CUSTOMIZED AEROBIC EXERCISE PRESCRIPTION STRENGTH DETERMINATION METHOD BASED ON DECISION TREE

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Abstract - In this study, the relative exercise intensity was set by using the Heart Rate Reserve (HRR), and the maximum oxygen uptake was estimated for each exercise intensity section based on the data of 20 men. In this paper, we tried to determine the appropriate exercise intensity by comparing the maximum oxygen intake value measured using Decision Tree and the maximum oxygen intake calculated by the formula for estimation of exercise intensity using preliminary heart rate It is meaningful to suggest a reliable estimation range even at relatively low exercise load, and it will be useful for the development of personalized group and personalized exercise program that requires repeated exercise evaluation.

Keywords - Aerobic Exercise, CART, Decision Tree, Optical Weight, Exercise Prescription Strength

I. INTRODUCTION

In recently, most of the physical activity is changed to the sedentary lifestyle due to the development and urbanization of transportation, while the amount of physical activity is greatly reduced, while the overweight and obese population is increasing due to the overnutrition caused by the high-calorie food intake. Obesity is one of the leading causes of heart-related diseases, and it has been found to be a major cause of increasing the prevalence of chronic diseases such as hypertension, arteriosclerosis, angina pectoris, myocardial infarction, diabetes, and stroke [1] [2] [3]. Physical fitness is the ability to perform occupational, leisure, and daily activities without excessive fatigue and consist of cardiopulmonary endurance, musculoskeletal strength, and flexibility. Cardiopulmonary endurance among the components of physical fitness is known as an indicator of the overall state of physical fitness by the ability of the heart, lungs, circulatory system to effectively deliver oxygen and nutrients to the muscles to exercise. Cardiopulmonary endurance is a very important factor in exercise prescription and is assessed by measuring the maximum oxygen uptake or oxygen consumption during aerobic exercise [4]

Depending on the method of estimating the oxygen intake at exercise load, it can be divided into direct and indirect methods. The direct method is to analyze the gas used for breathing by wearing a mask during exercise, and the indirect method is an indirect method by calculation using data such as a change in heart rate and execution time during exercise. The direct measurement method has the advantage of having high reliability, but it is economically limited because it requires a trained equipment operator to calibrate and operate the equipment used for respiratory gas analysis, and high costs are required for expensive equipment operation. And has the disadvantage of inconvenient to wear instruments for gas analysis. Indirect estimation method is calculated by substituting variables generated during exercise using the oxygen intake estimation formula. The indirect method has the advantage that there is no need for gas analysis equipment because it does not perform gas analysis, but because it uses the estimated formula generated by statistical method for a specific group, the characteristics and environment of the group used for generating the estimated formula If this is different, an error occurs and it is less reliable than the direct method. Maximum oxygen intake is measured at the maximum exercise state, and high exercise loads are dangerous to the general public as well as those with weak physical fitness. In order to reduce the risks caused by high exercise loads, previous studies on the measurement of maximum oxygen intake at low intensity are limited to specific groups such as relatively high risk patients, the elderly, and children, and to establish the appropriate exercise intensity for the general public. . [5] It is very important to set the exercise intensity appropriate to the subject during the physical examination. If the exercise is too intense for the subject's ability, it will be terminated prematurely, and clinically important responses will not be obtained. On the contrary, if the exercise is too easy, the test will last longer and endurance rather than aerobic exercise.

Therefore, in this paper, we tried to determine the appropriate exercise intensity by comparing the maximum oxygen intake value measured using Decision Tree and the maximum oxygen intake calculated by the formula for estimation of exercise intensity using preliminary heart rate.

II. PROPOSED METHOD

2.1. AEROBIC EXERCISE PRESCRIPTION STRENGTH

It can be divided into absolute strength by distance, weight, angle, etc. and relative strength by the degree of body reaction from external load. Traditionally, exercise intensity can be expressed as an individual's

maximum oxygen intake, oxygen intake reserve, preliminary heart rate percentage, and maximum heart rate percentage.

(1) Maximum oxygen uptake

The oxygen uptake is the difference between the amount of oxygen dissolved in the blood flowing through the arteries and the veins, and the maximum oxygen uptake is the maximum of the oxygen uptake per unit time. Oxygen intake during exercise reflects the amount of energy produced by the muscle, which means that the greater the maximum oxygen intake, the more energy can be produced. The higher maximum oxygen intake is used as a measure of cardiopulmonary endurance because of the longer duration of higher intensity exercise.

(2) Oxygen intake reserve

Oxygen intake reserve is the difference between the oxygen intake in the steady state and the oxygen intake measured in the exercise state, and is expressed as the expression of the increased oxygen intake during exercise. Since the oxygen intake of the individual in the steady state is reflected, it can be used as an indicator of relative exercise intensity.

(3) Maximum heart rate (HRmax)

The maximum heart rate measured at maximum exercise load reflects the heart's functional limits. As the age increases, the maximum heart rate tends to decrease. If the maximum heart rate can not be measured, the maximum heart rate may be calculated as 220 - age.

