……

Week 10:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] *To be completed by the physical therapist based on the exercise test before the start of the exercise program.*

[b] *To be completed by the patient.*

[c] *To be completed in consultation with the physical therapist.*

Week 10:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

……

……

……

Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

……

……

……

Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

……

……

……

Do you now have muscle pain?

❑ yes ❑ no

Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

……

……

……

Week 11:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] *To be completed by the physical therapist based on the exercise test before the start of the exercise program.*

[b] *To be completed by the patient.*

[c] *To be completed in consultation with the physical therapist.*

Week 11:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

……

……

……

Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

……

……

……

Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

……

……

……

Do you now have muscle pain?

❑ yes ❑ no

Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

……

……

……

Week 12:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] To be completed by the physical therapist based on the exercise test before the start of the exercise program.

[b] To be completed by the patient.

[c] To be completed in consultation with the physical therapist.

Week 12:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

……

……

……

Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

……

……

……

Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

……

……

……

Do you now have muscle pain?

❑ yes ❑ no

Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

……

……

……

Week 13:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] To be completed by the physical therapist based on the exercise test before the start of the exercise program.

[b] To be completed by the patient.

[c] To be completed in consultation with the physical therapist.

Week 13:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

……

……

……

Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

……

……

……

Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

……

……

……

Do you now have muscle pain?

❑ yes ❑ no

Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

……

……

……

Week 14:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] To be completed by the physical therapist based on the exercise test before the start of the exercise program.

[b] To be completed by the patient.

[c] To be completed in consultation with the physical therapist.

Week 14:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

……

……

……

Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

……

……

……

Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

……

……

……

Do you now have muscle pain?

❑ yes ❑ no

Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

……

……

……

Week 15:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] *To be completed by the physical therapist based on the exercise test before the start of the exercise program.*

[b] *To be completed by the patient.*

[c] *To be completed in consultation with the physical therapist.*

Week 15:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

……

……

……

Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

……

……

……

Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

……

……

……

Do you now have muscle pain?

❑ yes ❑ no

Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

……

……

……

Week 16:

	Date	Starting time
Exercise		
Session 1 (low intensity)		
Session 2 (high intensity)		
Session 3 (low intensity)		

	Exercise zone	Duration	Heart rate schedule[a]	Heart rate achieved[b]	Score on RPE scale schedule	Score on RPE scale achieved[b]	Resistance[c]	Pace[c]
Session 1	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			
Session 2	Warming up				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
	High intensity				≥ 14			
	Recovery				≤ 9			
Session 3	Low intensity				10 – 11			
	Recovery				≤ 9			
	Low intensity				10 – 11			

[a] *To be completed by the physical therapist based on the exercise test before the start of the exercise program.*

[b] *To be completed by the patient.*

[c] *To be completed in consultation with the physical therapist.*

Week 16:

Did you have any complaints this week after the exercise sessions?

❑ no ❑ yes, when did you have complaints and what were they?

……

……

……

Have you completed all exercise sessions this week?

❑ yes ❑ no, which ones were not completed and why?

……

……

……

Did you succeed in exercising in the exercise zones during all sessions?

❑ yes ❑ no, during which sessions not and why not?

……

……

……

Do you now have muscle pain?

❑ yes ❑ no

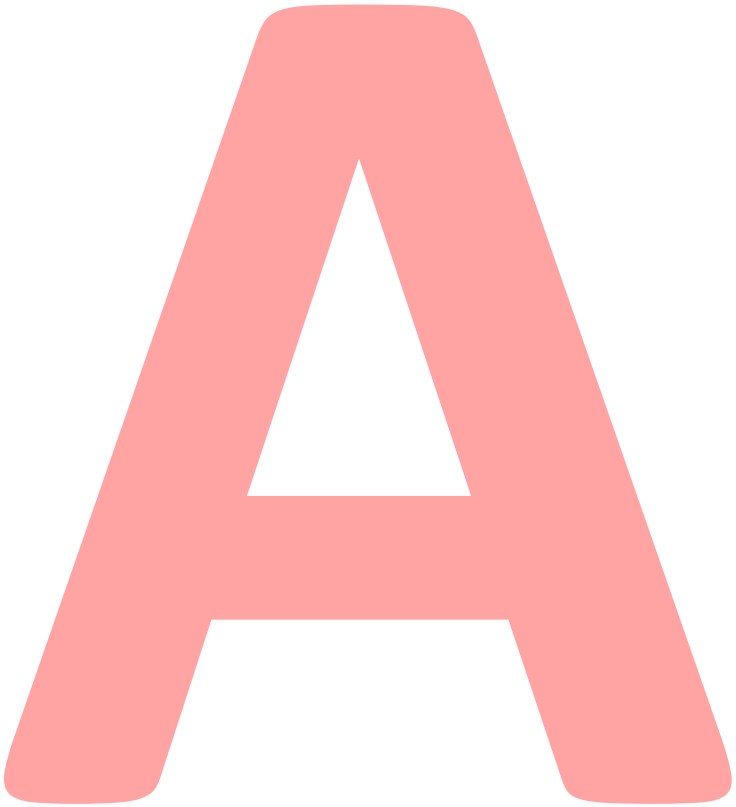
Do you feel other forms of pain or discomfort?

