

Nº de abstracts = **72**

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Attenuated relationship between cardiac output and oxygen uptake during high-intensity exercise.

Trinity JD, Lee JF, Pahnke MD, Beck KC, Coyle EF.: Acta Physiologica (Oxford, England), Março 2012, 204(3):362-70.

Aim: Recent findings have challenged the belief that the cardiac output (CO) and oxygen consumption (VO_2) relationship is linear from rest to maximal exercise. The purpose of this study was to determine the CO and stroke volume (SV) response to a range of exercise intensities, 40-100% of $\text{VO}_{2\text{max}}$, during cycling. Methods: Ten well-trained cyclists performed a series of discontinuous exercise bouts to determine the CO and SV vs. VO_2

responses. Results: The rate of increase in CO, relative to VO_2

, during exercise from 40 to 70% of $\text{VO}_{2\text{max}}$ was $4.4 \pm 1.4 \text{ L L}^{-1}$

. During exercise at 70-100% of $\text{VO}_{2\text{max}}$, the rate of increase in CO was reduced to $2.1 \pm 0.9 \text{ L L}^{-1}$ ($P = 0.01$). Stroke volume during exercise at 80-100% of $\text{VO}_{2\text{max}}$ was reduced by 7% when compared to exercise at 50-70% of $\text{VO}_{2\text{max}}$ (134 ± 5 vs. $143 \pm 5 \text{ ml per beat}$, $P = 0.02$). Whole body arterial-venous O

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difference increased significantly as intensity increased. Conclusion: The observation that the rate of increase in CO is reduced as exercise intensity increases suggests that cardiovascular performance displays signs of compromised function before maximal VO

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is reached.

A new VO₂max protocol allowing self-pacing in maximal incremental exercise.

Mauger AR, Sculthorpe N.: British Journal of Sports Medicine, Jan 2012, 46(1):59-63.

Introduction The traditional maximal oxygen uptake (VO₂max)) protocol has received criticism for being an unnatural form of exercise, lacking ecological validity and producing different VO

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max) responses depending on protocol duration and work rate increments. Purpose The purpose of this investigation was to design and test a new VO

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max) protocol allowing subjects to self-pace their work rate while maintaining an incremental test structure. Methods 16 untrained subjects completed a self-paced VO

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max) protocol (SPV) and a traditional VO

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max) test in a counter-balanced, crossover design. The SPV used incremental 'clamps' of ratings of perceived exertion (RPE) over 5 × 2-min stages (10-min duration) while allowing subjects to vary their power output (PO) according to the required RPE. Results Subjects achieved significantly higher (p

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max) values (40 ± 10 ml/kg/min vs 37 ± 8 ml/kg/min) and peak POs (273 ± 58 W vs 238 ± 55 W) in the SPV. Higher VO

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max) values were observed in the SPV even when a plateau (VO

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-time slope 1500 m) or high altitudes during either continuous or intermittent altitude preexposures. Generally, the degree of altitude acclimatization developed is proportional to the altitude attained and the duration of exposure. The available evidence suggests that continuous residence at 2200 m or higher for 1 to 2 days or daily 1.5- to 4-h exposures to >4000 m induce ventilatory acclimatization. Six days at 2200 m substantially decreases acute mountain sickness (AMS) and improves work performance after rapid ascent to 4300 m. There is evidence that 5 or more days above 3000 m within the last 2 months will significantly decrease AMS during a subsequent rapid ascent to 4500 m. Exercise training during the altitude preexposures may augment improvement in physical performance. The persistence of altitude acclimatization after return to low altitude appears to be proportional to the degree of acclimatization developed. The subsequent ascent to high altitude should be scheduled as soon as possible after the last altitude preexposure.

American medical research expedition to Everest.

West JB.: High altitude medicine & biology, 2010, 11(2):103-10. Department of Medicine, University of California San Diego, La Jolla, 92093-0623, USA.

The primary objective of the American Medical Research Expedition to Everest was to obtain information on human physiology at the highest possible altitude, including the Everest summit. An important data point was the barometric pressure on the summit, because this determines the inspired $P(O_2)$. The first measurement ever taken was 253.0 mmHg. Because modeling studies had shown that extreme hyperventilation was essential to reach these great altitudes, 34 alveolar gas samples were collected above an altitude of 8000 m, including 4 on the summit. These showed that hyperventilation reduced the alveolar $P(CO_2)$ to between 7 and 8 mmHg in one climber. An important finding was that alveolar $P(O_2)$ was defended at a value of about 35

mmHg by the increasing hyperventilation as the climbers ascended higher. Venous blood samples collected on two summiters gave a mean base excess of -7.2 meq.L^{-1} . Using the alveolar $P(\text{CO}_2)$ value, this gave an arterial pH of over 7.7, indicating an extreme degree of respiratory alkalosis. While climbing at an altitude of 8300 m, one summitter showed a respiratory frequency of $86 \text{ breaths.min}^{-1}$ and tidal volume of 1.26 L, indicating very rapid shallow breathing. Maximal oxygen consumption for the summit was derived by having well-acclimatized subjects exercise maximally at an altitude of 6300 m while breathing 14% oxygen. The $V(\text{O}_2)$ was just over 1 L.min^{-1} , which is sufficient to explain how exceptional humans can reach the summit without supplementary oxygen. In addition to the measurements at altitudes over 8000 m, data were obtained at two camps at 5400- and 6300-m altitude. These gave information on the control of ventilation, periodic breathing, blood physiology, cerebral function, and metabolism.

