

A COMPARISON OF PREDICTIVE TESTS OF AEROBIC FITNESS

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The purpose of this study was to compare the results from Astrand Step Test (ST), Canadian Aerobic Fitness Test (CAFT) and 1.5 Mile Run Test (DR). Thirty-three male students of Rasht physical education high school aged 15-18 years (Mean \pm S.D 16.56 \pm 0.85) were participated in the study. All subjects were performed three predictive tests. Predicted VO₂max scores were obtained for each subjects. The mean \pm S.D from the various test in ml. kg⁻¹. min⁻¹ were as follows: ST 57.18 \pm 6.88; CAFT 58.10 \pm 5.08 and DR 52.40 \pm 5.09. Significant correlation were found among the VO₂max

results on all possible pairing of tests ($p < 0.05$). Correlation coefficient between ST/DR and ST/CAFT were 0.92 and 0.84 respectively. While the correlation coefficient between CAFT and DR was 0.88. The results are in line with the similar studies, which have done before (Anderson.G.S. 1992; Jetteç. M. 1979). The findings indicate that each of three tests can be used as a predictor of aerobic fitness.

Key words: VO₂max, Canadian aerobic fitness test, Astrand step test, 1.5 mile run test.

MAXIMAL AEROBIC ABILITY ESTIMATED BY NEWLY DEVELOPED ORIGINAL ERGOMETRIC STEP TEST

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It is generally accepted that maximal aerobic ability (VO₂max) is the best measure of the functional limit of the cardiovascular system and is commonly interpreted as an index of cardiorespiratory fitness. When there is a need to estimate the aerobic power in a large group of people, the step test, as a simple field test, is the best choice. The test has to satisfy several prerequisites to be called ergometric: performance of cyclic, dynamic movements that engage large muscle groups, the possibility to control mechanical work and to express it in adequate units of measure. In other step tests, the mechanical work was not the same for all of the examinees. Changing bench height according to the individual body mass can standardize work in the step test. A team of experts in Belgrade constructed this specific bench for the new step test. The aim of this study was to prove validity of new ergometric step test by comparing values of aerobic capacity predicted using bicycle ergometer. Thirty-eight male athletes (mean age 16.6 \pm 0.3 years), engaged in different sports, and 38 non-athletes of the same age underwent classic Astrand's incremental test for bicycle-ergometer (starting from 100W)

and the new ergometric step test. In ergometric step test a workload of 12 kJ was used. Bench height (h) was determined according to individual body mass (BM): $h = W/2 \text{ BM} \times g \times n$ (n =stepping rate -25/min, $g = 9.81 \text{ m/s}^2$). Test lasted for 6 minutes. Heart rate (HR) was measured during the last minute of the test. Predicted values of maximal oxygen consumption were determined using nomogram (according to workload and HR). Results: Comparing predicted values of maximal oxygen consumption, gain from two tests there were no significant differences in both groups: athletes (3505.6 \pm 784.7 vs. 3294.9 \pm 653.4 ml min⁻¹ for step test; p more than 0.05) and in the group of non-athletes (2563.3 \pm 469.3 vs. 2471.8 \pm 353.6 ml min⁻¹; p more than 0.05). Conclusion: We have proved that the new ergometric step test is a specific test with high degree of validity, for indirect estimation of maximal oxygen consumption, and can be used as an easy and quick screening procedure for prediction of maximal aerobic power in large population.

Keywords: maximal aerobic ability, step test, ergometry.

PHYSIOLOGICAL DIFFERENCES BETWEEN SOCCER AND FUTSAL (INDOOR)

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The aim of this work was to value the physiological differences, in laboratory testing, between two teams -soccer and futsal- of the maximal level.

MATERIAL AND METHODS

The sample consisted of 53 male players (31 soccer and 22 futsal) from the Spanish First Division with excellent national and international results.

An aerobic intermittent and progressive test in treadmill was carry out until exhaustion with gases measured by open-circuit method breath by breath (Medical Graphics-Cardiopulmonary Exercise System CPX) and lactate determination (YSY). Anaerobic threshold was determined at 4 mmol.L-1. Four performance tests according to Bosco were included to evaluate the explosive power of the leg extensor muscle on a resistive platform connected with a digital timer (0.001 s.)(Ergo-Jump, Made by Globus). Margaria-Kalamen test was also done to evaluate the anaerobic power.

RESULTS

The soccer players were taller and heavier than futsal players but without significant differences. The VO2max in soccer (55.7 ml.kg-1.min-1) was very similar to the futsal (59.2

ml.kg-1.min-1). There weren't significant differences ($p < 0.05$) in maximal parameters-heart rate (191 vs 193 beats.min-1, speed 16.5 vs 16.1 km.h-1, and lactate 9 vs 8.7 mmol.L-1). At the anaerobic threshold (4 mmol.L-1), there weren't significant differences in speed (10.1 vs 9.5 Km.h-1) and heart rate (155 vs 154 beats.min-1). In Jump test (Bosco) there weren't any significant differences either between both teams. In Margaria-Kalamen test there were significant differences 1.67 vs 1.59 m.seg-1).

CONCLUSION

There weren't any significant differences between the teams in aerobic profile and jump test. The only significant difference was the Margaria-Kalamen test.

Key words: soccer, futsal, physiology

TAEKWONDO SPECIFIC ANAEROBIC TEST FOR ELITE COMPETITORS

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INTRODUCTION

Taekwondo is a Korean Martial Art considered Olympic Sport since 1988. Anaerobic metabolism is highly used during training and competition. Unfortunately we do not have specific tools or tests to evaluate the anaerobic physical performance evolution in the elite player. Objective. Evaluate a new test, based upon training technical elements, to explore the anaerobic metabolism response in elite taekwondo players.

MATERIAL AND METHOD

Test is based in a linear movement front and back kicking the Pao with a round kick, alternating both legs. One cycle of the test would be, round kick to the front with one leg and other round kick with the other leg, and then going forward, round kick with the first leg followed with other round kick with the second leg. Three series of 45, 30 and 30 seconds duration are followed by a rest periode of one minute in between. Pulse rate with Polar Sportster® and lactate in the rest perodes

and at 3rd and 5th minutes after the 3rd periode are obtained. Test was performed by men (20) and women (21) of the Spanish National Team of Taekwondo.

RESULTS

Basic results are shown in the table:

Lactate per kick and lactate per weight (0.5 ± 0.1 mM/Kg for both) shows no differences between men and women. A wide range of variability is observed and very related to technical performance in competition. Best performance of the test is observed when high number of kicks (>135 for women and >160 men) with a Lactate/kick 0.35-0.40 mM. Recovery HR is important after three minutes when maximal HR is observed, and values after 5 minutes (115 ± 11 for both) are needed to make decision on training procedures related to competition. Conclusion: Test allows to obtain data from the anaerobic capacity and tolerance using specific technical skills.

Keywords: Taekwondo, anaerobic, performance, testing.

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	Maximal values	Lactate	HR	HRrecovery at 3'	Kicks	Lactate/kick
Men	Mean(std)	16(4)	182(5)	122(9)	161(15)	0.29(0.08)
	Range(M-m)	10-25	173-189	108-145	123-189	0.2-0.5
Women	Mean(std)	14(3)	184(8)	124(12)	136(10)	0.30(0.05)
	Range(M-m)	10-20	175-206	106-159	117-152	0.2-0.4

ANALYSIS OF THREE DIFFERENT PORTABLE INSTRUMENTS FOR MEASURING BLOOD LACTATE CONCENTRATION

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INTRODUCTION

New instruments for measuring blood lactate in sport are appearing time to time and information about its performance is sometimes incomplete. Objective. Evaluate three different portable blood lactate analytic instruments for precision, accuracy, linearity, and intermethod comparison.

