Rockport and Queen exercise tests validity for estimation of VO2$_{max}$ in east Azerbaijan male Karatekas

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ABSTRACT

Since, estimation of VO2$_{max}$ is an important index for high level performances in training and competition periods, this study was done in order to identifying validity of Rockport and Queen exercise tests for estimation of VO2$_{max}$ in east Azerbaijan male Karatekas. Fifteen male elite karate competitors in east Azerbaijan [aged 19.4±2.02 years, BMI 21.45±2.84 Kg/m^2] were voluntarily participated in this study. VO2$_{max}$ of the subjects were separately measured by standard (Balke treadmill) and field (Rockport & Queen) exercise tests. Data were statistically analyzed by correlation and one-way ANOVA methods. Relationship between estimated VO2$_{max}$ in laboratory and field exercise tests was statistically significant ($r_{BR}^{1} = 0.525$, $r_{BQ}^{2} = 0.626$, $p \leq 0.05$). In addition, Relationship between estimated VO2$_{max}$ in laboratory and recovery heart rate in field exercise tests was statistically significant ($r_{BR} = -0.747$, $p \leq 0.001$; $r_{BQ} = -0.626$, $p \leq 0.012$). However, estimated VO2$_{max}$ in Queen Step test was slightly underestimated (%13.60) from two other tests ($F = 15.37$, $p \leq 0.00001$). Our results show that Rockport and Queen Exercise tests were valid for estimation of VO2$_{max}$ in male elite karate competitors. Although, estimated VO2$_{max}$ in Queen Step test was slightly underestimated from two other tests. However, estimation of VO2$_{max}$ could predict using provided linear regression equations.

Key words: Validity, Karate, Balke treadmill test, Rockport and Queen Tests, VO2$_{max}$.

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INTRODUCTION

Evaluation of physical –mental characteristics of athletes is one of the most important factors to achieve high athletic performances during training and competition. Exercise physiologists along with fitness experts, are always trying to evaluate physical and physiological condition of athletes by using different tests, in order to provide appropriate training programs at a special time period [19]. However, assessment of cardiovascular fitness or aerobic power, as the most fundamental element of physical fitness, have specific characteristics [1,2,10,21,27,28].Direct assessment of aerobic power or maximal oxygen uptake is used as a reliable indicator for determining the physical fitness situation in most sports, including karate [8].Due to the necessity of using modern equipment and employing experts, direct determination of aerobic power or maximal oxygen uptake is less being used[2,14,20,21].Thus measurement of maximal oxygen uptake would not be available for all[28].In the other words, sport scientists and coaches are always trying to provide simple and valid tests, in order to evaluate many athletes simultaneously with

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lower cost and greater ease[8,10,26].So far, standard and valid tests such as: Balke, Bruce and Asrand-rhyming has been designed to estimate maximal oxygen uptake [1,7,9,10,17,19,27,28].However, the high cost used for providing necessary equipment and facilities, have limited the coaches opportunity to measure all of them simultaneously. Therefore, some tests estimate the maximal oxygen uptake by the help of simple performance indicators, such as walking time and heart rate after exercise. Rockport and queen step tests are among the simple tests which because of their simplicity can be used simultaneously for a large group of people[1,9,15]. As, no detailed study has been done so far, about the validity of Rockport and Queen step tests in karate - which is a popular and honorable sport in Iran, this study aims to evaluate validity of these tests in estimation of maximal oxygen uptake in male karatekas, by using Balke standard test.

MATERIALS AND METHODS

This research was done as a descriptive – corelational one to determine the relationship (synchronization) between the main variables on the 15 volunteer Karatekas who have been invited to the Karate team camp in East Azerbaijan in 2005 (with the average age of $19/40\pm2/02$ and BMI $21/45\pm2/84$ kg/m^2)(table number 1).However, in addition to measuring key variables, a few of fitness and body composition indicators including body fat percentage and BMI along with some physical characteristics of the subjects were estimated to determine the level of physical fitness and homogenization of the subjects, local muscular endurance(sit-up and pull –up), agility (running 4×9 m), power (sergeant vertical jump) and flexibility(sit and reach) tests were used. Then the relationship between criterion and prediction variables was determined by using a nonparametric test (spearman).Because the number of subjects were less then 30.However, according to the scale of the variables , the Pearson correlation test was to evaluate relationship between the variables of this study. Finally, the difference between the estimated values of all three tests from ANOVA and post hoc tests (Tukey and LSD)were evaluated. Also, given the scale of the variables, the results obtained from all three tests were compared separately and two by tow, using paried t-test . All the statistical operations were done at the significant level of 5 percent by using SPSS 12 and Excel software's.

