as: knee area fatigue just brings change and fall of the function of muscles and afferent nerves of this area. Conversely, implementation of fatigue protocol on distal area of lower parts (ankle plantar flexors) only results in change and fall of the muscles and afferent nerves of ankle. Hence, the decrease of access distance in Star test after fatigue protocol on knee area can be attributed to the high correlation between performance of Star test, almost in all vectors, and proper function of knee extensor muscles (N. F., Horgan, F., Crehan, E., Bartlett, A. M., Grandy, A. R., Moore, C. F., Donegan, M., Curran, 2008, N., Pinsault and N., Villerme, 2008, J,, Treleaven N, lowchoy R, Darnell B, Panizza D., Brown-Roth well 2008). Another explanation for this issue may be the precedence of the role of neural afferent of proximal area to the role of neural afferent of distal area in balance control. The results of this study confirm a theory which considers partial fatigue in lower parts muscles (knee extensors and ankle plantar flexors) as the reason for decrease of dynamic balance and increase of probability for injuries among the elderly people caused by falling down.

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RELIABILTY AND VALIDITY OF A DISCONTINOUS GRADED EXERCISE TEST ON DANSPRINT® ERGOMETER

Carrasco Páez Luís[1], Martínez Díaz C. Inmaculada[1], De Hoyo Moisés Lora[1], Sañudo Corrales Borja[1], Ochiana Nicolae [2]
[1]University of Seville, SPAIN
[2]University of Bacau, ROMANIA
Email: sochiana@yahoo.com **/ 02.03.2010 / 19.03.2010**

Abstract

The aim of this study was to determine the validity and reliability of a graded exercise test on a specific kayak ergometer (Dansprint®) in which certain physiological and technical parameters that can to define kayaking performance were assessed. Fourteen male top-level kayak paddlers (all members of Spanish Kayaking National Team) participated in this investigation. All subjects carried out two ergometric tests (Ergo1 and Ergo2) and one flat water test (FWT) in random order. At anaerobic threshold (AnT) intensity, the results showed acceptable levels of reliability (comparison between data of Ergo1 and Ergo2 tests) in the assessment of velocity ($r=0.784$; $p=0.004$), stroke frequency ($r=0.976$; $p<0.001$), heart rate ($r=0.964$; $p<0.001$), and blood lactic acid concentration ($r=0.899$; $p<0.001$). Validity coefficients showed a strong relationships between Ergo2 and FWT tests in all physiological and technical parameters with the exception of velocity ($r=0.498$; $p=0.121$). It can be concluded that specific ergometry can be used to evaluate and to prescribe training AnT intensities of top-level kayakers attending to parameters such us heart rate, whole blood lactic acid concentration, and stroke frequency. Nevertheless, the training prescription through specific ergometry must be taken cautiously when velocity is the parameter of reference.

Key words: kayaking, testing, ergometry.

Introduction

Flat-water kayaking is an olympic sport that combines different types of boats (canoe and kayak) and distances (500 m for female and 500 m and 1000 m for male competition). The contribution of aerobic metabolism at individual races has been established between 60 and 80% for 500 m and 1000 m, respectively. In this sense, an accurate assessment of optimal kayaking training intensities to develop aerobic and anaerobic metabolisms is needed. This assessment can be achieved through field tests (flat water environment) or under simulated conditions in laboratory environment using specific kayak ergometers. Since 1973, when F.S. Pyke et al. (1973) designed and developed a specific kayak ergometer, a great number of engineers and researchers have tried to simulate the real conditions of paddling using both air-braked and mechanical resistance systems (A. Dal Monte, L.M. Leonardi, 1976; P.D. Campagna, D. Brien, L.E. Holt, A.B. Alexander, and H. Greenberger, 1982; G.E. Cooper, 1982; R.D. Telford, 1982; B. Larsson, J. Larsen, R. Modest, B. Serup, N.H. Secher, 1988; M. Witkowski, M. Wychowanski, M. Buczek, 1989; T.W. Pelham, L.E. Holt, 1995; J. Kruger, H. Schulz, R. Berger, H. Heck, 1997). Analysis of technical actions on these ergometers has shown a high level of coincidence between ergometer and flat water paddling when wrist, elbow and shoulder motions were compared (A. Dal Monte, L.M. Leonardi, 1976; P.D. Campagna, D. Brien, L.E. Holt, A.B. Alexander, and H. Greenberger, 1982). Moreover, a comparative analysis taken into account physiological variables were also performed (B. Larsson, J. Larsen, R. Modest, B. Serup, N.H. Secher, 1988), showing that air-braked kayak ergometers lead to reach the same ventilation, VO2 peak, and heart rate (HR) values that those observed on flat water kayaking. In this line, J. Bourgois et al. (1998) reported similar blood lactate concentration and HR values after comparing kayak ergometry and flat water paddling. Also, muscular power expressed on mechanical braked ergometer and on flat water channel was very similar (M. Witkowski, M. Wychowanski, M. Buczek, 1989).

