

Comparison of Two Methods of Prescribing Exercise Intensity during Cycling Test in Type II Diabetic Patients

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ABSTRACT

Introduction and Objectives: Recently, some studies have suggested that the America College of Sports Medicine (ACSM) guidelines on the relationship between exercise intensity index in healthy individuals are not applicable for certain groups of patients. This study aims to evaluate the relationship between two indicators of exercise intensity (%HRR and %VO₂max) in patients with type II diabetes and to compare it with the ACSM guidelines. **Methods:** For this purpose, 30 adult men with type II diabetes performed a standard exercise test on the stationary ergometer bike. Heart rate and consumed oxygen were calculated and recorded at each stage of the ergometry test. The values of heart rate and consumed oxygen measurements %VO₂max and %HRR were used at each stage of the test to calculate the said indicators. To determine the correlation pattern of the said indicators multiple linear regression analysis was used. **Results:** Statistical results showed that the correlation pattern between the two indices of %VO₂max and %HRR at each stage of the ergometry test was linear and statistically significant. In other words, the numerical values of %HRR overlap %VO₂max values at a certain level of ergometry test. **Conclusion:** Despite the contradiction between the findings regarding the correlation pattern between the two exercise intensity indices in healthy and patient populations, the findings of this study indicate the similarity model of the two indicators of exercise intensity in patients with type II diabetes to be similar to ACSM guidelines.

Keywords: Diabetes, Exercise intensity, Ergometer, Heart rate reserve.

INTRODUCTION

Scientific sources hold that exercise intensity is the most important component of any training program, particularly sports-rehabilitation and occupational therapy exercises used to improve and enhance cardiovascular fitness in healthy individuals and patients (1). Administering a training program that would not lead to health and clinical problems is one of the main objectives of coaches and occupational therapists. Therefore, devising a training program with appropriate intensity is the most important goals of this series. Scientific studies indicate that exercise intensity is the most important factor in maintaining and developing cardiovascular fitness (2). There are numerous methods to prescribe and control exercise intensity in training programs such as percentage of maximum oxygen consumption (%VO₂max), maximum heart rate percentage (%HRmax), heart rate reserve percentage (%HRR) and Borg scale (2).

Research evidence indicates that depending on certain confounding factors, these indices display a different degree or percentage of maximum exercise intensity which the body undergoes during exercise. Thus activity at any level (percentage) of any of these indices may be expressed by other indices with a different proportion of the maximum percentage of that index (2) and this would cause confusion among sports trainers and rehabilitation activities in developing an appropriate training program that is effective and free of side effects. In correlation pattern of any given pair of these indices, factors like age, body fitness level, the maximal or sub-maximal exercise intensities, cardiovascular condition and the ambient temperature are influential (1,3).

%HRR is widely used for prescription of exercise intensity in healthy people and in most cases as a factor determining the metabolic rate. The main reason is that it is easy to measure heart rate during exercise. Since in most non-laboratory cases it is impractical to measure oxygen consumption (VO₂) it is very difficult to control exercise intensity using %VO₂max. Hence, assuming there is a linear relationship between heart rate and oxygen consumption, heart rate measurements or in other words %HRR is used to determine exercise intensity. But often in laboratory tests metabolic rate is characterized by determining oxygen consumption (4).

American College of Sports Medicine (ACSM) states that to devise exercise programs for healthy individuals, %HRR and %VO₂max indices signify the same degree of intensity; while the findings of Simons about patients with Chronic obstructive pulmonary disease prove it otherwise (5). In a study on patients with cerebral palsy the regression model for each pair of indices was found to be inconsistent with ACSM exercise intensity guidelines (6). The findings of other studies in this area are also heterogeneous and arbitrary. A review of these findings demonstrate the remarkable impact of the type of disease

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in determining the correlation pattern and of these indices and imply that every disease depending on its effect on cardiovascular or neuromuscular system somehow disturbs the correlation pattern of these Indices. There are limited studies about the relationship between exercise intensity indices in diabetic patients. Hence, this study aims to identify the effect of diabetes on the pattern of relationship of the two indicators of exercise intensity (%HRR, %VO₂max) in diabetic patients and to compare it with healthy subjects.

METHODOLOGY

The statistics population consists of male with Type II diabetics in the city of Saveh. Statistical sample includes 30 males with Type II diabetics. All participants were informed verbally and in writing, as to the objectives of the experiments, together with the potential associated risks. All participants signed an informed consent document approved by the Research Ethics Committee of Azad University, Iran. Subjects included individuals with no cardiovascular diseases, gastrointestinal diseases, kidney and liver disorders or diabetes. In addition, if any of the people had been participating in regular exercise or diet program during the past 6 months, they were excluded study.

All subjects were non-smokers. After sampling and explaining YMCA test procedure to them, the steps of the project are performed on ergometry bike (Tunturi F90, Made in Finland) in the following manner:

After recording the resting heart rate of the subjects in a sitting position using a stethoscope, all subjects perform YMCA test (7) in the physiology lab. The test conditions are the same for all subjects. The said test includes four consecutive steps without resting intervals while the amount of work load increases through each step to the following step. The heart rates of the subjects are recorded in the last 15 seconds of each stage of the test by a Polar heart rate monitor (Telemetry). Pedaling speed at all stages of the test is 50 to 60 rpm. The oxygen consumption of each step of the test is calculated by the related equation. Maximum oxygen consumption is measured using a test specific pneumogram. Heart rate and oxygen consumption data of each stage of exercise are calculated and measured using both %HRR and %VO₂max indices. At the end a linear regression model is used to determine the relationship between %HRR and %VO₂max indicators during the exercise test.