❑ no ❑ yes, what kind of pain or discomfort?

……

……

……



Appendices

APPENDIX 1 ACTIVITY LIST.

To determine the activity level, the activity list below can be used (Table 2). Please note: if you use the activity list, it is recommended to pass it on to the patient at the end of the first visit (Section 2.12, overview of steps in the care pathway).

It is important that the patient not only indicates the absolute duration of each activity, but also the perceived level of physical effort. The RPE scale can be used as an aid. The RPE scale is a subjective exercise exertion scale which is intended to estimate the amount of effort, the workload and fatigue on a scale of 6 to 20. For reliable use, user training is necessary so the patient understands which score corresponds to which subjective experience. Good instructions also improve reliability. It is therefore recommended to provide the following standard instructions at least once (before the start of the measurement):

> *"While doing physical activity, we want you to rate your perception of exertion. This feeling should reflect how heavy and strenuous the exercise feels to you, combining all sensations and feelings of physical stress, effort, and fatigue. Do not concern yourself with any one factor such as leg pain or shortness of breath, but try to focus on your total feeling of exertion. Look at the rating scale below while you are engaging in an activity; it ranges from 6 to 20, where 6 means "no exertion at all" and 20 means "maximal exertion." Choose the number from below that best describes your level of exertion. Try to appraise your feeling of exertion as honestly as possible, without thinking about what the actual physical load is. Your own feeling of effort and exertion is important, not how it compares to other people's. Look at the scales and the expressions and then give a number."*

The patient must keep an activity list for three 'average' days. This means that the measurement period does not include events such as a holiday or weekend away. Shortly after the end of an activity (<5 minutes), the patient registers the duration of the activity and the experienced load on the basis of the RPE scale. Activities that are scored 11 or lower are low intensity, activities of 12 and 13 are moderate intensity and activities that are scored 14 or higher are high intensity.

At the end of the three-day period, the practitioner determines the total time per zone and examines how the activity level of the patient relates to the WHO physical activity guidelines. An example is given below (Table 1). In combination with information about the physical capacity of the patient (*what can someone do)*, which is usually obtained on the basis of clinical expertise, the practitioner determines to what extent there is deconditioning due to inactivity (Section 2.4).

Time	**Activity**	**Duration**	**Experienced level of effort**		
			Low intensity	**Moderate intensity**	**High intensity**
8:00	Get up, dress, wash	**30 min.**	**X**		
8:30	Breakfast, clean up	**30 min.**	X		
9:00	Walking the dog	**15 min.**		X	
9:15	Off to work	**60 min.**	X		
	Total		120 min.	15 min.	0 min.

Table 1. Using the activity list to determine the relative workload.

ACTIVITY LIST.

Name:

Date:

Time	Activity	Duration	Perceived exertion		
			Low intensity	Moderate intensity	High intensity

Table 2. The activity list for determining the relative load.

RPE SCALE		
6		6
7	Extremely light	7
8		8
9	Very light	9
10		10
11	Fairly light	11
12		12
13	Somewhat hard	13
14		14
15	Hard	15
16		16
17	Very hard	17
18		18
19	Extremely hard	19
20		20

APPENDIX 2. SUBMAXIMAL EXERCISE TEST.

The submaximal exercise test as described below can be used to determine whether the type of exercise is appropriate, to design the exercise schedule based on the individually determined exercise zones, and to evaluate the effect of the exercise on physical fitness. First, the conduction of the test is discussed. The following appendices describe how the test results can be used for various purposes.

Requirements.

- Exercise test protocol.
- Exercise test score form (Appendix 5).
- Ergometer (bicycle, arm, rowing, treadmill, etc.).
- RPE scale 6–20 (Appendix 1).
- Heart rate monitor (recommended).
- Stopwatch.
- Respiratory gas analysis equipment (recommended).

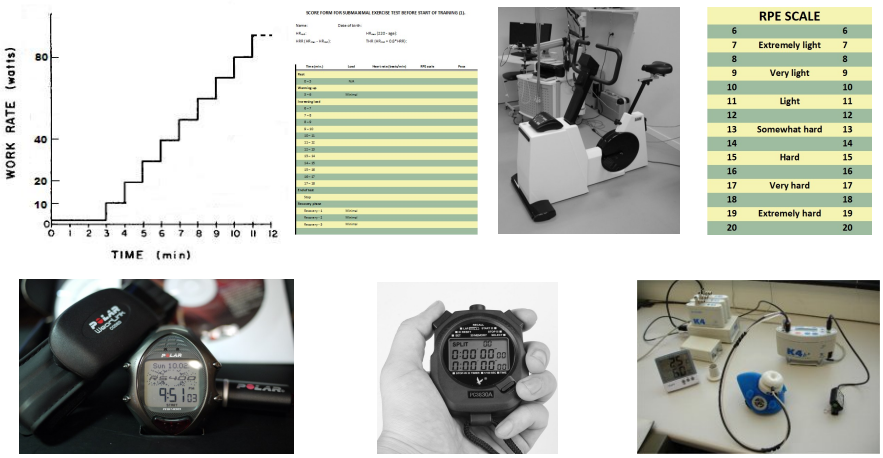


Figure 1. The requirements for the submaximal exercise test.