MATERIAL AND METHOD

Mini8 (Dr Lange, Germany), Diaglobal Diaglobal, Germany), and Lactate Pro (LPro) (Arkray KDK Co, Japan). Dr Lange and Diaglobal are photoenzymatic and Lpro electroenzymatic. A number of blood samples were analyzed by standard photoenzymatic (Hitachi/Boehringer Mannheim) as reference method and in addition by all instruments mentioned

above. Reference standards and duplicate capillary blood samples from the earlobe were used.

RESULTS

Precision and accuracy of the three instruments, when measuring L-lactate standards, were good in the whole range of measurement (mean variation coefficient, VC = 0.81-3.95%; mean difference = 1.05-3.67%). Correlation between the three methods was $r=0.992$ (LP8+), 0.993 (Dg) and 0.986 (LPro) in front of the PHE. The differences range from = 0.2-0.3 (2 mM.l-1) 0.1-0.4 (4 mM.l-1), 0.5-0.8 (10 mM.l-1), 0.9-1.5 (15 mM.l-1).

Key words: Lactate, analysis, instrument, testing.

INFLUENCE OF SEVERE ACUTE HYPOXIA ON VO₂ AND PERFORMANCE DURING 30-S WINGATE TESTS IN ELITE SPANISH TRACK CYCLISTS

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The impact of hypoxia on exercise performance and VO₂max is higher the greater the VO₂max. If this also applies to supramaximal exercise is not known. Ten track cyclists from the Spanish National Team, including several National Champions and a bronze medal winner in the last World Championship participated in this study. Five cyclists were speed specialists while the other 5 were endurance related event specialists. Wingate tests were performed while breathing room air at sea level (normoxia) or air from a bag containing 10.5% O₂ in N₂ (hypoxia) in random order and separated by a recovery period of 1 hour. While maximal power output was not affected by hypoxia in any group, mean

power output and pedalling rate were reduced by 6-7% in the speed cyclists ($P<0.001$). In the endurance cyclists, however, mean power output and pedalling rate remained at same level as in normoxia. In both groups hypoxia resulted in a 16% lower mean VO₂ ($P<0.01$). As depicted, the divergence between normoxic and hypoxic VO₂ during the Wingate test begun after 10 seconds after the start of the test and became more accentuated as the exercise progressed ($P<0.001$). Fatigue index was similar in normoxia and hypoxia, being more accentuated in speed than endurance specialists ($P<0.01$). VO₂ during the Wingate test correlated with VO₂max in normoxia ($r=0.86$, $p<0.001$).

DIFFERENCE BETWEEN EXERCISE AND RECOVERY HEART RATE AT ISO-VO₂ IN ATHLETES

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Heart rate (HR) increases linearly with oxygen uptake (VO₂) during exercise but little is known about this relationship during recovery. Because stroke volume and arteriovenous oxygen difference rapidly decrease in recovery, it is predictable that heart rate would be greater in recovery at iso VO₂.

The aim of this study was to evaluate the influence of fitness level, identified by maximal oxygen uptake (VO₂max) (ml/Kg/min), in the VO₂-HR relationship during exercise recovery.

34 subjects (26 males and 8 females) (21.8 ± 2.6 yr, 174.4 ± 7.6 cm, 69.8 ± 9.9 Kg) performed a ramp maximal exercise test on a cycle ergometer with increments of 25 W/min. We measured the VO₂ and HR, simultaneously, breath-by-breath (Medgra-phips® cardiorepiratory prognostic systems) during rest, exercise and 4 min of recovery. The HR difference (D-

HR) between recovery and exercise for the same VO₂ at 50% VO₂max was calculated (Fig. 1). There is significant correlation between the D-HR and VO₂ max. (Fig. 2).

D-HR is a parameter of subject's fitness; the larger D-HR, the more fitt.

INFLUENCE OF THE TOURS LENGHT IN THE PROFESIONAL CYCLIST EFFORT

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PURPOSE

To analyzing the effort carried out by the members of a professional cyclist team (Colchones Relax-Fuenlabrada) in long tours (21 days), half (8 days) and short lenght (5 days).

METHODS

The study was divided in two parts, in the first part, in order to determine the aerobic and anaerobic ventilatory threshold, during the 1999 and 2000 season, an incremental, ergospirometric and maximum test was carried out upon the members of a professional cyclist team at the beginning of the season, half of the season and before the beginning of the Vuelta a España. The second part of the study consisted on monitoring the cyclist heart rate (HR) in tours of 5 (V5), 8 (V8) and 21 days (V21), to analyze afterwards 3 zones of effort: above the VT2 (Z3), between the VT2 VT1 (Z2) and below the VT1 (Z1).

RESULTS

Neither the kms nor the average time of stage differs significantly between the analyzed turns. The turns of lower duration are those ones that show higher values in the maxim

heart rate (HRmáx.), (185 ± 0.52 , 187 ± 1.49 , 179 ± 0.43 beats·min.⁻¹ in V5, V8 V21), and average heart rate (HRm), (144 ± 0.85 , 147 ± 2.55 , 140 ± 0.81 beats·min.⁻¹). Percentages and times of work have been found in Z3 of $17.67 \pm 1.47\%$ and 28.74 ± 1.93 min. in V5, $19.69 \pm 3.86\%$ and 32.13 ± 4.05 min. in V8 being significantly higher to the values found for V21 ($11.08 \pm 1.05\%$ and 16.27 ± 1.13 min.), the same happens in Z1 obtaining percentages and times of $43.81 \pm 1.25\%$, 117.03 ± 3.62 min., $34.39 \pm 3.35\%$, 83.34 ± 8.38 min. and $36.08 \pm 1.20\%$, 88.15 ± 3.27 min. for V21, V8 V5 respectively. The work carried out in Z2 and the cadence of pedal of the analyzed tours didn't change significantly in this study.

CONCLUSION

The highest HRmáx and HRm obtained in the low tours compared with the V21 and the lower percentage of work of these last in Z3, in spite of having an higher number of mountain passes and time trials in the course, could be related to the accumulation of fatigue to local level, or to the initial genesis of overtraining which wouldn't let yield in Z3.

Keywords: Anaerobic threshold, heart rate, intensity of effort, fatigue.

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INTENSITY OF EXERCISE ACCORDING TO OROGRAPHY IN PROFESSIONAL CYCLISTS

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PURPOSE

The aim of the study was to analyze the intensity of effort made by professional cyclists in the different mountain passes climbed in the 1999 and 2000 Tours of Spain.

METHODS

During the ascent of mountain passes of the following categories; Special category (PME), 1st category (PM1^a), 2nd category (PM2^a) and 3rd category (PMA3^a), the response of the heart rate (HR) was analyzed as a according to HR

behavior observed in an ergospirometric test performed in a laboratory a week prior to the Tours of Spain. Three work zones were determined, one above the anaerobic threshold (Z1), one below the aerobic threshold (Z3) and one between the two thresholds (Z2).