RESULTS

This study aimed to identify the relationship between two exercise intensity indices: %VO₂max and %HRR in patients with Type II diabetes and compare it with the guidelines of American College of Sports Medicine. The results showed that the regression model between the numerical values of these two parameters is linear and that there is a significant positive relationship between their numerical values at any stages of exercise intensity in such a way that the resultant linear pattern of these two indices coincides with the line of best fit with only a slight difference. The linear regression equation between the two indices is: $\%VO_{2\max} = 0.83 \times \%HRR + 13.6$, $R = 0.88$.

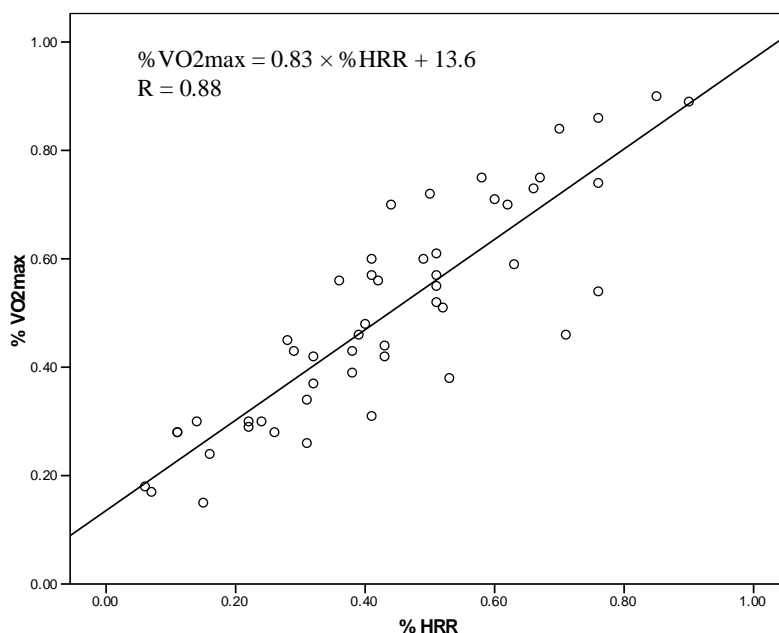


Fig 1: the relationship pattern %HRR in versus %VO₂max during cycling test in type II diabetic patients

DISCUSSION

Physiological benefits of exercise depend primarily on the intensity, duration and frequency of the training program. Exercise intensity is considered to be the main component of sports - rehabilitation programs in patients. It therefore seems that the pattern of exercise in each patient is to be devised individually according to the physical condition and the level of cardiovascular fitness lest it would bring about irreversible and irreparable consequences. Furthermore, some recent studies contend that the pattern of the training programs designed to improve cardiovascular fitness in healthy individuals are not applicable on patients especially those whose respiratory and cardiovascular systems have been affected due to the type of disease (3, 4, 5). One of the main reasons for this claim is the impact of medication they consume on their resting heart rate or their sub-maximal heart rate during exercise. Many diseases among which is Type II diabetes the use of drugs leads to changes in heart rate responses, including fluctuations (Increase or decrease) in the resting or exercise heart rate or in the maximum heart rate. The findings of Wonisch et al report significant reduction in resting heart rate and maximum heart rate due to taking beta blockers in patients with cardiovascular diseases (8). Also Colberg's and collegous findings suggest that due to taking certain drugs diabetics have higher resting heart rate and lower maximum heart rate than healthy people do and this would disturb the similarity pattern between exercise intensity indices (9). These factors bring about change or disturbance of the pattern of correlation between indicators in these patients, in such a way that ACSM model and guidelines regarding the concurrence of these indicators, which have been developed for healthy individuals, would be disturbed and the consequence of it would be prescribing sports or rehabilitation programs with inappropriate intensity for patients. Also the impact of the medication on heart rate affects prescribing training intensity based on %HRmax which is strongly dependent the heart rate. Therefore some researchers propose using %HRR method for these people and for that reason they have evaluated the correlation pattern of this intensity index with %VO₂max which is a basic method in devising training program. In this regard, ACSM claims that during exercise by healthy individuals, %HRR represents degrees of exercise intensity equivalent to the numerical values based on %VO₂max (10). Hence in many exercise programs this model is used to prescribe exercise intensity. But some recent studies consider it impractical to use the ACSM guidelines model for patients with low levels of physical fitness. The findings of this study also confirmed that the correlation pattern of the two indicators of %VO₂max and %HRR during exercise in patients with type II diabetes is consistent with ACSM guidelines. In other words, during exercise on ergometer bike by patients with type II diabetes the degree of exercise intensity in terms of %HRR are consistent with the numerical value of exercise intensity in terms of %VO₂max with only an insignificant slight difference. The overall conclusion of this study is that when it is not practical to control or prescribe exercise intensity by using %VO₂max method due to unfeasibility of measuring VO₂, using %HRR to prescribe training, would represent intensities equivalent to those of %VO₂max.

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