Preparation.

Because it is a submaximal exercise test, the presence of a physician is in principle not necessary. However, it must be determined before the test whether there are any contraindications. With absolute contraindications, the test and physical exercise are excluded. In the case of relative contraindications, the test can be performed after consulting a physician and possibly under the supervision of a (sports) physician (Section 2.6).

The patient must be given the following instructions and information at least 1.5 days before the test:

- Do not engage in heavy exertion during 24 hours before the test.
- Do not eat a large meal less than 2 hours before the start of the test.
- Bring comfortable clothing or sports clothing.
- Whether there is the possibility to shower afterwards.

Before the start of the test, the practitioner must:

- Adapt the ergometer to the patient (seat height, etc.) and record the settings on the score form.
- Put the heart rate monitor on the patient.
- If respiratory gas analysis is used, calibrate the system.
- If respiratory gas analysis is used, the equipment should be fitted to the patient.
- Inform the patient about the protocol.

Performing the submaximal exercise test.

Rest measurement and warming-up.

The test starts with a rest measurement. Here, the patient sits quietly in a chair for 3 minutes (near the ergometer).

- After 2 minutes, the resting heart rate (HR_{rest}) is noted on the score form. Because the heart rate varies, it is important to avoid any outliers.
- The HR_{rest} is used to calculate the 'heart rate reserve (HRR)' on the score form: HRR = HR_{max} - HR_{rest}, where HR_{max} = 220 - age.
- The HRR is used to calculate the 'target heart rate (THR)' on the score form (see also stop criteria test): THR = HR_{rests} + 80%HRR, where 80%HRR = 0.8 * HRR.

After the rest measurement, the patient takes his or her place on the ergometer. The patient starts to exercise, preferably without resistance, and otherwise at the lowest possible resistance. The patient continues to exercise at this workload at a constant pace for 2 minutes. This can also be seen as the warming-up.

- After 1.5 minutes, the RPE is scored and recorded on the score form along with the heart rate at that time.

Incremental workload.

The resistance is then increased in steps (every minute). The increase depends on the physical capacity of the patient and the chosen modality. For bicycle and arm ergometers, for example, the resistance will be increased every minute by 5–25 Watts (W). On a treadmill the resistance can be increased in two ways: by increasing either the speed or the incline. The magnitude of the increase is determined by the practitioner based on clinical expertise. The patient continues to exercise at the most constant pace possible; the duration of the incremental part of the test should preferably be between 8 and 12 minutes.

- After 30 seconds (at each load step), the score on the RPE scale is determined and is recorded on the score form together with the heart rate.

The termination of the submaximal exercise test.

The exercise test is terminated with one of the following stop criteria:

- When the heart rate reaches the THR (HR_{rest} + 80% HRR).
- When the pace becomes too low: with arm and bicycle ergometers <50 revolutions per minute; with rowing <18 strokes per minute. On a treadmill, when the patient can no longer maintain walking speed.
- If the patient's safety is at stake (e.g. with signs of poor perfusion (cyanosis or paleness) or with certain symptoms (such as dizziness or chest pain).

- The same criteria apply to *patients with beta blockers*. However, if the score on the RPE scale is ≥ 16 before the THR is reached, the test is stopped.

As soon as one of the stop criteria is reached, the resistance is brought back to the minimum level. At the end of the test, the score on the RPE scale is determined and is recorded on the score form together with the heart rate.

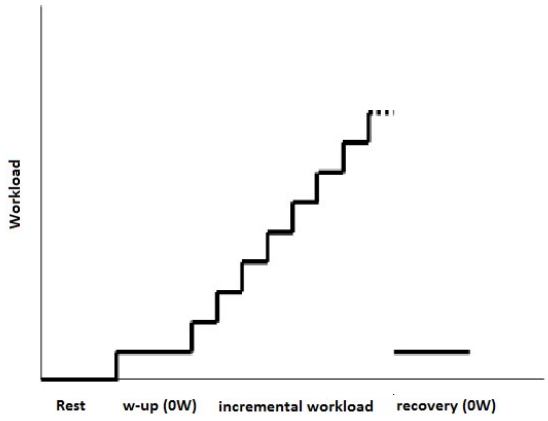


Figure 1. The protocol of the submaximal exercise test.

The recovery phase.

The patient continues to exercise for three minutes, preferably without resistance, and otherwise at the lowest possible resistance. The heart rate is recorded on the score form every minute. The recovery phase can be seen as cooling-down, and after this the submaximal exercise test is completed (Fig. 1).

APPENDIX 3. DETERMINING THE ANAEROBIC THRESHOLD AND INDIVIDUAL EXERCISE ZONES.

Determining the anaerobic threshold.

The submaximal exercise test can be used to determine the anaerobic threshold directly (by means of respiratory gas analysis) or indirectly (by means of the RPE scale) (Section 2.7). The anaerobic threshold is the basis for determining the individual exercise zones.