RESULTS

Maximum heart rates (HRmáx) of (174 ± 0.84 beats·min.⁻¹) and average heart rates (HRm) of (160 ± 0.99 beats·min.⁻¹) were obtained. These were significantly higher in the PM1^a

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with compared to the PME, PM2^a y PM3^a (155±1.06, 156±0.82, 153±0.99 beats·min.⁻¹, respectively). The average time spent in Z3 was 4.04±1.21, 10.72±1.42, 4.28±0.60 and 2.19±0.24min.; in Z2 it was 43.14±1.46, 44.26±3.14, 21.60±1.06 and 11.89±1.07min.; and in Z1 5.57±0.81, 4.80±0.58, 3.31±0.30 y 4.40±0.31min. in PME, PM1^a, PM2^a y PM3^a respectively. Finally the work percentages in Z3, Z2 and Z1 were respectively 8.08±2.49, 81.55±2.59 and 10.18±1.40% for PME; 21.16±2.90, 70.58±2.69 and 24±1.03% for PM1^a; 15±1.83, 71.99±1.80 and 12.99±1.24% in PM2^a and 17.31±1.98, 59.47±1.96 y 23.31±1.65% in PM3^a.

CONCLUSION

The ascent of mountain passes is an activity involving intense effort and this is reflected by the time, which the cyclists spend in Z3 and Z2. If we compare the different passes the intensity decreases in the following order, PM1^a, PME, PM2^a y PM3^a. The cadence of pedal employed in the PME, PM1^a, PM2^a doesn't differ significantly and turns out to be minor than the one considered as good from functional efficacy point view, action that doesn't take place in the PM3^a.

Keywords: Mountain pass, heart rate, telemeter, anaerobic threshold.

EFFECTS OF ENVIRONMENTAL HEAT ON THE ASSESSMENT OF LACTATE THRESHOLD DURING A SHORT DURATION INCREMENTAL PROTOCOL

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Eight physical education students, healthy, and moderately trained (VO₂max: 57.4 ml·kg⁻¹·min⁻¹) participated in this study. The subjects completed 2 cicloergometer trials consisting on 5 incremental workload up to an intensity corresponding to their individual lactate threshold (4.6±0.8 mM). The trials were performed in a randomized order in the HEAT (39.1° C; 27.3% relative humidity) and in a NEUTRAL environment (21.2° C; 43.4% relative humidity). Between trials subjects rested for at least 45 min in a thermoneutral environment while they were rehydrated when needed. At the lactate threshold load (225 watts) heart rate and ventilation rate were 8 bt/min and 6 l/min higher in the

HEAT than in the NEUTRAL trial (p<0.05), however tympanic temperature was similar in both trials (37.6±0.3 vs. 37.5±0.3 °C). Blood lactate level was 30% higher during HEAT than in NEUTRAL at 225 watts (4.6±1.0 vs 3.5±0.6; respectively, p<0.05). Rate of perceived exertion was also higher at the end of exercise in HEAT than in NEUTRAL (15.2±0.6 vs. 13.5±0.6; Borg units; p<0.05). In summary training advice based upon lactate threshold assessed during an incremental test in the HEAT may underestimate the training workload.

Key words: Lactate threshold, thermoneutral, environmental heat

COULD BE VO₂ MAX A PERFORMANCE PREDICTOR OF THE YO-YO INTERMITTENT ENDURANCE TEST?

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Soccer it's a prolonged intermittent sport, demanding high intensity short rallies interspersed with rest periods or less intense activities (Bangsbo, 1993). Facing those demands, endurance becomes an important capacity for performance during match. Many lab and field tests have been developed to assess endurance. Maximal aerobic power (VO₂max) as been considered a "gold standard" criteria for endurance fitness (Bassett & Howley, 2000). As major cardiorespiratory index to assess individual's capacity to deliver oxygen to the working muscles, it could be an important limiting factor to endurance. However, Bangsbo e Lindqvist (1992) suggest that in intermittent sports, maximal aerobic power can't fully explain or predict endurance performance. The aim of the present study was to investigate if VO₂ max of elite soccer

players could be used as predictor of the performance in an intermittent field test – the Yo-Yo Intermittent Endurance Test, Level 2 (Bangsbo, 1996).

Sixty-two (62) elite soccer players (age: 25.2±3.4 yrs; weight: 74.6±5.8 kg; height: 177.1±5.3 cm) from the Portuguese Pro League were tested with maximal treadmill lab and field tests in order to evaluate the VO₂ max and the maximal distance covered, respectively. For data analysis mean, standard deviation, Pearson correlation coefficient and simple linear regression were used.

The mean value of the subjects VO₂max was 53.0±5.6 ml/kg/min while the mean distance covered in the Yo-Yo test was

1360.6±352.4 mts. Concerning the relationship between VO₂ max and the distance covered in the field test, our results showed a moderate correlation coefficient ($r=0.54$) and a common variance (r^2) of 29.9%. The standard error of estimate was 297.4 mts.

The meaning of our results are in accordance with those of other researchers suggesting that VO₂ max is not a good

standard index to predict endurance performance both in soccer match and in intermittent tests. Since the tests we used are different in the muscular pattern activity, probably distinct limiting factors might explain the low association levels found between the two variables.

Key Words: endurance, aerobic power, intermittent exercise, criteria validity.

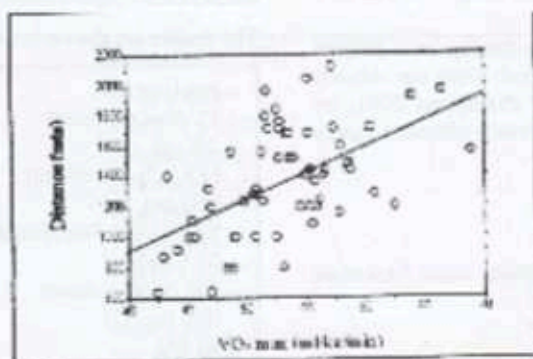


FIG. 1.-
Relationship between
distance covered in
the field test and VO₂
max.

THE VALIDITY OF A SMALLER TIME FRAME IN THE MEASUREMENT OF OLIMPIC AND WORLD CHAMPIONS BASAL METABOLIC RATE

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The recommendation of the FAO/WHO/ONU committee that the basal metabolic rate (BMR) serves as the basis for estimating dietary energy intake has rekindled interest in this fundamental physiological measurement and methodology improvement. Objective: The validity of measuring oxygen consumption to evaluate BMR in a 10 minute period.

SUBJECT

Champion athletes from Spain ($n=13$; years), of the masculine sex, of 4 different sports (marathon, route cycling, Athletic march and rowing). All these athletes qualified among the first three (of their sport) in the Olympic and World games.

METHODOLOGY

The date of evaluation of BMR gathered after the Olympic and World games is characterized in the Sports Calendar as a period of "post-competition". A Mijjhardt gas analyser was used for calculating of VO₂ and VCO₂. Routine

procedures were strictly followed in the preparation of basal conditions and during its measurements for BMR calculating. Three separate measurements were taken with 10 day interval between each. The first measurement lasted 10 minutes (1^oMEA), the second 35 min.(2^oMEA) and the third 10 min. again (3^oMEA). The Spearman method was used to verify if there was a correlation between the measurements.

