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The Relation Between Anaerobic Power and Rowing Ergometer Performance of Elite Rowers

Turgay OZGUR[1*], Bahar ODABAS OZGUR[2], Yusuf CELIK[3]

Tayfun GULER[4], Tacettin BUYUKDEMIRTAS[5]

[1] *Kocaeli University Physical Eduacation and Sport Hihgschool Trainer Education Department*
[2] *Kocaeli University Physical Eduacation and Sport Hihgschool Recreation Department*
[3] *Dicle University, Medical Faculty, Department of Biostatistics and Medical Informatics*
[4] *Kocaeli University Physical Eduacation and Sport Hihgschool Trainer Education Department*
[5] *Kocaeli University Physical Eduacation and Sport Hihgschool Sport Management Department*

Abstract

Background: *The aim of this study is to determine the relation between anaerobic power outputs and 2000 meter rowing ergometer scores.*

Method: *Randomly selected nine elite youth male rowers participated in the current study. Modified Wingate test and 2000 meter rowing ergometer tests were applied to subjects using Concept II-D rowing ergometer. The results of the study was discussed by the anaerobic power outputs, the time for 500 m intervals at a 2000 m rowing ergometer performance and some anthropometric variables.*

Results: *Data were presented as mean and SD for description porpuse. Variables were analysed and correlation coefficients were calculated by using Sperman's Corelation. As the result; significant and high negative correlation between 2000 m ergometer performance and mean anaerobic power was found (r = - 0.837; p = 0.005).*

Conclusion: *It has been understood that anaerobic energy system whereby the energy requirements at start and finish stages during 2000-mt performance and aerobic system are important complements of racing performances of rowing athletes.*

Keywords*: Rowers, Anaerobic Power, Wingate*

* Corresponding author: E-mail: tozgur@kocaeli.edu.tr, tlf; +90 (262) 303 36 16

Introduction

Olympic rowing races are conducted over a 2000-mt distance. The race lasts between 320 seconds 460 seconds. The development of rowing ergonometries has significantly contributed to performance as a control and reproducable mean.[1, 6]

2000-mt performance in rowing ergometry is limited with functional capacities of both aerobic and anaerobic energy systems. In 2000-mt performance, anaerobic energy system is 25-35 % effective.[18,19] Physiologic studies have shown that subjects have higher power values at high VO_2max, high rate of slow twitch fibres, and 4 mmol lactate concentration.[2, 4,5,9,10,13,16] Kramer and et al.(1994) have identified that among many other parameters VO_2max reflected the highest correlation with performance. Regression analysis showed that VO_2max alone provides a good predictor in estimate of 2000-mt performance.

The findings of researchers about effects of anaerobic system on 2000-mt performance show variations. Some studies report 10-20% effect, while others talk about 20-30% effect. Hartmann (1987); Droghetti and et al., (1991) reported that 2000-mt performance occured 65-75% percent aerobic and 25-35% percent anaerobic. This contribution of anaerobic metabolism indicates that glicosis and ATP- creatine phosphate played and important role. Rowers have a higher muscle endurance compared to others. Particularly their fat-free body weights are determinant in their performances.

Rowing is a sports defined as “power endurance”, as well as VO2max is a determinant in rowing performance. Therefore a bigger power production and a higher anaerobic metabolism may contribute to performance, since rowing lasts shorter compared to other endurance sports and requires slower muscle contraction speed. Riechman and et al. 2002 found that 75.7 % of the variation in 2000 m indoor rowing performance time was predicted by peak power in a rowing Wingate test for female rowers. Within the light of studies, assessment of the relation between 2000-mt rowing ergometry performance and anaerobic power for men rowers has gained importance. In addition, it is also important that atheletes are tested using their own equipment and environment conditions. Modified Wingate Test has been used to measure anaerobic power outputs of subjects.

The purpose of this study is to investigate the correlation between anaerobic power outputs and 2000-mt rowing ergometry scores.

Materials and Methods

Study Group

Study group consists of nine elite rowing athletes in young age catagory. All measurements of the study group have been done in special preparation period of their training program. A signed document was taken about their injury background and voluntary participation to the study from each subject. All experimental procedures were conducted in exercise physiology laboratuary of Kocaeli Univercity Exercise Physiology Labrotary. Measurements were taken in an athmosphere of 18C and 57% humidity.

Anaerobic Power Test (Modified Wingate Test)

For anaerobic power test, a modified wingate sprint test developed to be used in Concept II-D (Concept 2 INC.Vermont, USA) model rowing ergometry.[14] Subjects applied 5-10 minute warm up exercises on Concept II-D and stretching before testing. Following warm-up, ergometry was adjusted to maximum damper level, and then subjects completed the all-out test in 30-seconds with oral encouragement. Power outputs (w) were calculated automaticaly by Concept II-D and displayed on the screen. Power output of each stroke on Concept II-D was recorded by the test conductor.

