

Aerobic exercise exercise prescription design and calculation

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Abstract: With the rapid rise of the obesity rate and the rapid development of the sports industry in China, how to arrange the aerobic exercise scientifically and reasonably, and improve the physical fitness has become an important issue. Combined on practical and actual cases, this paper puts forward a complete exercise prescription design scheme around the relevant concept of aerobic exercise, and gives the calculation method of correlation coefficient, which can effectively help relevant practitioners and enthusiasts to accurately prescribe exercise according to the actual situation.

1. Introduction

Due to the change of people's lifestyle, the decrease of physical activity and the relative increase of eating volume, the incidence of overweight and obesity in China is increasing year by year, which has become one of the main reasons for the increased incidence of cardiovascular disease, diabetes and certain tumors. Scientific and reasonable exercise not only helps maintain healthy weight, but also reduces the risk of chronic diseases such as hypertension, stroke, coronary atherosclerotic heart disease, diabetes, colon cancer, breast cancer, and osteoporosis; but also helps to regulate psychological balance, effectively eliminate stress, relieve depression and anxiety symptoms and improve [2] such as sleep.

Although some people in order to improve physical health, attach great importance to physical exercise, but often with great blindness, or choose sports improperly, or exercise intensity, exercise amount is not reasonable, not only can not improve health, but even damage health. Therefore, how to carry out moderate exercise intensity of aerobic exercise, improve healthy physical fitness, is a subject facing each of us. This paper introduces the arrangement principles and calculation methods of exercise plan around the characteristics and related knowledge of aerobic exercise.

2. The benefits of exercise

Regular exercise plays an important role in preventing chronic diseases. Lack of exercise brings many health risks to individuals. In China, individuals participating in exercise only account for about

30% of the total population, and presents the phenomenon of more age groups at two ends and less middle, and most people lack exercise.

The lack of resident movement is not only a problem facing China, but also a world problem. The WHO noted that about 60% of people could not meet moderate-intensity exercise for 30min a day, three or more times a week. Evidence for an inverse association between systemic exercise and cardiovascular and cerebrovascular diseases, hypertension, stroke, osteoarthritis, type 2 diabetes, obesity, colon cancer, breast cancer, anxiety, and depression is growing in [3, 4]. This evidence is derived from large laboratory studies and a large sample of population observational studies. Numerous epidemiological studies have strongly demonstrated [5], a dose-response relationship between exercise and cardiovascular disease risk and early mortality in different genders and ethnic groups.

3. The basic elements of aerobic exercise prescription

The basic elements of exercise include [6], including exercise objectives, exercise content, exercise intensity, exercise time, frequency of exercise, and matters needing attention. Exercise improves physical fitness, muscle strength, muscle endurance, explosive strength, flexibility, sensitivity and coordination.

1) Exercise goals

Exercise goals, or recent goals, should be clearly defined before making an exercise plan. The exercise goal of improving heart and lung endurance involves improving cardiopulmonary function, weight loss, blood fat lowering, or prevention and treatment of coronary heart disease, hypertension, diabetes, etc. The exercise goal mainly to improve strength and flexibility should be specific to the exercise site, such as increasing the range of movement of a joint and enhancing the strength of a certain muscle group. Strength-based exercise prescription needs to determine what strength is necessary to enhance and what strength training method is necessary to be used, whether dynamic strength training or static strength training, centripetal exercise or centrifugal exercise.

2) Exercise content

The selection of exercise content should take into account the physical condition, exercise experience, interests, hobbies and specialties, as well as the exercise environment, conditions, whether there are companions and guidance and other factors, and effectively choose the exercise content.

Aerobic exercise is the most important and basic means of exercise prescription. Its sports include walking, jogging, walking and running alternately, swimming, cycling, up and down stairs, rope skipping, boating, skating, skiing, square dancing and other [7]. Aerobic exercise can be used as an effective exercise mode for general fitness or to improve cardiovascular and metabolic function, and can be used for the prevention and rehabilitation of many chronic diseases such as coronary heart disease and obesity.