RESULTS

Positive correlations were found between 1^o MEA and 2^o MEA ($r = 0,922$, $p = 0,0015$) and between 2^o MEA and 3^o MEA ($r = 0,958$, $p = 0,0001$) and between 1^o MEA and 3^o MEA ($r = 0,929$, $p = 0,0013$). The results suggest there is a strong correlation between the three measurements and the two time frames used.

CONCLUSION

This data supports the validity of the 10 min. measurement in evaluating for research purposes.

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Champions	Age (years)	VO ₂ max ML*kgW ¹ *min ⁻³	Height (cm)	Weight (kg)	Percent Fat (%)
Spain(n=13)	24,77±4,55	76,49±7,94	1,79±7,9	72,98±10,8	7,32±1,8

CARDIOPULMONARY TEST RESULTS IN ELITE BASKETBALL ATHLETES - WINNERS OF EUROPEAN CADET BASKETBALL CHAMPIONSHIP 2001

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PURPOSE

Our laboratory, NILFA, was testing the top-level athletes before and after the preparatory period. Since our subjects became European cadet basketball champions 2001, we found it interesting to present their results obtained shortly before the championship itself.

SUBJECTS

We examined 18 Members of Yugoslav cadet basketball team.

METHOD

We measured the following anthropometrical parameters: body weight (BW), body height (BH), body mass index (BMI), body surface area (BSA), percentage of body fat (%BF) and percentage of lean body mass (%LBM). After the resting period (6 min), while seated, our subjects performed the incremental exercise test on electronically braked cycle ergometer (Ergo-Oxycon Pro, Jaeger, Wurzburg, Germany). The initial step of exercise was begun at a workload of 100 W, and exercise intensity was increased by 50 W every 2 minutes, until the subject was unable to continue pedaling despite strong verbal encouragement. Oxygen uptake (VO₂) was monitored on a breath-by-breath basis. Respiratory parameters were measured by analysis of the expired gas every 30 s with the use of computerized system. The heart rate (HR) was monitored by 12-lead electrocardiogram (ECG). Blood pressure measurement was taken at rest, at every different load and at the third minute of recovery.

RESULTS

The results are shown in the following table:

Age (years)	15,78 ± 0,43
VC (%of predicted)	108,14 ± 5,64
BW (g)	83333,33 ± 13327,33
FEV1 (%of predicted)	103,15 ± 23,52
BH (cm)	196,56 ± 10,60
%FEV1/VC (%of predicted)	98,05 ± 19,20
BSA (m ²)	2,14 ± 0,23
PEF (%of predicted)	108,96 ± 16,18
BMI (kg/m ²)	21,42 ± 1,58
%LBM	87,28 ± 4,18
%BF	12,73 ± 4,18
HRr (bpm)	67,17 ± 4,38
HR max (bpm)	171,61 ± 12,05
VO ₂ max	3545,78 ± 541,59
VO ₂ /kg max	43,43 ± 8,82
HR recov (bpm)	115,67 ± 13,35
HR rec/HR rest%	173,33 ± 26,11
O ₂ /HR	21,37 ± 2,83

CONCLUSION

These results show the level of physical training of our athletes at one point in time. It would be interesting to compare them with the results after a period of time, which we intend to do in the nearest future.

Keywords: basketball, elite, athletes, cardiopulmonary, ergometry.

PULMONARY FUNCTION VARIABLES IN ELITE BASKETBALL ATHLETES - EUROPEAN CADET BASKETBALL CHAMPIONS 2001

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PURPOSE

The aim of our study was to assess the lung function in top-level athletes, the members of Yugoslav National team just before European Cadet Basketball Championship 2001.

SUBJECTS AND METHODS

We examined 18 members of National team (16 years of age)

and 19 members of different basketball teams from National league, same age and gender and measured the following anthropometric parameters: body weight (BW), body height (BH), body mass index (BMI), percentage of body fat (%BF) and body surface area (BSA).

The pulmonary function variables measured were vital capacity (VC), forced expiratory volume in first second

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(FEV1), Tiffenau index (%FEV1/VC) and peak expiratory flow (PEF), as the best of three reproducible trials. All data were recorded using conventional closed circuit spirometry (Jaeger).

RESULTS

There were no statistically significant differences between athletes from National team and athletes engaged in National

league comparing the following anthropometric values: BW, BH, BSA, but there was statistically significant difference in BMI ($p < 0.05$).

We found a highly significant statistical difference in VC ($p < 0.01$). Other parameters of respiratory function showed no significant statistical difference and all of our subjects were within physiological limits for their age, sex and body stature.

	Cadets (mean \pm SD)	National league (mean \pm SD)
Age (years)	15,78 \pm 0,43**	17,53 \pm 1,07
BW (g)	83333,33 \pm 13327,33	87236,84 \pm 9326,44
BH (cm)	196,56 \pm 10,60	197,50 \pm 8,21
BSA (m ²)	2,14 \pm 0,23	2,21 \pm 0,15
BMI (kg/m ²)	21,42 \pm 1,58*	22,63 \pm 1,78
%BF	12,73 \pm 4,18	12,82 \pm 2,45
VC (%of predicted)	108,14 \pm 5,64**	99,10 \pm 12,77
FEV1 (%of predicted)	103,15 \pm 23,52	102,62 \pm 12,93
%FEV1/VC (%of predicted)	98,05 \pm 19,20	104,26 \pm 8,03
PEF (%of predicted)	108,96 \pm 16,18	102,58 \pm 21,54

* $t < 0.05$ - ** $t < 0.01$

CONCLUSION

During the competition period, regardless of sport achievements, we found statistically significant differences only in BMI and VC. We assume that other factors determine

the level of sport achievement, such as anthropometric parameters (that we also measured and obtained interesting results, although we did not present them in this abstract).

Keywords: basketball, elite, athletes, pulmonary, spirometry.

CARDIOPULMONARY FITNESS IN ATHLETE AND NON-ATHLETE ADOLESCENTS EVALUATED BY ASTRAND PROTOCOL ON CYCLE ERGOMETER

Malicevic S., Mazic S., Igracki I., Mitrovic D., Nestic D., Petrovic M.

One of Belgrade well-known high schools developed an experimental program for competitive athletes, with the curriculum that was adapted to the training and competition schedule. The purpose of our study was to investigate the differences in cardiopulmonary fitness in athlete vs. non-athlete group of the high school students. Thirty-five, randomly selected, male athletes (16 and 17 years of age) with at least 5 years of competitive sports experience were compared to 35 non-athlete male high school students of the same age. Cycle ergometer submaximal stress test (protocol by Astrand) for estimating VO₂max was used in this study. We have measured heart rate (HR) and blood pressure (BP). HR was measured in rest (after 5 minutes in standing position), after each minute of workload and after first and sixth minute of recovery, placing stethoscope on the apex cordis. BP was measured after every three minutes of workload and at the end of the exercise test (after 1 and after 6 minutes), by wall-mounted Hg-sphygmomanometer. The diastolic BP was recorded at Korotkoff phase V. We started with 100 W of workload, and

rise it up for 50 W every six minutes until HR reached steady state (HR between 130-140/min, and difference in two consecutive measurements less than 5/min). Results: Cardiopulmonary fitness was noticeably bigger in athletes compared to non-athletes: VO₂max: 46,59 vs. 37,64 ml/kg/min (p less than 0,001); O₂Pulse: 24,74 vs. 17,53 ml (p less than 0,001); resting HR: 68,69 vs. 83,24/min (p less than 0,001); post-exercise HR: 100,80 vs. 115,93/min (p less than 0,001); total workload: 1416,67 vs. 725,00 W (p less than 0,001). According to Schwartz and Reibold classification, 44,4% of investigated athletes showed physical fitness higher than average, and only 5,6% of adolescents non-athletes). When comparing athletes vs. non-athletes there were no significant differences in systolic and diastolic BP at rest (p more than 0,05), but diastolic BP was bigger in group of non-athletes during recovery time (65,1 vs. 74,6 mmHg; p less than 0,05). There were no significant differences in Functional Aerobic Impairment (FAI) (22,02 vs. 25,39%; p more than 0,05).