Maximal power output was the avarage of the highest 5 power outputs and the minimal power output was the avarage of the 5 min power outputs among all obtained during the test. Percentage of fatigue was found by calculating the percentage changes of maximal and minimal power values.

2000-mt Rowing Ergometry Test

Study group has displayed performance in a formate of 2000-mt race on Concept II-D rowing ergometry. During trials, oral encouragements were used. Obtained time values from 2000-mt and every 500-mt were recorded from the digital screen of Concept II-D rowing ergomety.

Statistical analysis

Mean and standard deviation (SD) values were calculated for continuous variables. The normality of the variables was analyzed by Kolmogorov–Smirnov test. For the purpose of analysis, Sperman's Corelation test used as appropriate. Two-sided p values were considered statistically significant at ($p \leq 0.05$). Statistical analyses were carried out by using the statistical packages for SPSS 15.0 for Windows (SPSS Inc., Chicago, IL, USA).

Result

Descriptive statistics of variables included to the research and the values of Spearman Correlation coefficients and significant results of variables presented by Table 1 and Table 2.

Table 1 shows min, max values of veriables. Mean and Standard deviation of the variables were calculated. The results of Table 2 shows the coefficients of Spearman correlation and significant results of variables. According to the results of Table 2 age, training period, body mass, mean power, min power, max power were found significant ($p<0.05$).

Table 1. Descriptive Statistics of Variables Included in the Research

VARIABLES	Min	Max	Mean	SD
AGE (YEARS)	15.00	22.00	17.55	2.50
TRAINIG PERID(YEARS)	2.00	9.00	4.05	2.62
BODY FAT (%)	2.30	14.30	8.14	3.85
HEIGT (cm)	172.00	188.00	180.44	5.61
BODY MASS (kg)	62.70	83.50	73.35	7.04
HEART RATE (pulse/min)	174.00	179.00	186.22	8.09
MEAN POWER (watt)	465.00	743.00	595.55	80.24
MIN.POWER (watt)	250.80	529.20	407.80	78.51
MAX.POWER (watt)	499.00	860.20	682.44	101.98
FATIGUE (%)	33.08	49.73	40.47	5.75
2000 METER (min)	6.31	7.39	6.81	.39
1. 500 METER (min)	1.38	1.54	1.44	.05
2. 500 METER (min)	1.39	1.56	1.47	.05
3. 500 METER (min)	1.38	1.56	1.47	.05
4. 500 METER(min)	1.35	1.51	1.43	.05

Table 2: Spearman Correlation Coefficients and Significant Results.

VARIABLES	2000 m	
	r	p
AGE (YEARS)	- 0.839	0.005
TRAINING PERIOD(YEARS)	-0.919	0.000
BODY MASS (kg)	-0.795	0.01
BODY FAT (%)	- 0.485	0.185
MEAN POWER (watt)	- 0.837	0.005
MIN.POWER (watt)	- 0.678	0.045
MAX.POWER (watt)	- 0.720	0.029
FATIGUE (%)	0.377	0.318

Discussion

The aim of this study was to determine relationship between anaerobic power values and 2000-mt rowing ergometry values in rowing ergometry. Findings of the study were discussed within anaerobic power results. scores of 2000 meters and every 500 meters. and some antropometric characteristics.

Modified wingate test and 2000-mt rowing ergometry test were used in order to investigate the relation between anaerobic power outputs and 2000-mt scores of the subjects. Findings of the study have shown that there was a significant relation between anaerobic power values and 2000-mt rowing ergometry values.

Çelik (2002) has found that age as 21.7±2.8. tallness as 182.0±6.2. body weight as 81.1±12.8. body fat as 13.4±4.7 %. Topsakal (1996) has reported that age as 15.66±0.48 tallness as 180.93 ± 4.25. body weight as 70.07±8.03 kg. Sanı (1996) marked his subjects' age as 21.29±1.99. body weight as 78.77 ± 6.4. tallness as 185.35±4.76. and body fat as 10.87±1.40 %. Jurimae. J. And et al. (2002) have investigated effects of the days following intense training on the distribution for male rowing athletes. and reported age as 18.6 ±2.0 ; tallness as 186.9±5.7 cm; body weight as 82.4±6.9 kg for

14 rowing athletes at national level. Maestu. J. And et al. (2001) have detected male rowing athletes age as 21.5±5.0. tallness as 186.8±.7 cm. and body weight as 82.4±8.8 kg in their study. Maestu. J. And et al. (1999) have found age as 18.9±1.7. tallness as 186.2±6.3 cm. body weight as 79.3±7.3 kg. and body fat as 10.5±2.3 % in their study of estimating 2000-mt ergometry rowing performance from metabolic and anthropometric veriables among 10 experienced male rowing athletes.