Direct determination of the anaerobic threshold.

The most appropriate method for determining the anaerobic threshold (AT) is the direct method based on the plots of the respiratory gas analysis. The '*v-slope method*' and the '*ventilatory equivalent method*' are used to identify the AT.

- V-slope method (Fig. 1, top left): the increase in exhaled carbon dioxide (VCO_2) is greater than the increase in oxygen uptake (VO_2).
- The ventilation equivalent method (Fig. 1, bottom left): the ventilation equivalent for VO_2 increases (V_E/VO_2), while the ventilation equivalent for VCO_2 (V_E/VCO_2) remains constant.

For a more detailed description of the AT and its determination, refer to the book *Principles of exercise testing and interpretation* (Wasserman et al., 2011).

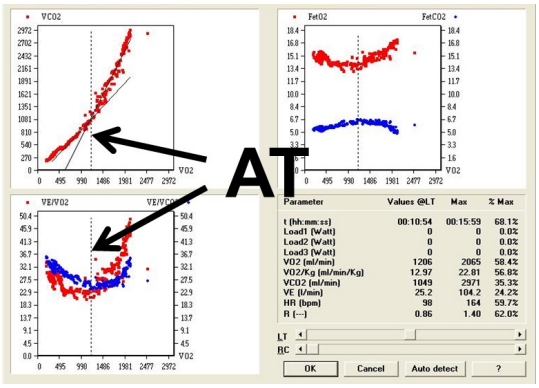


Figure 1. Plots of the respiratory gas analysis for the determination of the anaerobic threshold (AT). Top left. the 'v-slope method' and bottom left, the 'ventilation equivalent method'.

Both methods lead to the same point at which the anaerobic threshold occurs. The heart rate must then be determined at the anaerobic threshold (HR at AT). The HR at AT serves as the starting point for determining the individual exercise zones (Table 1).

Indirect determination of the anaerobic threshold.

If respiratory gas analysis equipment is not available, the AT can be determined indirectly based on the RPE scale. Determine the point during the submaximal exercise test when the score on the RPE scale was 12, and determine the heart rate at that point (HR at AT).

Sometimes 12 is not scored during the test. In that case, interpolation can be used to determine at what point 12 would have been scored, and then determine the heart rate at that point.

Determination of the individual exercise zones.

Based on the heart rate at the anaerobic threshold (HR at AT), the individual exercise zones can be determined based on the diagram below (Table 1).

	Percentage of HR at AT		Heart rate (beats/min)	
	Lower limit	Upper limit	Lower limit	Upper limit
Exercise zone				
Recovery	60%	80%	=0.6*HR at AT	=0.8*HR at AT
Low intensity	80%	100%	=0.8*HR at AT	= HR at AT
Moderate intensity	100%	105%	= HR at AT	= 1.05*HR at AT
High intensity	105%	115%	= 1.05*HR at AT	= 1.15*HR at AT

Table 1. The individual exercise zones based on the heart rate at the anaerobic threshold (HR at AT).

Assuming that patient A had a HR at AT of 120 beats per minute, then the lower and upper limits for the high-intensity exercise zone are:

Lower limit = 105% of HR at AT	Upper limit = 115% of HR at AT
Lower limit = 1.05 * HR at AT	Upper limit = 1.15 * HR at AT
Lower limit = 1.05 * 120	Upper limit = 1.15 * 120
Lower limit = 126	Upper limit = 138

Calculation tool for automatically determining the individual exercise zones and the exercise schedule

A calculation tool is available on the B-FIT website with which the lower and upper limits associated with the various exercise zones can be determined automatically and easily. You only have to fill in the heart rate at the anaerobic threshold (HR at AT):

1. Go to the following link: https://www.amc.nl/trainingguide
2. Open the file: *"Calculation tool"* (Fig. 2).
3. Make sure the exercise zones tab is active (bottom left).
4. Enter the HR at AT in the pink box.
   - Please note that in **block 1** the HR at AT before the start of the exercise program must be entered (upper pink box) and in **block 2** the HR at AT of the interim evaluation must be entered (lower pink box).
5. Press enter.

6. Go to the *Exercise schedule* tab. The heart rates corresponding with the various individual exercise zones are now filled in automatically.
    - Please note, this is an illustrative exercise schedule based on 16 weeks of exercise and three exercise sessions per week. As described in Section 2.8, the practitioner can make adjustments within the corresponding frameworks.