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CONCLUSION

Our study indicates that athletes show significantly better cardiopulmonary fitness than non-athlete students of the

same age.

Keywords: cardiopulmonary fitness exercise-test, adolescents.

INFLUENCE OF BODY MASS AND HEIGHT ON THE ENERGY COST OF RUNNING IN HIGHLY TRAINED MIDDLE AND LONG-DISTANCE RUNNERS

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Previous studies about the influence of body dimensions on running economy have not compared athletes specialized in different competition events. Therefore, the purpose of the present study was to assess the influence of body mass (mb) and height (h) on the energy cost of running (Cr) in 38 highly trained male runners, specialized in either marathon (M, n=12), long middle-distance (5000-10000 m, LMD, n=14) or short middle-distance (800-1500 m, SMD, n=12), and to assess possible differences in body dimensions for each event. Subjects performed a progressive maximal exercise on the treadmill to determine oxygen uptake (VO₂) at different submaximal velocities and maximal oxygen uptake (VO₂max). Cr was calculated from VO₂ measurements.

LMD runners had significantly higher mean Cr (0.192±0.007, 0.182±0.009, and 0.180±0.009 ml O₂ kg⁻¹ m⁻¹ for LMD, M and SMD, respectively) and VO₂max (74.1±3.7, 68.5±2.9 and 69.7±3.4 ml kg⁻¹ min⁻¹). Cr correlated with h (r = -0.86, p < 0.001) and mb (r = -0.77, p < 0.01) only in the SMD group. In conclusion, these data suggest that highly trained distance runners tend to show counterbalancing profiles of running economy and VO₂max (the higher Cr, the higher VO₂max and vice versa), and that anthropometric characteristics related with good performance are different in long-distance and middle-distance events.

Key words: body dimensions, running economy, maximal oxygen uptake, efficiency.

PHYSICAL PERFORMANCE OF FEMALE HANDBALL PLAYERS

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PURPOSE

There are only few data on the physical performance of female handball players in contrast to male athletes.

MATERIAL AND METHODS

We investigated three teams of the first German handball league of men (A, B, C) and one team of the first German handball league of women (F). All participants underwent ergospirometry. The exercise was started at 100 watts with an increase of 50 watts every three minutes. During exercise we measured maximum oxygen uptake (peak VO₂), oxygen uptake at the anaerobic threshold (AT-VO₂), and the maximum performance in watts/kg bw when exercise was discontinued.

RESULTS

Peak VO₂ was 46±6 for A, 44±4.4 for B, 38.4±3.7 for C and

41±4.2 ml/min/kg for FF. AT-VO₂ was 30.9±4.2 for A, 26.7±4.0 for B, 23.7±5.6 for C and 28.9±3.7 ml/min/kg for F. Maximum exercise was 3.5±0.4 for A, 3.4±0.5 for B, 3.6±0.4 for C and 3.5±0.4 watts/kg bw for F. Maximum increase in lactate level was 7.5±2.9 for A, 10.6±2.1 for B, 7.3±1.6 for C and 8.6±3.0 mmol/l for F.

CONCLUSIONS

In comparison to team A and B, team F showed no significant difference in maximum exercise. Peak VO₂ values are better in F than in C (p < 0.0001). There is no significant difference of AT-VO₂ between group F and groups A and B. The mean values obtained show no marked difference among the teams in terms of physical performance.

Key words: ergospirometry, female handball, anaerobic threshold, maximum exercise.

INCREASED GROWTH HORMONE RESPONSE TO PHYSICAL EXERCISE AFTER ACUTE EXPOSURE TO MODERATE HIGH ALTITUDE OCCURS ONLY IN TRAINED SUBJECTS*

Gutiérrez A, González-Gross M, Mesa JLM, Castillo MJ.

Exercise stimulates growth hormone (GH) release in an intensity-dependent fashion. This response can be blunted when the work load overwhelms the physical capacity of the subject. In this case, no beneficial effect is obtained in terms of training. Hypoxia and physical exercise are two independent and additive stressors. In fact, the adaptive hormonal response to exercise is influenced by hypoxia and the physical condition of the subject, but both may act in opposite directions. This study aims at investigating the GH response to a submaximal physical exercise test after acute exposure to moderate high altitude in physically active and sedentary young healthy subjects. Ten trained (T) and ten untrained (UT) male volunteers (mean age 23.8±3.36 years) underwent two submaximal exercise (ergocycle) tests of the same absolute intensity practiced in random order. One test was performed at the habitual living altitude of the subjects (690 m above sea level); the other after acute exposure to 2325 m above sea level. GH, Insulin-like growth factor (IGF-1) and lactate were measured just before and immediately after the exercise

tests. In both experimental conditions, and for both T and UT subjects, plasma GH-IGF-1 levels increased significantly after exercise ($p<0.05$) but hypoxia influenced the GH-IGF-1 response to exercise only in the T group. In fact, the increase in GH-IGF-1 was similar in T and UT subjects when exercise was performed at low altitude, by contrast, that increase was significantly higher in T than in UT when exercise was performed in hypoxic conditions. IGF-1 mirrored the changes of GH. In conclusion, after acute exposure to hypoxia, submaximal exercise increases the growth hormone response only in trained subjects. In untrained subjects, hypoxia may transform a submaximal exercise test in a supramaximal test leading to a blunted GH-IGF-1 response.

Key words: Altitude. Exercise. Lactate. Growth hormone. IGF-1.

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THREE DAYS FAST IN SPORTSMEN DECREASE PHYSICAL WORK CAPACITY BUT NOT STRENGTH OR PERCEPTION-REACTION TIME

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This study investigates the consequences of a three-days fast coupled, or not, to enhanced physical activity in young non-obese healthy athletes. Eight male subjects aged 21±2 years fasted for three days on two separate occasions, four weeks apart. On the first occasion, subjects continued their daily training activities. On the second occasion, a daily physical exercise program was added to these activities. Subjects were evaluated before and after 24 and 72h of fasting. Evaluation consisted of body composition, basal respiratory exchange ratio, plasma metabolic parameters, perception-reaction time (both simple and discriminant), hand grip strength and physical work capacity at 170 beats per minute (PWC170). Fasting determined significant reductions in body weight, body fat

and muscle mass. These reductions were not affected by enhanced physical activity. Basal respiratory exchange ratio decreased with fasting but was not influenced by increased training activities. Fasting determined a significant decrease in blood glucose levels while plasma proteins, urea, uric acid and free fatty acids increased. Perception-reaction time and hand grip strength were unmodified during fasting. By contrast, PWC170 was significantly and progressively reduced during fasting and this decrease was not reversed by an increase in training activities.

Key Words: diet restriction, exercise, fasting.

