Relationship between Exercise Intensity Prescription Indexes in Diplegia Spastic Patients during Cycling

Short Running title

Exercise intensity prescription for spastic patients

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ABSTRACT

the American College of Sport Medicine (ACSM) assumes that a percentage of heart rate reserve (%HRR) provides the same intensity as the equivalent percentage of maximal oxygen uptake (\( VO_{2\text{max}} \)). Recently studies demonstrated that some factors particularly kind of disease are influenced the relationship between exercise intensity indexes. Objective: The purpose of this study was to determine relationship between exercise intensity indexes (%HRR, %\( VO_{2\text{max}} \), %\( VO_{2\text{reserve}} \)) in children with diplegic spastic cerebral palsy during ergometer submaximal test. Method: The subjects consisted of 25 individuals with spastic cerebral palsy (ages, 9-14 years) that participated by voluntarily in study. For each subject, HR and \( VO_2 \) at rest and at the end of each stage of exercise and at the end of exercise determined using Macmaster ergometry protocol that is submaximal and specific for children and used of those for calculation exercise intensity indexes. The correlation between this index determined via statitical SPSS. Results: The results of study showed that %\( VO_{2\text{max}} \) correspond to %\( VO_{2\text{reserve}} \) in each stage of ergometry protocol (r =0.99) and the correlation between the other indexes is lower. Conclusion: The data showed that for prescription exercise-rehabilitation program in spastic cerebral palsy patients, %\( VO_{2\text{reserve}} \) and %\( VO_{2\text{max}} \) are similar and relation between exercise intensity indexes in children with spastic cerebral palsy is different in findings in the other patients and normal elderly.

KEYWORDS: cerebral palsy, Exercise intensity, cycling.

INTRODUCTION

Exercise intensity is the main factor in exercise program particularly Rehabilitation program in normal people and the people that have disability and refers to the percentage of maximal energy for performing aerobic and anaerobic performance [1]. The scientific studies are showed that exercise intensity is the best factor in improving and developing of cardiorespiratory fitness [1,2,3].

Resltnly, for prescribing exercise intensity in normal people is used from the percentage of heart rate reserve method (%HRR) and that calculation is need to measuring the rest heart rate(\( HR_{\text{rest}} \)) and maximal heart rate(\( HR_{\text{max}} \)) and heart rate during exercise(\( HR_{\text{exercise}} \)). %HRR refers to a percentage of the difference between resting HR and maximum HR. The formula used to calculate target HR by the %HRR method is: \( \%\text{HRR} = \frac{HR_{\text{exercise}} - HR_{\text{rest}}}{HR_{\text{max}} - HR_{\text{rest}}} \) [4]. The main reason for using of this method in determine of exercise intensity is the easily in measuring of heart rate during exercise. For the because, the measuring of energy expenditure(\( VO_2 \)) is impossible in often cases non laboratory, thus due to line relationship between heart rate and \( VO_2 \) and it increases linearly with oxygen consumption, for determine of exercise intensity is used of %HRR method[4]. But, usually in laboratory cases is used from measuring of energy expenditure [4,5].

The method for for prescribing exercise intensity is the percentage of maximal oxygen consumption(\( %VO_{2\text{max}} \)) and that calculation is need to measuring the maximal oxygen consumption(\( VO_{2\text{max}} \)) and oxygen uptake during exercise(\( VO_{2\text{exercise}} \)). The formula used to calculate target \( VO_2 \) by the %\( VO_{2\text{max}} \) method is: \( %VO_{2\text{max}} = \frac{VO_{2\text{exercise}}}{VO_{2\text{max}}} \) [4].

The results of studies demonstrated these indexes(%\( VO_{2\text{max}} \) and %HHR methods) are difference depended on certain effective factors. So that, probably the range of exercise intensity is difference between these methods in each surface of exercise [1]. The American College of Sport Medicine (ACSM) assumes that a percentage of heart rate reserve provides the same intensity as the equivalent percentage of maximal oxygen consumption [6]. But the certain study reported conflict results [7,8,9]. The effective factors in difference between %\( VO_{2\text{max}} \) and %HHR are age, physical fitness, intensity in aerobic and anaerobic exercise, cardiovascular fitness and enviroment temperature [1,2].

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cardiovascular fitness, the more difference between these indexes. Increasing in cardiovascular fitness decreased different between these indexes in each surface of exercise. The early studies are showed that after six months aerobic exercise on adult that increased VO2max (18%) leads to higher relation between %VO2max and %HRR[10]. Thus, the jacisic study is supported of this theory[11].