RESULTS

Research findings with regard to spearman assumptions indicated that there is a significant relationship between the estimated oxygen uptake by Balke test and Rockport and Queen Step tests (Rockport r= 0/525, p≤ 0/045 and Queen r= 0/625, p≤ 0/012) (table 3). In addition, Relationship between estimated VO2$_{max}$ in laboratory and recovery heart rate in field exercise tests was statistically significant ($r_{BR=}$ -0.747, p≤0.001; $r_{BQ=}$ -0.626, p≤0.012).This was also confirmed by Pearson parametric test. To ensure the estimated values of maximal oxygen uptake by both the field tests, differences of three tests were simultaneously analyzed by using ANOVA test. Despite the significant correlation between test results ANOVA test results indicated that the estimated amount of maximal oxygen uptake by all three tests varies significantly (table 2&4). Because the value of observed F(F= 15/37) at the significant level of 0/001 is much underestimated than the critical value. Since only overall differences are to be determined in ANOVA test, post hoc Tukey and LSD tests were used to determine homogenous groups. The findings of both tests indicate that the results of Queen Step test despite the significant relationship with other groups , are different. Moreover, the difference between the results of all three tests were evaluated two by two, using paired t-test. The results of this test also indicated that there is no significant difference between the estimated maximal oxygen uptake of Rockport and Balke tests. But the estimated average by Queen and Balke tests are significantly different. The results of this test, confirmed the results obtained by ANOVA and post hoc tests. In total, the obtained findings show that both the field tests are valid for measuring and comparison of aerobic power in male karatekas. But the mean maximal oxygen uptake estimated by the Queen and Balke tests show that the value estimated by the Queen test is significantly underestimated from Balke treadmill test (%-13/60). However, considering the relationship of both tests , we can estimate the maximal oxygen uptake of male karatekas by using regression equations derived from the results of Queen and Balke tests[V0$_{2max}$ Balke= 9/87+(0/82×Vo$_{2max}$ Rockport) and V0$_{2max}$ Balke= 37/67+(0/39×Vo$_{2max}$ Queen)].

Table 1- The mean and standard deviation of personal traits and recovery heart rate tests of subjects.

Queen recovery heart rate	Rockport recovery heart rate	Fat percentage	Weight (Kg)	Height (m)	Age (years)	
147/73	153/23	14/79	68/20	1/78	19/40	mean
14/95	11/88	3/21	10/03	0/03	2/03	Standard deviation

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Table 2-The amount of Vo$_{2max}$ estimated by Rockport, Queen and Balke tests.

Variance	Mean	Sum	Number		Tests
6/24	57/62	864/23	15	Vo$_{2max}$	Rockport
39/42	49/28	739/23	15		Queen
17/75	57/04	855/69	15		Balke

Table 3-The relationship between the Vo$_{2max}$ estimated by Balke test with recovery heart rate and estimated Vo$_{2max}$ of Rockport & Queen tests.

Recovery heart rate		The estimated maximal oxygen uptake			
Queen test	Rockport test	Queen test	Rockport test		
-0/626	-0/747	0/626	0/525	Correlation coefficient (r)	Balke Vo$_{2max}$
0/012	0/001	0/012	0/045	Significant level	

Table 4- One-way ANOVA test to determine differences between Vo$_{2max}$ estimated by different tests.