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DIFFERENCES BETWEEN PCV CALCULATING METHODS

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INTRODUCTION

Hematocrit value (PCV, Plasmatic cellular volume) is one of the blood analytic data used by athletes to control his/her health-performance status related to training. Traditional venous blood analysis has got two important problems, the delay in receiving the results and the excessive amount of blood sample when it is used as a training tool. Previous studies showed excellent correlation between Hematek ESR plus photometer and Westergren reference method for PCV<40 values; but for >40 values, more frequent in athletes, ESR plus results were slightly higher.

OBJECTIVE

Test the accuracy of ESR plus photometer to calculate PCV values (almost immediately and with a small sample).

MATERIAL AND METHODS

32 subjects (21 males and 11 females) participated in the study.

The instruments studied were: Hematek ESR plus photometer (HK) and Rubilabor mod radial (RB). HK uses EDTA coated

calibrated capillary blood tubes, filled with 25 microliter whole blood from an earlobe; the analysis obtained by laser is ready in 3 min. RB is performed with normal capillary blood tubes filled with 50-75 microliter whole blood from an earlobe and needs a manual system to calculate the specific weight and then convert it to real PCV by the tables according to Van Slyke classic method. Results are ready in about 10 min. Three patterns of the same subject were used for each analyzer, choosing the medial value for the study.

RESULTS

After a Student's T comparison test, statistical differences were found between both methods; correlation coefficient $r=0.980$, $p<0.01$; Range: HK: 39.5-52.9, and RB: 38.4-50.1; Mean values: HK: 45.2 \pm 3.6, and RB: 44.3 \pm 3.3

CONCLUSIONS

There are significant statistical differences in between both whole blood methods. Results are in the same health range so no important clinical differences ought to be seen.

Key words: Hematocrit, photometer, analysis, blood.

EFFECTS OF PHYSICAL EXERCISE ON THE LEVELS OF AMMONIA IN SWEAT AND IN BLOOD: RELATIONSHIP WITH MUSCULAR DAMAGE

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PURPOSE

Damage caused by exercise or the risk of provoking it could be controlled by non-invasive ways through the sweat, since it is known that it presents characteristics similar to plasma.

MATERIALS AND METHODS

We studied 14 university players of rugby (males, 30 years old, weight of 87 kg and VO_{2max} of 48 ml*kg*min⁻¹). After collection of samples in rest a cycloergometer test, with increments of 25 w min⁻¹ until exhaustion, was carried out. Samples of sweat were collected at the beginning of an official match and, by means of humid sauna, before the match and at 24,48 and 72 hrs later. VO_2 was estimated during the match front heart rate data. Samples of blood were also collected both in the match and the saunas. The sweat was picked up through sheets stuck to the skin (24 cm²). The variables in sweat were expressed as accumulated concentration (x*L) and in function of the volume of sweat (x), of the corporal surface (x*m²) and of time (x m² min⁻¹).

RESULTS

At an intensive of effort during the match estimated at 80% of VO_{2max} (38,5 \pm 5,8ml kg min⁻¹, creatin kinase activity (CK) reached a maximum at 24 hrs (350 \pm 126 UL versus 140 \pm 85 U L at rest, $P<0,05$) returning to values near to the normality at 72 hrs (160 \pm 83 UL, $P<0,05$). Ammonia and urea increased progressively in blood at 24, 48 and 72 hrs after the match (ammonia=29-36-44 mmol L; urea=3,8-4,5-4,6 mmol L). Sweat ammonia and urea (x L) presented a profile similar to blood during those periods. When corrected for volume (x) and corporal surface (x m²), urea in sweat at 24 and 48 hrs and ammonia at 24 hrs were significantly lower than rest values ($P<0.05$). This coincides with the increment of the muscular damage marker (CK) at 24 hrs.

CONCLUSION

1) Exercise causes changes in the concentration of ammonia and urea both in plasma and sweat that can partly represent

internal metabolic modifications caused by muscular damage.
2) the corrections applied in the sweat measurements are an alternative for the standardization of future non-invasive

analysis when different samples are compared.

Words key: Sweat, muscular damage, ammonia, urea.

CORRELATION PLASMA/SWEAT, IN EXERCISE AND IN REST, FOR UREA, AMMONIA AND LACTATE

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PURPOSE

The different constituents found in sweat allow to consider it as a plasmatic ultrafiltrated. Some of these components are affected by glandular activity. The aim of this work was to study the correlation among plasma and sweat concentration of different sweat constituents.

MATERIALS AND METHODS

14 university sportsmen (males, 30 years-old, weight of 87 kg and VO₂max of 48 ml kg min⁻¹) were enrolled. Sweat was collected through sheets stuck to the (24 cm²). Values in sweat were expressed as accumulated concentration (xL) and as function of the volume of sweat (x), of the corporal surface (x m²) and of time (x m² min⁻¹). Samples were collected under 6 different conditions: 1) in rest (minimum 4 days without training during cycloergometry, with increments of 25 w min⁻¹ until achieving the exhaustion; 3) in an official match of rugby; 4) 24 hrs later; 5) 48 hrs later, and, 6) 72 hrs later. Sweat samples 5 and 6 were obtained after sweating stimulation with humid sauna (relative humidity 86%

temperature 82°C), and blood near to the application of sauna. In the cases 2 and 3 blood collected among the minute 4 and 5 after the effort and sweat at 10 minutes.

RESULTS

The correlations plasma/sweat are shown as: total (n=84); without exercise (sauna of rest and days after the match, n=56) and in exercise (ergometry plus match, n=28).

When correcting data in function of the volume of excreted sweat excreted, improver were detected only for ammonia and lactate correlations in the ergometry test. Corrections in function of the corporal surface and time did not produce significant changes.

CONCLUSIONS

The concentration of urea in sweat was significant correlated, with plasma urea, both in rest and in exercise. Concentrations may be directly expressed without necessity of corrections.

Words key: Sweat, ammonia, urea, lactate.

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PLASMA/SWEAT	1+2+3+4+5+6/n=84	1+4+5+6/n=56	2+3/n=28
Ammonia (μmol-L)	R=0,54 **	R=0,11	R=0,21
Urea (mmol-L)	R=0,66**	R=0,76	R=0,50*
Lactate (mmol-L)	R=0,58**	R=0,08	R=0,74*

(*) P < 0.0 1; (**) P < 0 .00

SENSITIVITY OF THE YO-YO TEST TO MONITOR CHANGES IN ENDURANCE PERFORMANCE DURING THE SEASON

Oliveira J., Magalhães J., Ascensão A., Marques A., Soares J.M.C.

Endurance is an important physical capacity in soccer related with the ability to exercise during prolonged periods of time and at high intensities as well as to recover rapidly (Bangsbo,1994). Training schedules must include the development of endurance and several moments of assessment for controlling the functional level of the players. Recently a simple and not time-consuming intermittent field test was developed by Jens Bangsbo (1996) to evaluate endurance in

intermittent sports. The main goal of the present study was to determine the sensitivity of the Yo-Yo Intermittent Endurance Test – Level Two (Bangsbo, 1996) to assess changes in endurance performance induced by training and detraining in different periods of the season.

