

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_{2Max}). 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_{2Max} , % $VO_{2Reserve}$) 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 indexs determind via statical SPSS. **Results:** The results of study showed that % VO_{2Max} is correspond to % $VO_{2Reserve}$ 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, % $VO_{2Reserve}$ and % VO_{2max} are similar and relation between exercise intensity indexes in children with spastic cerebral palsy is different to 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].

Resntly, 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_{rest}) and maximal heart rate(HR_{max}) and heart rate during exercise($HR_{exercise}$). %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: $\%HRR = \frac{HRe xercise - HRrest}{HRmax - HRrest}$ [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_{2max}) and that calculation is need to measuring the maximal oxygen consumption(VO_{2max}) and oxygen uptake during

exercise($VO_{2exercise}$). The formula used to calculate target VO_2 by the % VO_{2max} method is: $\%VO_{2max} = \frac{VO2exercise}{VO2max}$ [4].

The results of studies demonestrated these indexes(% VO_{2max} and %HRR methods) are difference depnd on the 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_{2max} and %HRR are age, physical fitness, intensity in aerobic and anaerobic exercise, cardiovascular fitness and enviroment temperature [1,2]. The lower

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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 jacsic study is supported of this theory [11].

Resently, 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 = $\frac{VO_{2exercise} - VO_{2rest}}{VO_{2max} - VO_{2rest}}$ [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 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 in diabetic patients[5]. Therefore, the purpose of this study was to determine relationships between exercise intensity indexes (%HRR, %VO₂Max, %VO₂Reserve) in children with diplegic 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 ergometry 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=1.023× %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=1.055× %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 %VO₂max is also lineally, but Correlation Coefficient between those is significantly lower. The regression equation between %HRR and %VO₂max is (%VO₂max=1.034× %HRR – 13.8 , R=0.92) (Figure 3).

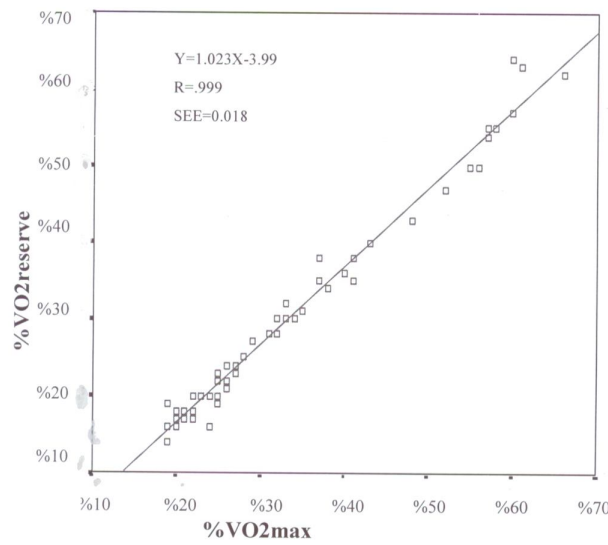


Figure 1: Relation of change in percent maximal oxygen uptake reserve (%VO₂R) and change in percent maximal oxygen uptake (%VO₂Max) in spastic children during MacMaster ergometry protocol.

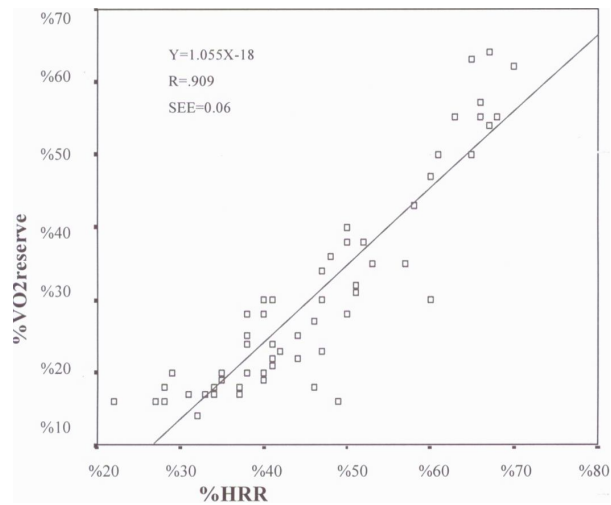


Figure 2: Relation of change in percent maximal oxygen uptake reserve (%VO₂R) and change in percent heart rate reserve (%HRR) in spastic children during MacMaster ergometry protocol.

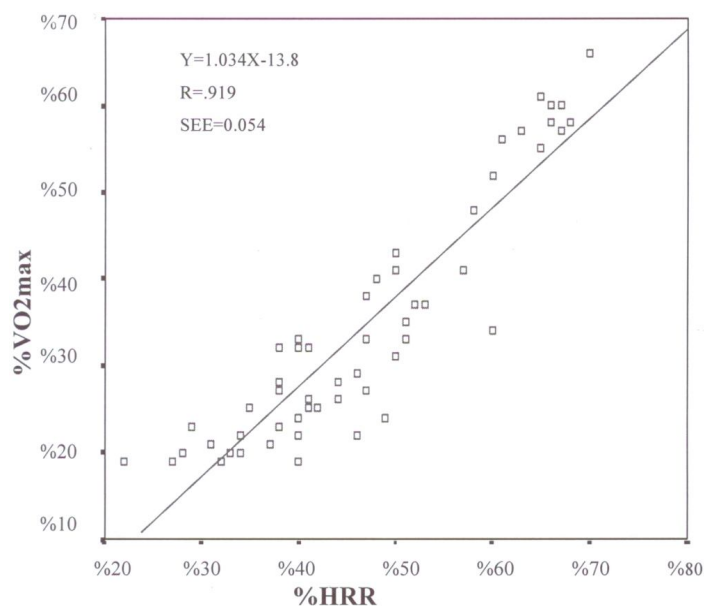


Figure 3: Relation of change in percent maximal oxygen uptake reserve (% $\dot{V}O_{2max}$) and change in percent heart rate reserve (%HRR) in spastic children during MacMaster ergometry protocol.

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 program 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 % $\dot{V}O_{2max}$ that supported by some researcher 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 % $\dot{V}O_{2max}$ rather it was shown that %HRR was equivalent to the values % $\dot{V}O_{2reserve}$ [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 % $\dot{V}O_{2max}$ and % $\dot{V}O_{2reserve}$ 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(% $\dot{V}O_{2max}$ and % $\dot{V}O_{2reserve}$) 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.

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