Despite of all above mentioned, it is very difficult that ergometry can reproduce exactly the metabolic demands of simulated sport activity. In this sense, several investigations have questioned the use of specific ergometers as an alternative to field test. K.A. Van Someren and G.M.J. Dunbar (1996) reported a lack of correspondence between kayak ergometry and flat water paddling when muscular power and blood lactate concentration were compared, not advising the use of this kind of devices for monitoring kayakers' training adaptations. J. Kruger et al. (1997) observed how HR response to an effort on air-braked kayak ergometer was lower than that registered on flat water paddling at the same exercise intensity.

So, the aim of this study was to determine the validity and reliability of a graded exercise test on a specific kayak ergometer taken into account physiological and technical parameters that can to define kayaking performance.

Methods

Subjects. Fourteen male top-level kayak paddlers (all members of Spanish Kayaking National Team) participated voluntary in this investigation. Participant characteristics were as follows (mean ± SD): age 25.2 ± 2.3 yr; height 1.81 ± 0.05 m; body mass 84.7 ± 5.3 kg; training experience: 11.1 ± 2.1 yr, VO2max: 67.7 ± 2.5 $mL·kg·min^{-1}$.

Procedures. All subjects carried out two graded exercise tests on a specific ergometer (Ergo1 and Ergo2) and one flat water test (FWT) in random order and separated by 48 h. Ergo1 and Ergo2 were performed on a Dansprint® ergometer (Dansprint ApS, Denmark) using a drag resistance coefficient of 35. After a 5 min warm-up at a speed of 9 $km·h^{-1}$, the first stage was set at 11.5 $km·h^{-1}$ and the speed increments were 0.5 $km·h^{-1}$ every 3 min including pauses of 30 s between work intervals. Each kayaker was allowed to freely adjust his stroke rate (SR) as needed, being continuously recorded by a stroke counter (Interval 2000, Nielsen-Kellerman, USA). Heart rate (HR) was monitored using standard HR telemetry (S610i; Polar Electro Oy, Finland) and recorded every 5 s. Also, capillary whole blood samples were taken from each kayaker's earlobe during test pauses, just at the end of the effort, and during recovery period (min 1, 3, 5 and 7). In any case, paddlers were encouraged to give maximal effort and to complete as many stages as possible. The test concluded when the subjects voluntarily stopped paddling or they were unable to maintain the imposed speed.

FWT was performed on a flat water channel and its structure was similar to Ergo1 and Ergo2 test. Environmental conditions were also similar in all testing sessions and velocity was monitored thorough FWT using a GPS (Garmin mod.305).

Anaerobic threshold (AnT) was calculated from blood lactate concentrations (miniphotometer LP20; Dr. Lange, France) according to D-max method (B. Cheng, et al, 1992) . At this key point HR, SR, paddling velocity (PV), and blood lactate concentration were assessed.

Statistical analysis.

Standard statistical methods were used for the calculation of means and standard deviations (SD). Kolmogorov-Smirnov test was performed to evaluate conformity to a normal distribution and one-way ANOVA was applied to compare testing sessions for physiological and kayaking performance variables. After that, and Pearson's correlation coefficient was calculated to check both reliability (Ergo1 vs. Ergo2) and validity (Ergo2 vs. FWT). Significance was accepted at $p<0.05$ level.

Results

At AnT intensity level, no statistical differences were observed between testing sessions for any physiological or kayaking performance variables registered. Moreover, the results showed acceptable levels of reliability (comparison between data of Ergo1 and Ergo2 tests) in the assessment of PV (r=0.784; p=0.004), SR (r=0.976; p<0.001), HR (r=0.964; p<0.001), and blood lactic acid concentration (r=0.899; p<0.001). Validity coefficients showed a strong relationships between Ergo2 and OWT tests in all physiological and technical parameters with the exception of velocity (r=0.498; p=0.121) (table 1).

Discussion

Several investigations have attempted to test the validity of kayak ergometers, comparing flat water kayaking and kayak ergometry. The results of some of these studies showed a lack of correspondence of physiological responses to open water and ergometric tests. However, there have been advancements in the development of air-braked kayak ergometers that can to offer new possibilities in the application of laboratory test for prescription and evaluation of kayak paddlers. This is the case of Dansprint® kayak ergometer, a new air-braked device that gives new possibilities to improve kayak testing.

In the present investigation we proposed a discontinuous graded exercise test on Dansprint® ergometer (Ego1 and Ergo2) that was applied on flat water channel too (FWT). The main aim of this test was to calculate the AnT point, a valid criteria to determine kayaking performance. After comparing physiological and kayaking performance variables from Ergo1 and Ergo2 testing sessions, we observed high levels of reliability in the assessment of PV, SR, HR, and blood lactic acid concentration at AnT paddling intensity. On the other hand and when validity indexes were calculated (Ergo 2 vs. FWT) we observed high values of Pearson correlation coefficients for SR, HR, and blood lactic acid concentration at AnT intensity. Although validity level for PV was acceptable, and a significant relationship was established, this data suggest certain differences in paddling velocity calculation. Probably, different devices used for PV calculation (on-board computer and GPS terminal in ergometric and FWT, respectively) induced a lower value for this kayaking performance variable.