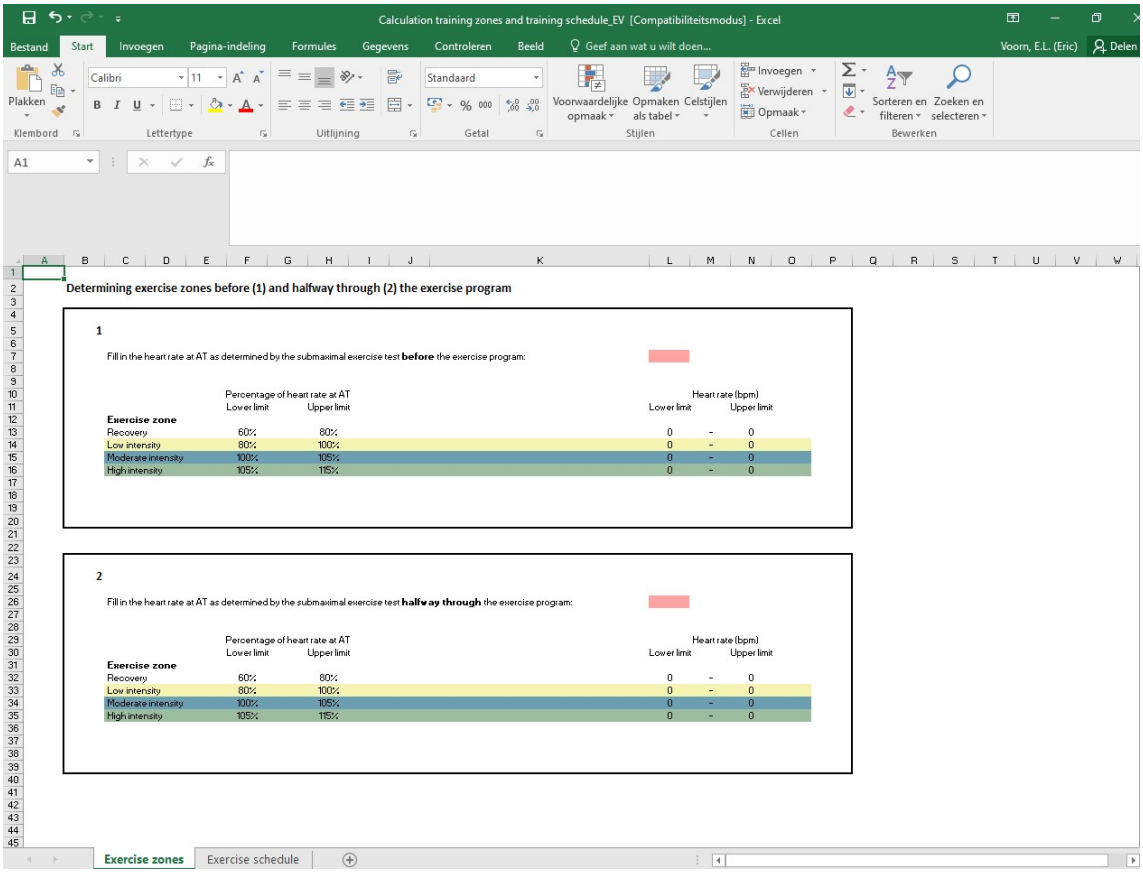


Figure 2. Calculation tool for exercise zones and exercise schedule.

APPENDIX 4. EXAMPLE OF AN EXERCISE SCHEDULE.

Name:

		Exercise zone	Duration	Heart rate*	Score on RPE scale	Resistance**	Pace**
Week, session	**Date**						
Week 1, session 1		Low intensity	10		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	10		10 – 11		
Week 1, session 2		Warming up	3		≤ 9		
		High intensity	3		≥ 14		
		Recovery	3		≤ 9		
		High intensity	3		≥ 14		
		Recovery	3		≤ 9		
		High intensity	3		≥ 14		
		Recovery	3		≤ 9		
Week 1, session 3		High intensity	10		10 – 11		
		Recovery	5		≤ 9		
		High intensity	10		10 – 11		
Week 2, session 1		High intensity	10		10 – 11		
		Recovery	5		≤ 9		
		High intensity	10		10 – 11		
Week 2, session 2		Warming-up	3		≤ 9		
		High intensity	4		≥ 14		
		Recovery	3		≤ 9		
		High intensity	3		≥ 14		
		Recovery	3		≤ 9		
		High intensity	3		≥ 14		
		Recovery	3		≤ 9		

** To be completed by the physical therapist based on the exercise test before the start of the exercise program.** To be completed in consultation with the physical therapist.*

Week, session	Date	Exercise zone	Duration	Heart rate*	Score on RPE scale	Resistance**	Pace**
Week 2, session 3		Low intensity	10		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	10		10 – 11		
Week 3, session 1		Low intensity	11		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	11		10 – 11		
Week 3, session 2		Warming up	3		≤ 9		
		High intensity	4		≥ 14		
		Recovery	3		≤ 9		
		High intensity	4		≥ 14		
		Recovery	3		≤ 9		
		High intensity	3		≥ 14		
		Recovery	3		≤ 9		
Week 3, session 3		Low intensity	11		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	11		10 – 11		
Week 4, session 1		Low intensity	11		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	11		10 – 11		
Week 4, session 2		Warming up	3		≤ 9		
		High intensity	4		≥ 14		
		Recovery	3		≤ 9		
		High intensity	4		≥ 14		
		Recovery	3		≤ 9		
		High intensity	4		≥ 14		
		Recovery	3		≤ 9		

** To be completed by the physical therapist based on the exercise test before the start of the exercise program.** To be completed in consultation with the physical therapist.*

