

# Research on Indirect Determination of Maximum Oxygen Uptake by Athletes and Applicability

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**Abstract:** At present, our country attaches great importance to the development of sports, and the physical quality and sports potential of sports athletes determine the future development of athletes and the sports direction of athletes. Indirect determination of maximum oxygen uptake of athletes is a common method in sports training. This paper analyzes several indirect determination methods of maximum oxygen uptake of athletes, and introduces its applicability in detail, hoping to further strengthen the analysis effect of athletes' physical quality.

## 1. Introduction

For a long time, our country has carried on the key support in the sports cause development, the government invested a lot of manpower, the material resources and the system management way, effectively improved our country's sports environment, created the strong sports atmosphere in our country. The athlete maximum oxygen uptake indirect method has the higher application superiority in the analysis athlete's physical quality and the sports potential. It can help the relevant trainers to adjust the training program of athletes scientifically.

## 2. Analysis of Indirect Determination of Maximum Oxygen Uptake by Athletes

### 2.1 Astrid Line Diagram Method

Astrid line chart method has a high proportion of application in indirect determination of maximum oxygen uptake of athletes. This method was put forward by Astrid of Sweden in 1954. In the actual application process, it is mainly aimed at the athletes aged 15-60. According to different sports direction, sports items and sports types of athletes, more accurate measurement results can be obtained. The specific measurement items of this method include heart rate, body weight, load power, etc. according to the actual test environment and test props, Astrid line chart method can be divided into step test and power bicycle test. The main test indexes of step test are heart rate and body weight, while the test indexes of power bicycle include heart rate and load power, which have certain differences. In addition, the step test method of Astrid line chart mainly includes 40 cm high steps and weight meter, metronome, recorder, heart rate telemeter, etc. in the application of power bicycle test method, the main test items include power bicycle, stopwatch, heart rate telemeter, etc. Although the two measuring paths have some differences in measuring instruments and measuring indicators, they are relatively unified in the actual measurement principle. Finally, according to the actual measurement data, the determination result of Astrid nomogram method will be obtained through nomogram and calculation table, so as to meet the requirement of indirect measurement of maximum oxygen uptake of athletes..

### 2.2 12-Min Running Prediction Method

The 12-min running prediction method has a high comprehensive application advantage in the indirect determination method of the maximum oxygen uptake of the athlete, and the indirect determination method of the maximum oxygen uptake has only a single measurement scheme, but

due to the simplicity and convenience of the measurement process, the application ratio of the measuring method is high. The 12 minute running prediction method was put forward by Cooper of the United States in 1968. It is mainly used to measure the maximum oxygen uptake of athletes over 18 years old. In the actual measurement process, the specific test index is the distance that the athletes run in 12 minutes. The accuracy of the method is 90%. In the actual measurement process, stopwatch, maximum oxygen uptake extrapolation meter of 12 min running and other related measuring equipment are used. It is necessary to conduct the actual measurement of oxygen uptake of athletes in the 400 m track and field, and the measurement data recorded in the measurement equipment is used to complete the orderly derivation of the measurement results in the way of extrapolation table. The 12 min running prediction method involves less measuring equipment in the application process, which can meet the requirements of most athletes' oxygen uptake measurement needs and the specific requirements of the actual measurement site. Therefore, it has a high proportion of application in indirect determination of maximum oxygen uptake of athletes.

### **2.3 Step Index Estimation Method**

The step index conjecture method is an indirect method for determining the maximum oxygen uptake of athletes, which is independently studied and put into use in China. In the actual application process, the scientific measurement is mainly aimed at the athletes aged 17-27. The measurement results can be obtained according to the athletes' exercise time and the sum of the heart rate of 30 seconds after the first, second and third minutes of recovery. However, due to the lack of actual comparative analysis and scientific statistics, the accuracy of step index estimation method in indirect determination of maximum oxygen uptake of athletes is unknown. Therefore, in the test process with high accuracy, the step index extrapolation method is generally not used. This indirect method mainly includes 30-40 cm steps, weight meter, stopwatch, metronome, recorder and heart rate telemeter. After the athletes exercise reasonably, the sports data are counted and analyzed, the useless data and the wrong data are deleted, and then the statistical model of regression equation is used to export the measured results orderly. Step index conjecture method is commonly used in the actual application process of measuring equipment, the measuring site is more flexible, so it still occupies a large proportion of application in the actual process of indirect determination of athletes' maximum oxygen uptake.