(4) Heart Rate Reserve (HRR)

The preliminary heart rate is the difference between the maximum heart rate and the resting heart rate, which represents the range in which the individual heart rate can change, also known as the Karvonen method. HRR is reported to reflect better than HR. The HRR method can be used to set the target heart rate according to the intensity of exercise, and the target heart rate can be obtained using the following equation [6]. MET is a unit for energy consumption, and 1MET represents energy consumption in a resting state, which is the same as oxygen uptake at 3.5 mL / kg / min [7]. RPE is a numerical representation of strength based on your judgment. It has been reported that there is a possibility of estimating the maximum oxygen uptake in an appropriate environment although it is the intensity by subjective judgment. [8] Since the load that the body receives for the absolute exercise load is different for each individual, it is necessary to express the exercise load degree in a relative concept. In order to fit the notion of the adjective, which is considered by each individual, the adjectives used in daily life are expressed with numerals to distinguish the steps between the adjectives.

2.2. Exercise Prescription Strength Determination Method based on Decision Tree

In this paper, we tried to determine the appropriate exercise intensity by comparing the maximum oxygen intake value measured using Decision Tree and the maximum oxygen intake calculated by the formula for estimation of exercise intensity using preliminary heart rate. it is possible to use CART [9-22] based learning based on a combined examination method of biological information. The CART algorithm is Non-parametric Technique, which generates a classification or duration tree depending on whether the dependent variable is categorical or numeric. The CART algorithm generates a decision tree based on a splitting rule, but the basic idea of this partitioning rule is that the purest result child node (Child Node) among all possible partitions It is to choose a single split so that it can be obtained. Classification of Decision Making Using CART Algorithm The tree learning method can be defined by the following steps. Based on the above-described biometric information, the training data set for simulation is displayed with Maximum oxygen uptake W 1 Oxygen intake reserve W 2, Maximum heart rate W 3, Heart Rate Reserve Z class. Since the CART algorithm does not have a rule for termination (stop), the division procedure is repeated until it can not divide any further. The result of applying the CART algorithm shown in FIG. 1 to the learning data set of Table 3 can be expressed as shown in FIG.

Dm	W1	W2	W3	Z
D1	32	55	13	Z2
D2	37	65	15	Z1
D3	38	70	20	Z1
D4	33	58	15	Z2
D5	32	59	16	Z2
D6	33	60	19	Z2
D7	36	85	22	Z1
D8	37	90	19	Z1

Table 1- Training data set

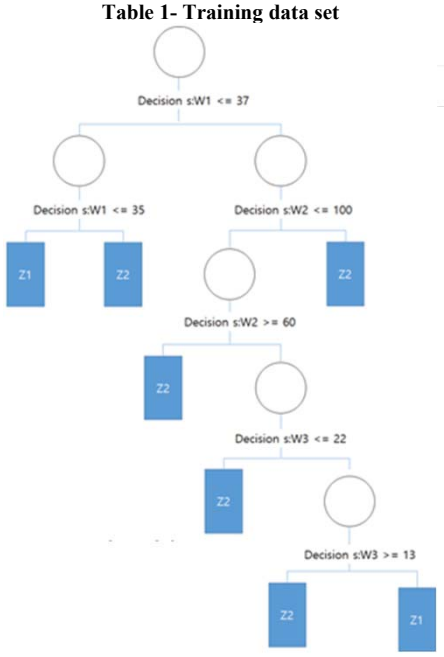


Fig.1 Final decision tree

Proposal in this paper The error matrix (Confusion Matrix) of the value simulated by constructing 50 kinds of random sets for the test data set for evaluating the diagnostic technique of the dangerous situation was calculated.

Confusion matrix	Proposed method
True Positive	43
False Positive	2
True Negative	44
False Negative	1

Table 2 - Confusion matrix result

It was possible to derive TP and TN with high error matrix calculation result and to check low numerical values of FP and FN indicating error.

III. CONCLUSIONS

In this study, the relative exercise intensity was set by using the Heart Rate Reserve (HRR), and the maximum oxygen uptake was estimated for each exercise intensity section based on the data of 20 men (26.9 ± 2.2). HRR was the value of the individual's maximum heart rate and resting heart rate, and the maximum heart rate was set by the '220-age' method. Experimental results showed that the maximum heart rate was similar.

the maximum heart rate calculated in the equation obtained using the graph. HRR was calculated at intervals of 10% in order to obtain the estimation equation based on the HRR that reflects the intensity of exercise. The HRR interval was increased from 0-60% to 0-90% by 10%, and the maximum oxygen uptake was calculated and compared with the measured maximum oxygen uptake. A significant estimation (error rate less than 10%) was possible up to 70% HRR,

(0-20% HRR) to increase the ratio of highly correlated data to estimate the maximum oxygen uptake in the HRR range of 20-70%. The error rate was reduced from 9.46 ± (8.34) d to 6.01 ± 3.40%.

In this paper, it is meaningful to suggest a reliable estimation range even at relatively low exercise load, and it will be useful for the development of personalized group and personalized exercise program that requires repeated exercise evaluation.

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