Week, session	Date	Exercise zone	Duration	Heart rate*	Score on RPE scale	Resistance**	Pace**
Week 4, session 3		Low intensity	11		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	11		10 – 11		
Week 5, session 1		Low intensity	12		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	12		10 – 11		
Week 5, session 2		Warming up	3		≤ 9		
		High intensity	5		≥ 14		
		Recovery	3		≤ 9		
		High intensity	4		≥ 14		
		Recovery	3		≤ 9		
		High intensity	4		≥ 14		
		Recovery	3		≤ 9		
Week 5, session 3		Low intensity	12		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	12		10 – 11		
Week 6, session 1		Low intensity	12		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	12		10 – 11		
Week 6, session 2		Warming up	3		≤ 9		
		High intensity	5		≥ 14		
		Recovery	3		≤ 9		
		High intensity	5		≥ 14		
		Recovery	3		≤ 9		
		High intensity	4		≥ 14		
		Recovery	3		≤ 9		

** To be completed by the physical therapist based on the exercise test before the start of the exercise program.** To be completed in consultation with the physical therapist.*

Week, session	Date	Exercise zone	Duration	Heart rate*	Score on RPE scale	Resistance**	Pace**
Week 6, session 3		Low intensity	12		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	12		10 – 11		
Week 7, session 1		Low intensity	13		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	13		10 – 11		
Week 7, session 2		Warming up	3		≤ 9		
		High intensity	5		≥ 14		
		Recovery	3		≤ 9		
		High intensity	5		≥ 14		
		Recovery	3		≤ 9		
		High intensity	5		≥ 14		
		Recovery	3		≤ 9		
Week 7, session 3		Low intensity	13		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	13		10 – 11		
Week 8, session 1		Low intensity	13		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	13		10 – 11		
Week 8, session 2		Warming up	3		≤ 9		
		High intensity	6		≥ 14		
		Recovery	3		≤ 9		
		High intensity	5		≥ 14		
		Recovery	3		≤ 9		
		High intensity	5		≥ 14		
		Recovery	3		≤ 9		

** To be completed by the physical therapist based on the exercise test before the start of the exercise program.** To be completed in consultation with the physical therapist.*

Week, session	Date	Exercise zone	Duration	Heart rate*	Score on RPE scale	Resistance**	Pace**
Week 8, session 3		Low intensity	13		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	13		10 – 11		
Week 9, session 1		Low intensity	14		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	14		10 – 11		
Week 9, session 2		Warming up	3		≤ 9		
		High intensity	6		≥ 14		
		Recovery	3		≤ 9		
		High intensity	6		≥ 14		
		Recovery	3		≤ 9		
		High intensity	5		≥ 14		
		Recovery	3		≤ 9		
Week 9, session 3		Low intensity	14		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	14		10 – 11		
Week 10, session 1		Low intensity	14		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	14		10 – 11		
Week 10, session 2		Warming up	3		≤ 9		
		High intensity	6		≥ 14		
		Recovery	3		≤ 9		
		High intensity	6		≥ 14		
		Recovery	3		≤ 9		
		High intensity	6		≥ 14		
		Recovery	3		≤ 9		

** To be completed by the physical therapist based on the exercise test before the start of the exercise program.** To be completed in consultation with the physical therapist.*

Week, session	Date	Exercise zone	Duration	Heart rate*	Score on RPE scale	Resistance**	Pace**
Week 10, session 3		Low intensity	14		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	14		10 – 11		
Week 11, session 1		Low intensity	15		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	15		10 – 11		
Week 11, session 2		Warming up	3		≤ 9		
		High intensity	7		≥ 14		
		Recovery	3		≤ 9		
		High intensity	6		≥ 14		
		Recovery	3		≤ 9		
		High intensity	6		≥ 14		
		Recovery	3		≤ 9		
Week 11, session 3		Low intensity	15		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	15		10 – 11		
Week 12, session 1		Low intensity	15		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	15		10 – 11		
Week 12, session 2		Warming up	3		≤ 9		
		High intensity	7		≥ 14		
		Recovery	3		≤ 9		
		High intensity	7		≥ 14		
		Recovery	3		≤ 9		
		High intensity	6		≥ 14		
		Recovery	3		≤ 9		

** To be completed by the physical therapist based on the exercise test before the start of the exercise program.** To be completed in consultation with the physical therapist.*

Week, session	Date	Exercise zone	Duration	Heart rate*	Score on RPE scale	Resistance**	Pace**
Week 12, session 3		Low intensity	15		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	15		10 – 11		
Week 13, session 1		Low intensity	16		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	16		10 – 11		
Week 13, session 2		Warming up	3		≤ 9		
		High intensity	7		≥ 14		
		Recovery	3		≤ 9		
		High intensity	7		≥ 14		
		Recovery	3		≤ 9		
		High intensity	7		≥ 14		
		Recovery	3		≤ 9		
Week 13, session 3		Low intensity	16		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	16		10 – 11		
Week 14, session 1		Low intensity	16		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	16		10 – 11		
Week 14, session 2		Warming up	3		≤ 9		
		High intensity	8		≥ 14		
		Recovery	3		≤ 9		
		High intensity	7		≥ 14		
		Recovery	3		≤ 9		
		High intensity	7		≥ 14		
		Recovery	3		≤ 9		