Recently, the some scientific studies reported the other method for prescription exercise intensity particularly in patients that named percentage of oxygen consumption reserve(%VO2reserve) [3,5,9] and that calculation is need to measuring the rest oxygen consumption(VO2rest) and maximal oxygen consumption(VO2max) and oxygen consumption during exercise(VO2exercise). Similar to %HRR, %VO2reserve represents a percentage of the difference between VO2rest and VO2max. The formula used to calculate target VO2 by the %VO2reserve method is: %VO2reserve = \( \frac{VO2_{exercise} - VO2_{rest}}{VO2_{max} - VO2_{rest}} \) [4]. Swain et al are stated that the values of %VO2max and %HRR is not similar during exercise on cycle ergometer in each surface of exercise[9]. Thus, Recently some studies demonstrated that the values for %HRR do not correspond to the values of %VO2max rather it was shown that %HRR was equivalent to the values %VO2reserve[3,5,12]. The theory of Swain is stated that, in spite of high corellation between %HRR and %VO2max during exercise on treadmill, but the corellation between %HRR and %VO2reserve is higher significantly [2, 12].

Certain studies showed that when prescribing exercise to patients with heart disease based on VO2, relative intensity should be given as %VO2reserve [4]. Recently some studies demonstrated that some factors such as age, physical or cardiovascular fitness particularly kind of disease are influenced the relationship between exercise intensity indexes [1,2,13]. Sheri et al showed corellation high significantly between %HRR and %VO2reserve during exercise in patients that had spastic cerebral palsy during ergometer submaximal test by means of prescription the exercise-rehabilitation program with exercise intensity suitable for these patients.

**MATERIALS AND METHODS**

Methods: The subjects consisted of 25 individuals with spastic cerebral palsy (ages, 9-14 years) that participated by voluntarily in study. The intensity of spastisity in patient children was average to severe or three degree according to ashword scale [14]. The subjects inhibited of performing exercise and eating that having nutritive value before ergometry protocol. For each subject, HR and VO2 at rest, at the end of each stage of exercise and at the end of exercise determined using McMaster ergometery protocol on Tunturi cycle ergometer(E 604, finland) that is submaximal and specific for children [15] and used of those for calculation exercise intensity indexes. The ergometry MacMastor protocol is performed in 4 stages and time for each stage is 2 minute that after performing of each stage workload is increased according to protocol. The heart rate of each stage of protocol is recorded in 15 second end of that stage by polar telemetry. After collection of the all data, relationship between these indexes calculated by regression in statically spss and formula of the each even of indexes is calculated.

**RESULTS**

The findings showed that in these patients the correlation between %VO2max and %VO2reserve is perfectly lineally and regression equation is %VO2reserve=1.023x %VO2max – 3.99 (R=0.99). Therefore percentage of maximal oxygen uptake (%VO2max) provides the same intensity as the equivalent percentage of maximal oxygen uptake reserve (%VO2reserve) (Figure 1).

Thus, the results showed that the correlation between %HRR and %VO2reserve is lineally, but Correlation Coefficient between those is significantly lower. The regression equation between these indexes is %VO2reserve=1.055x %HRR – 18 (R=0.91) (Figure 2).

The results indicated that the correlation between (%HRR , %VO2reserve) and (%HRR , %VO2max) are similar, so that the correlation between %HRR and %VO2reserve is also lineally, but Correlation Coefficient between those is significantly lower. The regression equation between %HRR and %VO2max is (%VO2max=1.034x %HRR – 13.8 , R=0.92) (Figure 3).
Figure 1: Relation of change in percent maximal oxygen uptake reserve (\%O2R) and change in percent maximal oxygen uptake reserve (\%VO2max) in spastic children during MacMaster ergometry protocol.

Figure 2: Relation of change in percent maximal oxygen uptake reserve (\%O2R) and change in percent heart rate reserve (\%HRR) in spastic children during MacMaster ergometry protocol.
DISCUSSION

Karvonen (1957) demonstrated a method for determine of exercise intensity that refers to a percentage of the difference between resting heart rate and maximum heart rate [16]. He introduced this method as percentage of heart rate reserve (HRR) and used from that for prescribing exercise intensity in exercise and rehabilitation programs in normal people and patients with disability(3). Besides, American College of Sport Medicine (ACSM) assumes that during exercise the changes in %HRR is similar to %VO2max that supported by some researchers in physical education that this method also numerous used in often scientific studies. But recently, some studies are stated during exercise or activity on cycle ergometer the values of %HRR is not equivalent to %VO2max rather it was shown that %HRR was equivalent to the values %VO2reserve(17).

The findings of our study are demonstrated that in each surface of activity during aerobic exercise in patients with cerebral palsy spastic, the values of two exercise intensity indexes included %VO2max and %VO2reserve are equivalent and with enhancing exercise workload lead to increasing relationship and correlation between these indexes. The results are showed that the values of %HRR is difference with two other indexes(%VO2max and %VO2reserve) that according to the findings of Miler et al on obesity men and women(18). Probably, the reason of this phenomenon is in the effect of disturbance in neuromuscular on cardiovascular system. Therefore, the results of our study and the other studies(18,19) are suggest that the relation between exercise intensity indexes depend on physical fitness and kind of disease is different and determine of relation between these indexes is main factor for prescription intensity of exercise program particularly exercise-rehabilitation program in disability patient.

REFERENCES