The subjects were fourteen male pro soccer players (age: 26.9 ± 4.1 yrs; weight: 76.5 ± 5.6 kg; height: 176.7 ± 7.5 cms) who

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were evaluated in four different moments during the season: beginning of pre-season (PS); competitive period: four (CP1) and seven (CP2) months after starting the season; in the final of transition period (TP). The assessment conditions were almost similar (surface, hour, temperature) in the four different moments. For data analysis we used the procedures of descriptive statistics (mean, standard deviation) and the repeated measures ANOVA for testing the mean differences between the four moments of evaluation.

Results are presented in table 1.

The results have showed that the distance performed in the two moments of the competitive period (CP1 and CP2) were

significantly different from those registered in the detraining periods (PS and TP). During the competitive period, the Yo-Yo mean distance covered in PC2, although superior to that registered in PC1, it was not significantly different.

Therefore, the Yo-Yo test seems to be sensitive to the longitudinal changes in endurance performance induced by training and detraining through the soccer season. Concluding, the Yo-Yo test is a simple and not time-consuming instrument to evaluate endurance providing valuable information to the coach concerning the level of athlete's endurance conditioning.

Key words: endurance, chronic adaptation, intermittent exercise, evaluation.

	PS	CP1	CP2	TP
Mean±sd	1251.4±280.4	1601.4±318.2*	1734.2±476.3**	1251.4±287.7
Range	800-1720	1240-2360	1000-2520	800-1760

TABLE 1.- Distance covered in different moments of the season.

*statistically different CP1 vs. PS and TP: $p < 0.05$

** statistically different CP2 vs. PS and TP: $p < 0.05$

PHYSIOLOGICAL AND PERFORMANCE RESPONSES TO A 6- DAY TAPER IN MIDDLE-DISTANCE RUNNERS: INFLUENCE OF TRAINING FREQUENCY

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PURPOSE

To examine the influence of training frequency on performance and some physiological responses during a 6-day taper. Methods: after 18 wk of training, 9 male middle-distance runners were assigned to a high frequency taper (HFT, N = 5) or a moderate frequency taper (MFT, N = 4), consisting of training daily or resting every third day of the taper. Taper consisted of an 80% nonlinear progressive reduction in high intensity interval training. Blood samples were obtained, and 800-m performance and peak blood lactate ([La]peak) measured before and after taper. Results: performance improved more ($P < 0.05$) after HFT (121.8 ± 4.7 vs 124.2 ± 4.9 s) than MFT (126.6 ± 2.8 vs 127.1 ± 2.1 s). Neutrophils (2.89 ± 0.68 vs 2.56 ± 0.61 103.mm⁻³),

granulocytes (3.08 ± 0.70 vs 2.77 ± 0.66 103.mm⁻³), haptoglobin (79.7 ± 47.9 vs 60.7 ± 33.6 mg.dl⁻¹), total testosterone (7.39 ± 1.67 vs 5.52 ± 0.88 µg.l⁻¹) and [La]peak (15.5 ± 1.5 vs 14.4 ± 2.0 mmol.l⁻¹) significantly increased with taper. [La]peak correlated with performance time before taper ($r = -0.76$, $P < 0.05$), and change in [La]peak with change in serum cortisol ($r = -0.75$, $P < 0.05$) and total testosterone:cortisol ratio ($r = 0.82$, $P < 0.01$). Conclusion: training daily during a 6-d taper brought about higher performance gains than resting every third day. High [La]peak and a hormonal milieu propitious to anabolic processes seemed to be necessary for optimum performance.

Keywords: granulocytes, haptoglobin, testosterone, cortisol, lactate.

SERUM MYOGLOBIN AS ADDITIONAL MARKER OF MUSCLE METABOLISM-A STUDY AMONG GERMAN TOP HANDBALL PLAYERS

Mellwig K.P., Van Buuren F., Schmidt H.K., J. Körfer H.K., Bergemann C., Horstkotte D.

PURPOSE

Creatinine kinase (CK) is regarded as a laboratory parameter for the analysis of muscle metabolism. Major physical performance, particularly of isometric kind, is associated with an

increase in CK. In order to more accurately assess muscle metabolism, serum myoglobin was measured as an additional parameter.

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MATERIALS AND METHODS

We investigated 40 players of three clubs of the first German handball league. Five of them belonged to the German team at the 2000 Olympic Games (OG) in Sydney, who had been subject to even major physical stress and had to cope with a shorter recovery period. Following clinical/cardiological examination, the athletes underwent ergospirometry. In addition, serum myoglobin was measured.

RESULTS

In team I (n=14), the mean value for serum CK was 324.6 ± 152.8 U/L and for serum myoglobin 178.5 ± 84.2 mg/l, in team II (n=13) 154.1 ± 82.8 U/l and 36.0 ± 13.7 mg/l, in

team III (n=13) 228.0 ± 213.7 U/l and 56.4 ± 33.7 mg/l, respectively. When considering the OG group alone (n=5) mean CK was 287.4 ± 207.0 U/l, mean myoglobin 135.0 ± 62.9 mg/l.

CONCLUSIONS

Myoglobin serves as an additional parameter for the assessment of physical performance. Because of the shorter half-time of myoglobin compared to CK, markedly increased values indicate a muscular stress shortly before.

Key words: muscle metabolism, serum myoglobin, creatinine kinase, handball players.

VO2MÁX EN DISTINTAS FASES DEL CICLO OVÁRICO

Martínez Jiménez R, Martínez Martínez H, Gómez Trullén EM, Blasco Gómez A, Ladaga A, Martínez Ballarín E.

OBJETIVO

Se estudió la capacidad física de un grupo de mujeres en las fases del ciclo ovárico folicular (FF) y lútea (FL), valorando el VO₂máx y su relación con otros parámetros antropométricos.

MATERIAL Y MÉTODOS

Una población de 37 mujeres púberes, de edad entre 14 y 16 años, realizaron pruebas de esfuerzo submáximas en cicloergómetro para valorar su VO₂máx, que se relacionó con la superficie corporal (SP) y el índice de masa corporal (IMC). En extracciones sanguíneas basales se determinó la progesterona en plasma y el pico de LH que permitió dividir la población en grupos ovulatorio (OV) y anovulatorio (AN).

RESULTADOS

El VO₂máx. fue mayor en la segunda fase del ciclo, tanto en el grupo OV como en el AN, aunque sin diferencias significativas. El IMC (kg/m²) fue mayor en OV (21.85) que en AN (20.90) sin embargo, la superficie corporal (m²) fue semejante en ambos grupos (1.60). Estos parámetros antropométricos se correlacionan con VO₂máx y VO₂máx/peso, tanto en FF como en FL, obteniéndose en AN correlaciones moderadas o buenas ante IMC y VO₂máx, ($r = 0.6$ en FF y $R = 0.6$ y $r = 0.9$ en FL).

CONCLUSIONES

Según nuestro estudio podremos concluir: 1) VO₂máx aumenta en la fase lútea de ciclos ováricos ovulatorios y anovulatorios. 2) En ambas fases de ciclos anovulatorios, IMC y SC se correlacionan positivamente con VO₂máx.

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THE CORRELATION BETWEEN THE NEURO-PSYCHICAL QUALITIES AND THE ANAEROBIC EFFORT CAPACITY OF THE TOP-LEVEL SPORTSMEN

Codita Ionela, MD; Ionescu Anca, PhD; Gheorghiu Doina.

OBJECT

The aim of this study was to establish the correlation between neuro-psychical qualities of the top-level sportsmen and the value of the anaerobic effort capacity in the sports games. We have chosen this correlation because that the requests of the anaerobic efforts are especially neuro-psychical and neuromuscular ones.