Strength exercise is to restore and improve muscle strength, and promote limb functional activity exercise, mainly including resistance movement, active exercise, power exercise, etc., mainly used for muscle atrophy, muscle mass reduction, muscle strength decline caused by various reasons.

Due to the differences in exercise content, different sports have different effects on improving physical quality, such as football and basketball against large ball sports have more comprehensive requirements for physical quality.

3) Exercise intensity index and analysis

Exercise intensity is the core problem of quantification and scientific nature of designing exercise prescription, and also the most difficult part of designing exercise prescription. It affects the effect and safety problems of exercise, and needs to determine whether exercise intensity is appropriate

through monitoring. These aspects should be taken into account when formulating exercise intensity: ① Purpose of rehabilitation or fitness; ② Results of clinical examination and functional examination; ③ Results of exercise test and physical fitness test; ④ Selected sport content ; ⑤ Subjects' Age, sex, sports experience, etc. [7, 9, 10].

Exercise intensity is divided into absolute intensity (also known as "physical intensity") and relative intensity (also known as "physiological intensity") indicators. The absolute intensity of the same exercise is consistent, while the relative intensity, such as individual fatigue across age, sex, and physical conditions, may vary greatly.

The level of intensity measured by the absolute physical load of physical activity is usually the result of some kind of movement measurement in an ordinary healthy adult. Common used indicators are metabolic equivalent. Metabolic equivalent refers to the intensity of activity in which 1MET is equivalent to 3.5ml of oxygen per minute, or per kilogram of 1.05 kcal (4.4 joules) per hour relative to levels of energy metabolism during quiet rest.

Relative exercise intensity is the intensity level of exercise as measured by the physiological response situation. Including: a objective heart rate level, oxygen consumption, etc. The common indicator is the maximum percentage of heart rate (% HR_{max}). Maximum percent oxygen consumption (% VO_{2max}), Bullseye rate, etc. The objective heart rate during exercise can be measured by the exercise smart bracelet. b. Subjective fatigue is commonly measured by the conscious exercise intensity scale, which is divided into three levels: light, medium and heavy.

Table 1: Quantification analysis of movement intensities at different activity intensities

	Lower exercise intensity	Medium exercise intensity	Large exercise intensity
Absolute exercise intensity / METs	1.6~2.9	3~5.9	≥6
Relative exercise intensity /%HR _{max}	57~64	64~76	76~96

Aerobic exercise is carried out around moderate exercise intensity, and the corresponding relationship between absolute exercise intensity and relative exercise intensity is as follows:

(1). Absolute exercise intensity is in the range of (3~5.9) METs, and the relative exercise intensity is within (64~76)%HR_{max}. The interval indicates that the exercise intensity is appropriate, just exercise in the range of moderate exercise intensity.

(2). Absolute exercise intensity is within the range of (3~5.9) METs, and the relative exercise intensity is within (57~64)%HR_{max}. The interval indicates that the intensity of exercise is too small, and the exercisers have good cardiopulmonary endurance, and did not reach the moderate exercise intensity aerobic exercise target heart rate range, but also need to increase the intensity of exercise.

(3). Absolute exercise intensity is in the range of (3~5.9) METs, and the relative exercise intensity is within (76~96)%HR_{max}. The interval indicates that the exercise intensity is too large, and the cardiopulmonary endurance is poor. In the aerobic exercise target rate range of greater exercise intensity, there is a safety risk, and it is necessary to reduce the exercise intensity of exercise.

(4). Absolute exercise intensity is within the range of 6METs, with the relative exercise intensity (76~96)%HR_{max}. Range, indicates that the exercise intensity is appropriate, just in the larger exercise intensity aerobic exercise target rate range of exercise, improve cardiopulmonary endurance is very beneficial.

The following two cases were selected for the relevant analysis:

Case 1: As shown in Figures 1 and 2, the man was 50 years old, jogging at an average speed of 7:09 minutes / km, with an average heart rate of 138 beats / min. The moderate exercise intensity range (110 to 130 beats / min), equivalent to 8.4 km / h, is converted to absolute exercise intensity of

9METs; from the APP, the average heart rate of jogging intensity is 138 beats / min. It shows that the man in the greater exercise intensity of aerobic exercise, improve cardiopulmonary endurance is beneficial, and the exercise intensity is moderate.