Critical F	P-value	Observed F	mean square	df	Sum of squares	Source of variance
3/22	0/00001	15/37	324/95	2	644/91	Between-group variance
			21/14	42	887/73	Within-group variance
				44	1537/63	The total variance

DISCUSSION

The results of this research suggest that there is a significant and positive relationship between the estimated maximal oxygen uptake from Balke treadmill test and Rockport walking test (p≤o/o45 , r=0/525).In addition, the significant relationship between Rockport recovery heart rate and the maximal oxygen uptake estimated by Balke test, confirm the above findings(p≤0/001,r=-0/747). The correlation coefficient, obtained by Rockport and Balke tests is somewhat lower while confirming the previous studies [4,6,7,11,12,13,14,16,20,22,25,26].For instance, Mc Carron RF et al obtained high correlation coefficient (r=0/92) on 343 individuals (165 male , 178 female) with the average age of 30 to 69 years [22].But in the present study, only 15 trained elite male karatekas with the average age of 19/4 years participated. By comparing Pober and Zwirens study, this becomes more clear [6,16]. Because both studies have been done by using old and untrained subjects. So that, Zwirens group reached to a positive and significant relationship(r=0/73) between the estimated maximal oxygen uptake obtained by treadmill and 1mile walking test, only by the study on 38 females of 33 years old [16].While Pober et al by the study on 304 subjects (154 males and 150 females) aged averagely 57/6 years, achieved a much more higher reliability(r=0/96)[6]. This probably depends on the physical condition, age and large number of subjects, participating in research. In other words, sex differences and physiological differences due to aging of the subjects can influence the outcome of contradictory results. In fact, it should be pointed out that the numbers of subjects have affected the reduction of sampling error and relatively the observed high correlation coefficients and validity of Rockport test in previous studies. Because the number of subjects used in previous studies have been reported mostly more then 30 and even in some cases more than 300 people. While the number of subjects used in this study is less than 30.

On the other hand, effects of IQ and mental readiness of the subjects on correlation coefficient of field and criterion test cannot be overlooked [4,13,14,25]. The results of Perkins and Kittredge study on the untrained and mentally retarded subjects confirmed this[13,14].However, given the above contents, it seems that Rockport test is more valid for estimating maximal oxygen uptake of untrained, mentally retarded and older subjects. But this point should be considered that, according to the results of this study, Rockport test is proper and valid for sport elites, especially karatekas, trained, active and young subjects. George et al and Tabarsa et al also confirm the relatively high validity of Rockport test for estimation of maximal oxygen uptake [11,12].

The findings of Queen test suggest that, there is a positive and significant relationship between the maximal oxygen uptake of Balke treadmill test and Queen step test (p≤0/012).In addition, significant relationship of Queen test recovery heart rate and maximal oxygen uptake estimated by Balke test, confirm the above findings(p≤0/012, r=-0/626).In other words, the above findings, confirm the results of previous studies, indicating that there is a significant relationship between the standardized tests and Queen step test[5,16,23,24]. However, the obtained correlation coefficient of this study is slightly underestimated from the Zwiren et al study[16]. Probably,the differences related to the sex and age of the subjects is not without effect on the observed high coefficient. In this regard, Chatterjee et al their study on 40 inactive female university students, mean age 21/9 years, achieved a

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relatively high negative correlation(r=-0/83) between the heart rate of recovery period in Queen test and maximal oxygen uptake estimated by direct ergometer test[23]. However, the type of criterion test, number, age, sex and fitness level of subjects are different. For example, the criterion test in Chatterjee study was ergometer test[23]. While the validity of Queen test in this study was determined by valid Balke test. The amount of maximal oxygen uptake estimated by treadmill test is always more than that of the ergometer[8,13]. So, it wouldn't be far from the minds that, correlation coefficient achieved by criterion test of treadmill be slightly underestimated from the ergometer test. The results of Chatterjee et al study on the relationship between the estimated maximal oxygen uptake and heart rate of recovery period in 30 inactive male university students ,mean age 22/6 years (r= -0/96), confirm this[24]. Furthermore, the results obtained by Khorshidi study on male students (age 16-17 years)(r= 0/87) confirm the above findings too[5]. Thus, the differences between age, sex, criterion test, number of subjects and fitness level of participants, may be the main factors related to the relatively low observed relationship in this study. So that, the subjects who had participated in previous studies .considering fitness level were inactive and untrained. While in this study, elite Karatekas were used.

CONCLUSION

In total, based on this research's findings and comparison with other studies, it can be concluded that Rockport and Queen tests are appropriate and valid for assessment of aerobic power in male Karatekas. Accordingly it can be offered to the Karate coaches to estimate maximal oxygen uptake or aerobic power of their athletes by using specific formulas and regression equations .

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