METHODS

In the National Institute of Sports Medicine we have tested on 216 middle age 24+/-5 year-sportsmen who were members of national football, rugby and handball teams. The valuation of the anaerobic effort capacity has been taken by the TTR method (10" for the alactic anaerobic maximum power and 45" for the lactic anaerobic maximum capacity). At the end of

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the valuation of the neuro-psychical qualities of those sportsmen, we have made tests on the kinesthetic sensibility and the concentrated and distributive attention. This study has been done during the period of time between the 1-st of January 1999 and the 1-st of June 2001.

RESULTS

Applying the correlation coefficient, we have observed that, the sportsmen having high values for both of TTR, the

correlation referring to the neuro-psychical qualities has been usually very good.

CONCLUSIONS

The results of this study indicate on one hand that the neuro-psychical qualities are good, and on the other hand that the level of the anaerobic effort capacity obtained after the training is high, and there for the correlation coefficient is superior.

PERCEIVED EXERTION, PERCEIVED RECOVERY AND MORNING BLOOD UREA DURING PRO-CYCLING COMPETITION

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The purpose of this study was to evaluate perceived fatigue, perceived recovery (TQR) and rest blood urea during a pro-cycling competition.

METHODS

9 world class pro-cyclists were studied during a professional multi-stage cycling race (1999 "Giro d'Italia"). Heart rate was recorded during each stage. Also, global (RPE-G) and local (RPE-L) perceived fatigue after exercise was evaluated. In the morning TQR, BU and delta blood urea (D-BU: difference between two consecutive morning values) were studied.

RESULTS

The mean heart rate (mHR) for the overall race was of 133.8 ± 17.9 beats/minute. The mean total time (TT) of each stage was 269.6 ± 122 minutes (min). The mean stage time over 90% of VO₂ max (AN) was 17.5 ± 15.7 min; the time between 90 and 70% of VO₂ max (IA) was 75.2 ± 47.6 min; the time between 70 and 50% of VO₂ max (MA) was 97.2 ± 57.4 and the time under 50 % of VO₂ max (RE) was 79.6 ± 60.5 min. These results are similar to those observed in the other two top level multi-stage cycling races (Tour of France and Tour of Spain). Mean RPE-G and RPE-L during

the whole race was 14.39 ± 2.24 and 14.18 ± 1.53 respectively. There is a significant relationship between RPE-G and RPE-L ($r=0.899$). During mountain stages the exercise was rated between "hard" and "very hard", (mean RPE-G was 16.31 ± 1.91), while in the other stages were rated as "some hard" (13.29 ± 1.59). Also, there was a significant correlation between RPE-G and IA and the TT. Mean TQR during whole race was 14.26 ± 0.96 . TQR decreased, as expected, along the race, however after the first week of the race the level of morning TQR remained in a steady state (plateau). There was a negative significant correlation between TQR and BU ($r=-0.637$), when morning BU increase, increase the feeling of tiredness in the TQR scale. In this way, there is a high relationship between D-BU and G-RPE ($r=0.882$) and RPE-L ($r=0.827$).

CONCLUSIONS

There are no differences between RPE-G and RPE-L response to exercise during cycling competition, and both could be useful in professional cycling evaluation. BU is a parameter that could be used as an indicator of poor recovery. And D-BU is related to previous RPE-G and RPE-L.

Key words: Blood urea, perceived exertion, cycling, exercise intensity.

ENDOTHELIAL NITRIC OXIDE SYNTHASE GENE EXPRESSION IN LYMPHOCYTES FROM ENDURANCE ATHLETES AND ROLE OF ECNOS GENE-VARIATION IN PHYSICAL PERFORMANCE

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Nefrológica an Nitric oxide modulates several physiological responses to exercise, such as hypoxic vasodilatation, flow dilation of arterioles and myogenic coronary responses, and the maintenance of the balance between oxygen supply to tissue and metabolic demand. NO-production would be involved in the physiological adaptations to training. Our aim was to analyse the levels of endothelial constitutive Nitric Oxide Synthase (ecNOS) mRNA in leukocytes from elite-endurance athletes and healthy non-trained controls. In addition, we genotyped elite athletes and controls for two DNA polymorphisms at the ecNOS gene to define a possible association to physical performance. A total of 10 athletes and 10 controls contributed to the ecNOS expression analysis. A total of 73 athletes and 216 controls were genotyped for the intron 4 VTR and -786 T/C polymorphisms at the ecNOS gene. RNA was isolated from leukocytes of athletes and controls. Total cDNA was synthesised and a fragment from the ecNOS sequence was PCR-amplified (30 cycles). The β 2macroglobulin was used as an internal control. For the analysis of the two ecNOS polymorphisms, genomic DNA

was PCR-amplified and electrophoresed either directly (intron 4 VTR) or after digestion with MspI (-786 T/C). The chi-square test was used to compare allele and genotype frequencies between athletes and controls. Leukocytes from athletes amplified higher amounts of ecNOS than non-trained individuals. Allele and genotype frequencies did not differ between athletes and controls, suggesting a lack of association between these ecNOS-gene variants and the condition of elite-athlete.

CONCLUSION

Leukocytes from athletes amplified higher amounts of the ecNOS-cDNA sequence compared to non trained controls. This is in agreement with a role for ecNOS-expression in response to physical training. The VTR and the -786 T/C ecNOS-polymorphisms would not contribute to the making of an endurance athlete.

Key-Words: Nitric oxide. Physical performance. Gene expression. DNA-polymorphisms.

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PHYSIOLOGICAL DIFFERENCES AND RATING OF PERCEIVED EXERTION (RPE) IN PROFESSIONAL, AMATEUR AND YOUNG CYCLISTS

Pérez-Landaluce Javier, Fernández-García Benjamín, Rodríguez-Alonso Manuel, García-Herrero Fernando, García-Zapico Pedro, M. Patterson Angeles, and Terrados Nicolás.

BACKGROUND

The aim of this study is to measure and compare the physiological characteristics and the rating of perceived exertion (RPE) in 72 high level road cyclists of three different categories. METHODS: These cyclists were divided in three groups according to their age and sport category (24 professional, 22 amateur and 26 junior). Measures. They carried out a progressive test to exhaustion in a specific cycloergometer, starting with a power output of 100 watts and increasing 50 watts each 4 minutes. VO₂ was measured continuously. At the end of each one of the 4 minutes step the subject is asked about his RPE using the 6-20 Borg scale. RESULTS: Professional cyclists showed a VO₂ max, VO₂.kg⁻¹ and a maximum power output significantly higher than other groups, while there are not significant differences

between amateurs and juniors. VO₂ max and RPE are significantly different, in all the categories, with high loads. No significant differences are found between RPE and %VO₂ max. RPE and heart rate (FC) are significantly different between professionals and juniors. RPE and %FC max are significantly different with low loads, but not with high loads. In the same way, RPE/w and RPE/(w.kg⁻¹) are significantly different in all categories. CONCLUSIONS: We conclude that professional road cyclists reached a VO₂ max, VO₂ max.kg⁻¹ and a maximum power higher than the other categories; so, therefore these parameters are good as performance indicators, and RPE is of practical value to prescribe exercise training intensities in each category.

Key Words: Perception of effort, exercise intensity, oxygen uptake, graded exercise, heart rate, cycling.

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