Figure 1: Exercise Speed Situation in Case 1



Figure 2: Case 1 Changes in heart rate during exercise

Case 2: As shown in Figure 3 and 4, the man is 40 years old and walked at an average speed of 10:49 minutes / km, equivalent to 5.6 km / h, and the absolute exercise intensity is 4METs. From the APP corresponding to the sports smart bracelet, you can see that the average heart rate corresponding to the exercise intensity of moderate speed walking is 98 times / min. The moderate exercise range of a 40-year-old man was (115 to 136 times / points), which did not reach the range at 5.6 km

/ h, indicating that the man had good cardiopulmonary endurance and fast walking was small for him. When you exercise, increase the intensity of exercise, adopt the form of walking and running or jogging, which can exercise in the target heart rate range of moderate exercise intensity, and improve the exercise effect of cardiopulmonary endurance.



Figure 3: The exercise speed situation in case 2



Figure 4: Case 2 Changes in heart rate during exercise

4. Run duration

Exercise time refers to the time of each sustained exercise, which is an important factor in the amount of exercise. When making exercise prescriptions, sometimes lower load intensity and longer exercise time are taken, and sometimes short, high-intensity repetitive exercise (e. g., during intense

strength exercise). After the load intensity is determined, the exercise duration of that intensity becomes important to affect the exercise effect. Exercise time is too short, can not produce an effect on the body, can not achieve the due effect; exercise time is too long, and may exceed the body's bearing capacity, causing fatigue accumulation and damage to the body. Therefore, the exercise time should be set according to the purpose of the movement and the load strength of the body, that is, the necessary exercise time.

The duration of endurance exercise is 20 min to 60 min, generally 20 min to 30 min (excluding preparation and finishing activities), and the time to achieve the appropriate heart rate must last more than 10 min to 15 min.

When formulating a strength exercise prescription and flexible exercise prescription, the number of repetitions, number of completed group, and time interval between sub and sub, and groups should be specified. The total time of each force exercise is about 30min / times, 3 groups / times ~4 groups / times.

Skeletal muscle usually recovers from 2 to 3 days after training. Therefore, at the start of the exercise program, each training takes 48 h to 72 h. When the training reaches a certain stage, the movement frequency can be 2 to 3 times a week. When the muscle adapts to the established training load, the load gradually increases. To further stimulate the growth of muscle strength and endurance. When the set goal is achieved during training, the frequency of training can be reduced to 2 days a week to maintain vested muscle strength or endurance.

5. Movement frequency

The frequency of exercise is the number of exercises per week. The effect of exercise is shown in the gradual accumulation of the benign effect of each exercise on the human body, which is a process from quantitative change to qualitative change, so exercise requires frequent exercise, or according to different exercise purposes, the implementation of a certain period of exercise. Movement should not be too frequent by temporary interest, nor by a rush for success. If a physical exercise, the benign effect on the body completely subsided after the second exercise, the effect of the previous exercise can not be accumulated; if the benign effect on the body has not appeared (that is, the fatigue of the previous exercise has not been eliminated) immediately after the second exercise, it will cause the accumulation of fatigue. Neither of the above two movement interval forms achieves satisfactory results; the latter form will cause excessive fatigue to the body as in the long term. It can be seen that the frequency of exercise is very important in making the exercise prescription. Correct set the frequency of exercise, should be treated differently according to the purpose of exercise and physical health conditions.

On the frequency of exercise, Japan shows that: once / week, exercise training effect does not accumulate, muscle pain and fatigue every time, 1~3 days after exercise, prone to injury accidents; 2 times / week, pain and fatigue reduction, exercise training effect is not obvious; 3 times / week, no pain and fatigue, exercise training effect is obvious; 4 times / week ~5 times / week, the effect is more obvious. Exercise 3 ~4 times a week is the more appropriate frequency. However, due to the motor effect and the excessive recovery effect, the time interval between the two exercises should not exceed 3 days.

