Assessment of The Validity of McArdle Step Test for Estimation Oxygen Uptake (Vo2max)

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Abstract

The purpose of this study is to assess the suitability of the McArdle step test for determine maximum oxygen uptake in male students. For this purpose we randomly selected thirty male students of Shiraz University, with mean age, height, and weight of 22.6 year, 166.4 cm, and 56.9kg, respectively. Vo2 max of each participant was determined by shuttle run test and also by applying McArdle test within an interval of seven days between the tests. The mean of Vo2 max subjects were 45.53 (ml/kg/min) in Shuttle run (20 m) test and 44.53 (ml/kg/min) in McArdle step test. Also, the results show that Exhibited significant statistical correlation (r=0.71, p<0.001) between the two tests. The result suggest that McArdle step test can be applied in the studied population to produce a good estimation of maximum oxygen uptake, specially in the field where large numbers of participants are to be evaluated without a well equipped laboratory.

Keywords: Vo2 max, McArdle step test, Male university students, Shuttle run test.

Introduction

Cardio respiratory fitness is in fact the capacity of heart, lung, blood vessels to brought the oxygen and food for muscles during Specific time (Rogers, 1990). Uncouthly, much of the victories and resist ration of records in sport competitions and also having physical healthiness is due to cardiorespiratory fitness which in directly related to efficiency of cardiorespiratory and the rate of maximum oxygen consumption of person (Asadmanesh, 1997). Maximum oxygen consumption is one of the parameter of resistance performance (Satpally, 2005). Vo2max is the maximum amount of oxygen that a person consume during maximal exercise and many expert of sport sciences have an announced it as a method for evaluating aerobic fitness and as factor for predicting the success of athletes in resistance activities. Various methods have designed for measuring Vo2 max either in laboratory or in field. Although the methods in laboratory has high validity and precision, but because of its high costs and many expe...
1972). Also, Zwiren (1991), reported 73% of correlation coefficient for this test and that of VO2 max of treadmill. According to the fact that each of these tests in performed in different procedure and each of them requires specific instruments and equipment which can be not at access. So, this research is pursuing top show to which extent, these two tests in determining VO2 max have correlation. In other words, the most accurate assessment of aerobic capacity is the direct measurement of maximum oxygen uptake (VO2 max) during a graded exercise test. However, despite its level of accuracy, direct measurement of VO2 max is primarily reserved for the laboratory setting because of the cost of the equipment, the need for trained technicians, and the inability to test large numbers of people at one time. For these reasons, the aim of this research is to compare and show the different of the result of VO2 max of male students of Shiraz University by these two tests (20 meter shuttle run test and McArdle step test).

**Methodology**

The study was an experimental research. Since the study was performed on human beings, so all variants were not controllable. The research method was half empirical. The static society composed of all male students of Shiraz university who were passing general physical education and among them 30 male student, with mean age, height, and weight of 22.6 year, 166.4 cm, and 56.9kg, respectively, were randomly selected as a static sample. First all of the information of their physical status, their medical and sport background was gathered by questionnaire. Then, the information regarding their cardio respiratory capabilities measured by utilizing two kinds of tests were statically analyzed on the basis of hypothesis of the study. Description of Shuttle run (20 m) test: This test involves continuous running between two lines 20m apart in time to recorded beeps. For this reason the test if also often called the 'beep' or 'bleep' tests. The time between recorded beeps decrease each minute (level). There are several versions of the test, but one commonly used version has an initial running velocity of 8.5 km/hr, which increases by 0.5 km/hr each minute (Zahrayee, 1996).