** To be completed by the physical therapist based on the exercise test before the start of the exercise program.** To be completed in consultation with the physical therapist.*

Week, session	Date	Exercise zone	Duration	Heart rate*	Score on RPE scale	Resistance**	Pace**
Week 14, session 3		Low intensity	16		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	16		10 – 11		
Week 15, session 1		Low intensity	17		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	17		10 – 11		
Week 15, session 2		Warming up	3		≤ 9		
		High intensity	8		≥ 14		
		Recovery	3		≤ 9		
		High intensity	8		≥ 14		
		Recovery	3		≤ 9		
		High intensity	7		≥ 14		
		Recovery	3		≤ 9		
Week 15, session 3		Low intensity	17		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	17		10 – 11		
Week 16, session 1		Low intensity	17		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	17		10 – 11		
Week 16, session 2		Warming up	3		≤ 9		
		High intensity	8		≥ 14		
		Recovery	3		≤ 9		
		High intensity	8		≥ 14		
		Recovery	3		≤ 9		
		High intensity	8		≥ 14		
		Recovery	3		≤ 9		

** To be completed by the physical therapist based on the exercise test before the start of the exercise program.** To be completed in consultation with the physical therapist.*

		Exercise zone	Duration	Heart rate*	Score on RPE scale	Resistance**	Pace**
Week, session	**Date**						
Week 16, session 3		Low intensity	17		10 – 11		
		Recovery	5		≤ 9		
		Low intensity	17		10 – 11		

Table 1. Exercise schedule for aerobic exercise on an ergometer

APPENDIX 5. EVALUATING THE EFFECT OF EXERCISE ON PHYSICAL FITNESS.

The test results of the submaximal exercise test can also be used to determine the effect of exercise on physical fitness. The aerobic exercise evaluation form can be used for this purpose (see below).

In the diagram, the values for the heart rate and RPE scale on the submaximal exercise test score form can be entered for the time points before, during and after the exercise program (see the evaluation form below). A more reliable method, however, is to calculate the average heart rate over the last 30 seconds of each load level and to record this data on the evaluation form. This requires the heart rate not only to be monitored during the exercise test, but also recorded, so that the data is available after the test to determine the average values over the last 30 seconds. Indicators of improved physical fitness after the exercise program are when:

- A lower heart rate at similar submaximal exercise workloads.
- A lower score on the RPE scale at similar submaximal exercise workloads.
- The anaerobic threshold occurs at a higher exercise workload.
- The stop criterion is reached at a higher exercise workload.
- A faster recovery in heart rate occurs after the end of the exercise test.
- A faster recovery on the RPE scale occurs after the end of the exercise test.

Graphical display of exercise results

An Excel template can be found on the B-FIT website with which a graphical representation of the achieved exercise effects can easily be obtained (Fig. 1).

1. Go to the following link:
   https://www.amc.nl/trainingguide

2. Open the file: "*Training results*".

3. Enter the date and time the exercise tests were conducted.

4. Enter the exercise workload. Note that the value for rest must remain at -10. For recovery, the entered load values must always be higher than the highest value of the increasing load. For example, in Fig. 1, the highest value for the increasing load is 80 W. Therefore, the values 100, 110 and 120 W are used for recovery.

5. Enter the heart rate and RPE score corresponding with the various load steps. The values will be shown automatically in the figures.

6. Check which indications there are for improved aerobic capacity. Take into account both the results of the exercise tests and the personal experiences of the patient.

Submaximal exercise test

Time		Workload	Heart rate			RPE score		
			29/03/2016	31/05/2016	26/07/2016	29/03/2016	31/05/2016	26/07/2016
			10:00u	*10:00u*	*10:00u*	*10:00u*	*10:00u*	*10:00u*
Rest								
	0-3	-10	101	79	73	7	7	6
W-up								
	3-6	0						
Ascending workload								
	6-7	10	103	90	78	8	7	6
	7-8	20	106	93	81	9	8	7
	8-9	30	112	99	85	9	9	9
	9-10	40	125	109	94	10	10	9
	10-11	50	133	115	105	12	12	11
	11-12	60	140	122	113	15	14	12
	12-13	70	146	134	126	16	16	15
	13-14	80		143	132		17	17
	14-15							
	15-16							
	16-17							
	17-18							
	18-19							
	19-20							
End test								
Recovery								
	Herstel - 1	100	118	132	99	9	10	9
	Herstel - 2	110	119	112	93	8	10	6
	Herstel - 3	120	112	103	87	7	8	6

Indications for increased aerobic capacity	
Submaximal heart rate	reduced
Submaximal RPE score	reduced
Anaerobic treshold	increased
Peak workload	increased
Recovery heart rate	unchanged
Recovery RPE score	accelerated

Experiences
Tough at the start, particularly high intensity (2nd part better of training program was better, after adjustments of training zones)
Is feeling fitter, less fatigued
No complications after training
Increased activiy in daily life