Cosgrove. M.J. and et al. (1999) have found age as 19.9±0.6 years. body weight as 73.1±6.6 kg. and tallness variation as 180.5±4.6 cm in their study aiming to find out the relation between 2000-mt timed test at Concept II Modal D rowing ergometry and selected physiologic variables among the subjects consisting 13 male rowing athletes from a club. In their study aiming to asssess the relation between a 6-min full power ergometry test and physical performance indices among 10 university rowing athletes. Jurimae. J. Adn et al. (1999) have found age as 21.60±4.20. tallness as 186.90±5.64 cm. body weight as 84.10±6.59 kg. and body fat as 9.62±%2.81%.

In our study age tallness body weight trainig age and body fat percentage were found as 17.55±2.50. 180.44±5.61. 73.35±7.03. 4.05±2.62. 8.14±3.85 % respectively.

These values correspond to the andropometric variables of the athletes at the national team level. The obtained body weight value is higher than the upper limit- 72.5 kg- for leight-weight rowing athletes. It has been detected that taler and heavier rowing athletes have an advantage in terms of anaerobic power compared to short and light-weight ones. [15]

Sanı has also found that athletes with low vital capacity have a higher body fat percentage. Body fat percentage values obtained in our study show similarities with the literature results. The obtained values are the smallest body fat percentage ratios among other studies. Sanı has. in the findings of his study. determined that individuals with high body weight and low body fat should be sought at starting age of rowing sports.

Many studies in literature have investigated performance capacities of endurance athletes and variables which are likely to effect this. In activities related with distance. variables effecting performance are: maximal aerobic power. body composition. economy of locomotion. and lactate and respiratory tresholds (Çelik. 2002).

Recent research have also investigated variables associated with anaerobic variables which account for 20-25 % of the energy requirement in 2000-mt rowing performance. besides variables such as aerobic power and VO'max. In this sense. our study has investigated the effect of anaerobic power as a physiologic factor on performance.

Ingham and et al. (2002). in their study titled the definitives of 2000-mt rowing performance. have detected meaningful correlations between 2000-mt performance and maximal power value (watt) ($r=0.88$. $p< 0.001$); body fat percentage ($r=-0.48$. $p<0.05$); tallness ($r=0.66$. $p< 0.001$). Riechman and et al. (2002) have found that mean anaerobic power value obtained from modified wingate test had a profound effect- 96 % ($R^2= 0.960$) on 2000-mt performance according to regression results. Ingham and et al. (2002) have identified that maximal power and maximal power variables showed a high correlation with measured performance ($r=0.95$. $p<0.001$). In addition. they have found that power and maximal anaerobic power values at VO_2 max had tha strongest dependent relation in 2000-mt performance. Maestu. J. and et al. (1999) relations among metabolic parametres. andropometric characters and 2000-mt ergometry rowing performance. performance of combinations of these variables have been analyzed to test the hyphoteses that can provide better estimates than these variable categories or each of these variables can. They have proved that the estimate modal using combinations of andropometric and metabolic variables categories had the best estimate for 2000-mt rowing ergometry performance time ($R^2=0.99$). followed by equations using only metabolic ($R^2 = 0.98$) and andropometric ($R^2 = 0.86$) parametres. It has been concluded that 2000-mt rowing ergometry performance is dependent of both andropometric and metabolic physiologic variables.

In our study supportive of the literature. a very strong and high negative correlation (r = 0.837. p = 0.005) between 2000-mt rowing ergometry and mean anaerobic power and a mudium but not meaningful negative correlation between tallness variable (r = - 0.361. p = 0.339) and body fat percentage variable (r = - 0.485. p = 0.185) have been identified.

Maestu. J. and et al. (2001) have detected a high correlation among aerobic. anaerobic treshold. workload and 2500-mt performance. In our study. variables of aerobic and anaerobic tresholds have not been investigated yet 30-sec modified wingate test has yielded in reliable results about anaerobic endurance. As Riechman and colleagues (2002) reported in their study. anaerobic mean power variable is effective on rowing performance about 75.7 %.

Ingham and et al. (2002) have expressed that andropometric variables (tallness. weight. body fat percentage) are difficult to be controlled and trained. and have not included these variables in their regression analysis formulas for 2000-mt estimate. Jurimae. J. and et al. (2002) have found the mean heart rate as 184.6±7.5 for 2000-mt rowing performance in their study.

In our study mean heart rate variable was found as 186.22±8.08. The results of this study in paralel with many others in literature suggest that anaerobic power variable is meaningfully associated with 2000-mt rowing ergometry performance. It has been understood that anaerobic energy system whereby the energy requirements at start and finish stages during 2000-mt performance and aerobic system are important complements of racing performances of rowing athletes.

The results of this study may be helpful in developing performances and providing insights related with performances of rowers.

Suggestions

1. Our study was carried out among elite male rowers. Further investiagtion should be carried out among female rowers and different age groups. Measuremets were undertaken during special training periods of athletes. Measuremets could be taken at different training periods.

2. In this study aerobic-physiologic components were not included in details. Further studies may be designed to include both aerobic and anaerobic capacities.

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