**Scoring:** The athletes score is the level and number of shuttles (20m) reached before they were unable to keep up with the recording. This score can be converted to a VO2 max equivalent score using calculator and also an estimation of VO2 max can be calculated form the test results, using the formula below (Ramsbottom, 1988):

\[
VO_{2}\text{max (ml/kg/min)} = 31.025 + 3.238 \times \text{Speed} - 3.248 \times \text{Age} + 0.1536 \times \text{Speed} \times \text{Age}
\]

Description of McArdle step test: The athlete steps up and down on the platform at a rate of 22 steps per minute for females and at 24 steps per minute for males, for a total of 3 minutes. The athlete immediately stops on completion of the test, and the heart beats are counted for 15 seconds from 5-20 seconds of recovery (Zahrayee, 1996). Scoring: an estimation of VO2 max can be calculated form the test results, using the formula below (McArdle, 1972):

\[
VO_{2}\text{max (ml/kg/min)} = 111.33-0.42 \times \text{Heart Rate}
\]

It should be noted that of tests were performed separately in two weeks and subjects performed the tests at a same day in each week and at the same time.

**Data analysis**

The data were analyzed using SPSS 11.5 with Pearson’s coefficient of correlation and statically significance was set at P ≤ 0.05.

**Results**

The Mean and standard variation of Maximum oxygen uptake resulted from two tests-20 meter shuttle run test and McArdle step test is presented at table1. The mean of VO2 max subjects were 45.53 (ml/kg/min) in Shuttle run (20 m) test and 44.53 (ml/kg/min) in McArdle step test. Also the Variance of VO2 max estimation between McArdle step test and shuttle run (20m) is represented by figure 1. The results of analysis of data represented significant correlation \((r=0.71, p<0.001)\) between 20 meter shuttle run test and McArdle step test in assessing maximum oxygen uptake. As table 2 shows, correlation coefficient is \((r=0.71, p<0.001)\) and there is significant correlation between 20 meter shuttle run test and McArdle step test.

<table>
<thead>
<tr>
<th>Shuttle run(20 m) test</th>
<th>McArdle step test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>45.5341</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>6.2075</td>
</tr>
<tr>
<td>Sample number</td>
<td>30</td>
</tr>
</tbody>
</table>

| Table2. Correlation between VO2 max estimation between McArdle step test and shuttle run (20m). |
|-------------------------------|-------------------|
| Result | P-Value | Correlation coefficient |
| Significant | 0.000 | 0.71 |
Figur1. Variance of Vo2 max estimation between McArdle step test and shuttle run (20m).

Discussion and Conclusion

Finding of present study regarding McArdle step test represent a significant correlation (r=0.71) between this test and that of 20 meter shuttle run test. But there is differences between correlation coefficient of this study and that of other studies, such as Zwiren (1991) (McArdle step test and treadmill r=0.51). The reason of such difference can be the age and gender of subjects. In a research directed by Gay (2004), the validity of step test in studied in comparison with ergo-meter bicycle test for measuring maximum oxygen consumption (Vo2 max) and there are was not a significant difference results. According to this result, it is purposed that step test can be used for measuring maximum oxygen consumption (Vo2 max) in studying samples (Chatter, 2004). The other study directed by Satipati (2005) to evaluation the validity of step test for estimating maximum oxygen consumption (Vo2 max) of female student. At the end, they realized that in big samples, the step test can be used to estimate the maximum oxygen uptake, where there is no access to well equipment laboratory. Buckley et al., (2004) evaluated the validity and reliability of step test for estimating the maximum oxygen uptake (Vo2 max). The result showed that there are was not significant differences of Vo2 max between the groups. Rodgers et al., reported significant relation between the result of (Vo2 max) of step test and running on treadmill and shuttle run (Rogers, 1990).

The finding of current study show significant correlation with that of other studies. Although there is a difference between correlation coefficient of this study and that of others in some cases, but there differences are not high and significant. The main reasons for these differences are related to age, gender and the differences of characteristics of subjects. In conclusion, the finding of current study reported a significant and direct correlation between two tests, McArdle step test and 20 meters shuttle run test, for estimating the maximum oxygen uptake (Vo2 max). Accordingly, it can be suggested that these two tests can be used substituted. Whenever it is impossible to perform 20 meter shuttle run test we can substitute other tests such as McArdle step test.

References