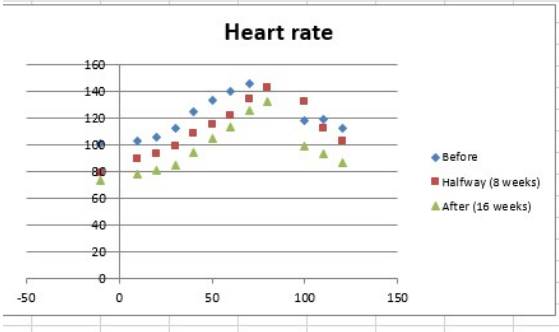


Figure 1. Display of exercise results based on the three exercise tests. Note that the template consists of a single tab, but for legibility it is shown here as two separate parts

EVALUATION FORM AEROBIC EXERCISE WITH NMD.

Time (min.)	Load	Pace	Heart rate (beats/min)			RPE scale		
			Before	During	After	Before	During	After
Rest								
0 – 3	N/A							
Warming-up								
3 – 6	Minimal							
Increasing load								
6 – 7								
7 – 8								
8 – 9								
9 – 10								
10 – 11								
11 – 12								
12 – 13								
13 – 14								
14 – 15								
15 – 16								
16 – 17								
17 – 18								
End of test								
Stop								
Recovery phase								
Recovery	Minimal							

SCORE FORM FOR SUBMAXIMAL EXERCISE TEST BEFORE THE EXERCISE PROGRAM (1).

Name: ……Date of birth: ……

HR_{rest}: …… HR_{max} (220 - age): ……

HRR (HR_{max} - HR_{rest}): …… THR (HR_{rest} + 0.8*HRR): ……

Time (min.)	Load	Heart rate (beats/min)	RPE scale	Pace
Rest				
0 – 3	N/A			
Warming-up				
3 – 6	Minimal			
Increasing load				
6 – 7				
7 – 8				
8 – 9				
9 – 10				
10 – 11				
11 – 12				
12 – 13				
13 – 14				
14 – 15				
15 – 16				
16 – 17				
17 – 18				
End of test				
Stop				
Recovery phase				
Recovery - 1	Minimal			
Recovery - 2	Minimal			
Recovery - 3	Minimal			

SCORE FORM FOR SUBMAXIMAL EXERCISE TEST BEFORE THE EXERCISE PROGRAM (2).

Reason for terminating the test:

☐ THR achieved
☐ Score on RPE scale ≥16 (for beta-blocker users)
☐ Pace insufficient
☐ Other, (please specify)

……

Ergometer settings:

……

……

……

……

Specifics:

……

……

……

……

SCORE FORM FOR SUBMAXIMAL EXERCISE TEST HALFWAY THE EXERCISE PROGRAM (1).

Name: ……Date of birth: ……

HR_{rest}: …… HR_{max} (220 - age): ……

HRR (HR_{max} - HR_{rest}): …… THR (HR_{rest} + 0.8*HRR): ……

Time (min.)	Load	Heart rate (beats/min)	RPE scale	Pace
Rest				
0 – 3	N/A			
Warming-up				
3 – 6	Minimal			
Increasing load				
6 – 7				
7 – 8				
8 – 9				
9 – 10				
10 – 11				
11 – 12				
12 – 13				
13 – 14				
14 – 15				
15 – 16				
16 – 17				
17 – 18				
End of test				
Stop				
Recovery phase				
Recovery - 1	Minimal			
Recovery - 2	Minimal			
Recovery - 3	Minimal			

SCORE FORM FOR SUBMAXIMAL EXERCISE TEST HALFWAY THE EXERCISE PROGRAM (2).

Reason for terminating the test:

☐ THR achieved
☐ Score on RPE scale ≥16 (for beta-blocker users)
☐ Pace insufficient
☐ Other, (please specify)

……

Ergometer settings:

……

……

……

……

Specifics:

……

……

……

……

SCORE FORM FOR SUBMAXIMAL EXERCISE TEST AFTER THE EXERCISE PROGRAM (1).

Name: ……Date of birth: ……

HR_{rest}: …… HR_{max} (220 - age): ……

HRR (HR_{max} - HR_{rest}): …… THR (HR_{rest} + 0.8*HRR): ……

Time (min.)	Load	Heart rate (beats/min)	RPE scale	Pace
Rest				
0 – 3	N/A			
Warming-up				
3 – 6	Minimal			
Increasing load				
6 – 7				
7 – 8				
8 – 9				
9 – 10				
10 – 11				
11 – 12				
12 – 13				
13 – 14				
14 – 15				
15 – 16				
16 – 17				
17 – 18				
End of test				
Stop				
Recovery phase				
Recovery - 1	Minimal			
Recovery - 2	Minimal			
Recovery - 3	Minimal			

SCORE FORM FOR SUBMAXIMAL EXERCISE TEST AFTER THE EXERCISE PROGRAM (2).

Reason for terminating the test:

☐ THR achieved
☐ Score on RPE scale ≥16 (for beta-blocker users)
☐ Pace insufficient
☐ Other, (please specify)

……

Ergometer settings:

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Specifics:

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