Anyway, our results are opposed to those described by K.A. Van Someren and G.M.J. Dunbar (1996) and J. Kruger et al. (1997), who reported a lack of correspondence between kayak ergometry and flat water paddling when blood lactate concentration and HR were compared. Also, our data are in agreement with the previous report by J. Bourgois et al. (1998) and J.E. Oliver (1999) who registered similar blood lactate concentration and HR values after comparing kayak ergometry and flat water paddling.

It can be concluded that Dansprint® ergometry can be used to evaluate and to prescribe training AnT intensities of top-level kayakers attending to parameters such us HR, whole blood lactic acid concentration, and SR. Nevertheless, the training prescription through specific ergometry must be taken cautiously when velocity is the parameter of reference.

Table 1. Physiological and kayaking performance variables registered in both ergometric and flat water tests.

	Ergo1	Ergo2	r1; p1	FWT	r2; p2
PV ($km \cdot h^{-1}$)	12.99±0.22	13.05±0.32	0.784; 0.004	13.30±0.31	0.496; 0.121
SR ($st \cdot min^{-1}$)	79.5±5.7	79.5±5.6	0.976; 0.000	73.9±5.0	0.985; 0.000
HR ($bp \cdot min^{-1}$)	173.0±6.6	174.5±6.3	0.964; 0.000	172.0±4.7	0.924; 0.000
Lactate ($mMol \cdot L^{-1}$)	2.98±0.56	3.21±0.50	0.899; 0.000	3.13±0.37	0.920; 0.000

r1 and p1 show Pearson correlation coefficient between Ergo1 and Ergo2, and its level of significance, respectively. r2 and p2 show Pearson correlation coefficient between Ergo2 and FWT, and its level of significance, respectively.

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THE EFFECTS OF TWO DIFFERENT ENDURANCE TRAINING PROGRAMS PERFORMED IN HOT ENVIRONMENT ON BODY TEMPERATURE AND SOME PHYSIOLOGICAL PARAMETERS

Cicioglu Ibrahim[1], Kiyici Fatih[2]
[1]Gazi Univ. School of P.E. Ankara / TURKEY
[2]Ataturk Univ. School of P.E. Ankara / TURKEY
Email: cicioglu@gazi.edu.tr / **11.03.2010 / 20.03.2010**

Abstract

The purpose of this study was to compare the effects of two different endurance training programs performed in hot environment on body weight (BW), body fat percentage (BF %), body mass index (BMI), body fluid (humour) percentage (Bf %), basal metabolic rate (BMR), body temperature (BT) and maxVO$_2$. The subjects Ataturk University School of Physical Education and Sports were divided into two groups randomly as Interval Running Group (IRG) (n= 12) and Continuous Running Group (CRG) (n=12). The subjects participated in training program with three sessions per week during 8 weeks under the hot weather condition, mean weather temperature and humidity ration were 30.76 $\pm$ 1.76 C and 57.92 $\pm$ 5.8 % during 8 weeks period. Before and after the training program all parameters that were mentioned above tested as pre and post test. Also at the beginning and the end of the each training session some physiological parameters and body temperature of subjects were measured to examine adaptation level to the hot environment conditions.

Statistical analysis of data was done by two-way ANOVA with SPSS 11.5 for Windows statistical program.

At the end of the 8 weeks maxVO$_2$ scores of both groups significantly increased (P<0.001). Body temperature and loss of body fluid (***dehydration)*** significantly higher in CRG than that of IRG. Also except BMI, significant changes were observed in BW, BF%, BMR scores of both groups (P<0.01).

Consequently, although both endurance training methods are beneficial to improve aerobic capacity, to avoid damages of training in hot environment interval running method is more acceptable than continuous running method.
Key word : Hot Environment, Endurance Training, Aerobic Capacity, Body Temperature.

Introduction

In resting condition, organism produces approximately 1.5 kcal/min. energy. Especially during exercise with the increase in heat production 15 – 40 % of chemical energy converted into mechanical energy, the rest of the energy produced converted into heat that is required to remove from body to maintain heat balance (H.A. Devries, 1986; E.L. Fox, 1988).

Heat dissipation mechanism in body, is unable to cope with the metabolic heat production starts to accumulate and cause on increase in body temperature (S.S. Cheung et al., 2000). In normal weather conditions, players can use 80 % of energy reserves when exercising in hot environment, exhaustion occurs before it reached that level or they perform less work (T. Lav, 1995).

Exercise increases the metabolic heat generation, this increment can be 30 times more in heavy exercise. One important factor affecting body heat loss is the ratio of moisture in the air. In other words, unlike exercising the hot-dry weather the removal of heat is more important in hot-humid air.

Exercises in hot environments have different effects depending on type, duration and intensity of exercise. In such case, organism makes some physiological regulation to resume normal functions of the body. Increased heat during exercise done with 70 % of maxVO$_2$ removed from body with conduction