When determining the duration and frequency of exercise prescription:

- (1) Results of clinical examination and functional examination.
- (2) Results of exercise test and physical strength test.
- (3) The determined movement content. If you walk (100 steps / minute) for 30 minutes a day.
- (4) Determine tained intensity. If jogging at a speed of 10 km / h, running for 20 minutes, about 3 km, running 3 times a week, consuming about 800 to 900 kcal / wk; running for 30 minutes, about

5 km, and running twice a week, also consuming 800-900 kcal / wk.

(5) Age, exercise experience, etc. The frequency of movement depends on the movement intensity and the duration of each movement. It is generally believed that exercise 3~4 times a week is the most appropriate frequency, that is, exercise once the next day. Strength exercises occur in a frequency of 2 to 3 times / week. Flexibility training can be combined with aerobic exercise and strength exercises.

6. Exercise

The amount of exercise is determined jointly by the frequency, intensity, and time (duration) of the exercise.

The reasonable amount of aerobic exercise recommended by the American Society of Sports Medicine (ACSM) for most adults is 500 to 1,000 METs min / wk. This exercise is approximately equivalent to moderate physical activity consuming 1000kcal / wk, or approximately 150 min moderate physical exercise per week; or walking at least 5400 to 7900 steps per day. There is a potential error in estimating the amount of exercise using a pedometer, so it is most sensible to combine 100 steps of min with the currently recommended time / duration of exercise. It turns out that at least 1000kcal of energy consumed accumulated weekly through exercise does yield health / physical fitness benefits to [11].

For some lower fitness individuals, less than 1000kcal per week also improves their health / fitness levels. But for most adults, more exercise has more fitness / fitness benefits, while more exercise can also help promote weight loss and long-term weight loss outcomes.

The ACSM recommends rhythmic, large muscle group-engaged aerobic exercise to improve cardio-cardiopulmonary endurance and cardiopulmonary fitness, and classifies aerobic and cardio-endurance exercise based on intensity and skills required:

Class A exercises can be recommended to all adults because few skills are required to complete these exercises, and the exercise intensity is easily adjusted to those suitable for most physical fitness levels. Category B exercises are typical of higher intensity exercises, recommended for those with moderate or higher physical fitness levels, or with regular exercise habits. Class C sports need certain skills to complete, and this group of sports is best carried out by those with relatively good control skills and physical fitness under the premise of ensuring safety. Category D exercise is a recreational exercise and can improve physical fitness, but it is generally recommended to use such exercise as an auxiliary means of physical training. Category D sports are only recommended for those who have enough control skills and fitness to complete such exercises, though some of them can be adjusted to fit those with low skill and fitness.

The frequency, intensity, time, manner, volume, and schedule of an aerobic exercise prescription depend on the physical conditions and training objectives of the practitioner.

7. Precautions and taboos

Exercise prescriptions for the purpose of treatment and rehabilitation should point out taboo sports, self-observation and stop exercise indications, pay attention to preparation activities and sorting activities. At the same time, let the fitness person master and understand some necessary sports and health knowledge, such as do not sit down or lie down immediately after exercise, so as not to cause "gravitational shock" or other discomfort, can not immediately eat raw and cold food, can not immediately swim or cold bath and other [12].

Exercise prescription should propose the corresponding specific matters for attention according to the specific situation of each practitioner or patient:

- (1) Point out the taboo sports and some activities prone to dangerous occurrence.
- (2) Point out the self-observation index in the movement and the standard to stop the movement

when the indicators are abnormal.

(3) Make full preparations and organizing activities before and after each exercise.

8. Conclusion

This paper mainly introduces the arrangement principles and calculation methods of the aerobic exercise plan, and explains the impact of the exercise plan on the effect through the computational analysis. Through this article, physical education teachers, personal trainers and other related practitioners and sports fans to better arrange the training plan, improve the scientific training.

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