### **2.4 Pwc170 Test Method**

The PWC170 test method has certain unity with the Astrid line diagram method in the practical application process, and it is also divided into two ways: step test and power bicycle test. The application object of this kind of athletes' maximum oxygen uptake indirect method is mainly athletes and general young people, and there is no specific requirement in age. Therefore, it has a older age span. In the specific test process, in order to ensure the accuracy of the measured results and data, the two measuring paths have certain differences in the measured indexes: the measuring indexes of step test mainly include power and heart rate, while the measuring indexes of power bicycle are including compound power, body weight and heart rate. According to the experimental analysis and scientific comparison, the actual measurement results of PWC170 test method have more than 90% accuracy. Among them, the step test method of PWC170 test method, the main test equipment includes 30-40 cm high steps, weight meter, stopwatch, metronome, recorder, heart rate telemeter. The measuring instrument of power bicycle mainly includes power bicycle (as shown in Figure 1), stopwatch, heart rate telemeter and weight meter. Finally, through refined data analysis and integration, the regression equation is used to complete the effective export of test results [1].



Fig.1 Power Bicycle

### 3. Applicability of Indirect Determination of Maximum Oxygen Uptake by Athletes

#### 3.1 Reliability

The paper mainly analyzed the Astrid line chart method, the 12-min running prediction method, the step index estimation method and the PWC170 test method. In order to further strengthen the application effect of the athletes' maximum oxygen uptake indirect method, the indirect determination result of the maximum oxygen uptake of the athlete can meet the need of the relevant personnel to understand the physical fitness and the sports potential of the athlete, and the maximum oxygen uptake indirect method of the athlete should be fully ensured to have higher reliability and accuracy, The reliability of the above-mentioned indirect measurement method for the maximum oxygen uptake of the above-mentioned athletes is analyzed in the following: the relevant personnel have obtained the relevant research results through the experimental investigation and the concrete practice. According to the experimental data, the two test paths of the step test and the power bicycle of the Ashland line chart method are 0.919 on the reliable coefficient, and the method for measuring the precision and the highest reliability in the four methods has the advantages of high reliability, The reliability coefficient of the 12-min running prediction method and the PWC170 test method is 0.9, and the step index estimation method can not perform the actual reliable coefficient test in the application process, so the reliability coefficient is not known, and therefore, the Ashland line graph method has a high application advantage in the reliability.

#### 3.2 Population

In the long-term application, the Astrid line diagram method, the 12-minute running prediction method, the step index estimation method and the PWC170 test method have a higher application proportion, and also have higher application advantages in the indirect determination of the maximum oxygen uptake of the Chinese athletes, Through practical analysis and specific application, it can be found that the indirect determination method has a specific measurement population, and the following description is given to it: the determination per person of the Ashland line graph method is mainly carried out for athletes between 15 and 60 years, and the age span is large, the highest oxygen uptake measurement requirement of the athletes of different age groups can be met, The prediction method is mainly aimed at the indirect determination of maximum oxygen uptake of athletes over 18 years old, while the step index estimation method is used to determine the maximum oxygen uptake of athletes aged 17 years and 27 years old, while the PWC170 test method is mainly aimed at the indirect determination of maximum oxygen uptake of athletes and young people. It can be seen that these four methods have significant differences in the applicable age. In the actual determination process, the athletes should be reasonably selected according to the age composition and the main age span, and the athletes should be comprehensively evaluated.

#### **4. Conclusion**

In a word, our country is in the critical period of sports development. In the actual training process of athletes, it is necessary to use the indirect measurement method of maximum oxygen uptake of athletes to reasonably measure and accurately evaluate the physical quality of athletes, In order to adjust the training program of athletes scientifically and ensure the sports safety of athletes. In the actual measurement, different methods should be selected scientifically according to the specific situation of athletes.

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