A longitudinal assessment of running economy and tendon properties in long-distance runners.

Kubo K, Tabata T, Ikebukuro T, Igarashi K, Tsunoda N.: Journal of strength and conditioning research / National Strength & Conditioning Association, 2010, 24(7):1724-31. Department of Life Science, University of Tokyo, Meguro, Tokyo, Japan.

The aim of this study was to investigate longitudinal changes in tendon properties and running economy of long-distance runners (LDRs) in the preparatory periods of track season (TS) and road season (RS). Eleven well-trained LDRs and 6 untrained subjects participated in the present study. In each period, muscle strength, neural activation level, and tendon elongation for both knee extensors and plantar flexors, jump performances, and oxygen consumption during submaximal running velocities were measured. No significant differences observed in any measured variables between the 2 seasons for untrained subjects. For LDRs, the total running distance during 1 month preceding RS ($832 \pm 95 \text{ km}$) was significantly longer than that during 1 month preceding TS ($718 \pm 80 \text{ km}$). No significant differences in the muscle strength,

neural activation level, and jump performances were found between TS and RS. The stiffness of tendon structures in RS was significantly lower than those in TS for both knee extensors (-14.4%, $p = 0.023$) and plantar flexors (-16.6%, $p = 0.040$). At 3 running velocities, the oxygen consumptions in RS were significantly lower than those in TS. These results suggested that the lower oxygen consumption during submaximal running velocities observed in the preparatory period of RS may be attributable to the more compliant tendon structures but not in the neuromuscular characteristics.

Physiological demands of team-handball referees during games.

da Silva JF, Castagna C, Carminatti LJ, Foza V, Guglielmo LG, de Oliveira FR.: Journal of strength and conditioning research / National Strength & Conditioning Association, 2010, 24(7):1960-2.

Physical Effort Laboratory, Sports Center, Federal University of Santa Catarina, Florianópolis, Brazil.

The objective of the present study was to examine the aerobic fitness and the physiological demands during competitive games in elite handball referees. Sixteen referees (age: 34.9 ± 3.4 years, body mass: 77.4 ± 10.6 kg, height: 173.5 ± 7.5 cm, percent fat: $22.3 \pm 6.6\%$) of national and international levels (14 men and 2 women) were submitted to a multistage fitness test, to determine peak velocity (PV) and maximal heart rate (HR). After 48 hours, referees performed a submaximal intermittent shuttle-running test (3 minutes at 75 and 90% PV with 1-minute recovery), to determine speeds and HR at selected blood-lactate concentrations (2.0 and 4.0 mmol.L(-1)). Game intensities were arbitrarily established as follows: HR4mmol (severe). Eight referees (2 per game) were monitored in 4 national level games. The mean $\text{VO}(2)\text{max}$ of the referees was 48.5 ± 6.1 ml.kg(-1).min(-1). Maximal HR, HR2mmol, and HR4mmol were 193 ± 10 , 154 ± 13 , and 167 ± 10 b.min, respectively. The percent time spent in the moderate intensity domain was predominant (moderate 96.4%, heavy 2.3%, and severe 1.3% of total time, p

Physical and physiological attributes of female volleyball players--a review

Lidor R, Ziv G.: Journal of strength and conditioning research / National Strength & Conditioning Association, 2010, 24(7):1963-73. The Zinman College of Physical Education and Sport Sciences, Wingate Institute.

The main objective of this article was to review a series of studies ($n = 31$) on physical attributes, physiological attributes, and on-court performances of female volleyball players. Empirical and practical knowledge emerging from studies on training-related issues in volleyball, such as body mass, fat-free mass, aerobic profile, strength, and agility and speed, should be integrated and applied when planning annual training programs for volleyball players. Based on our review, it was found that (a) players of a higher skill level are taller, somewhat heavier, and have higher vertical jump values than players of a lower level; (b) the aerobic profile of female volleyball players is similar to that of female basketball players; (c) ballistic resistance training can increase vertical jump values in female volleyball players; and (d) preseason conditioning should be conducted to prevent fatigue and reduced performance at the beginning of the season. Among the research concerns discussed in the article are that there is a lack data for on-court performance and time-motion analysis in female volleyball players and that more experimental/manipulative studies are needed to examine the effectiveness of different training programs on physiological attributes of female volleyball players. Two practical implications are suggested for volleyball and strength and conditioning coaches: (a) functional and nonfunctional overreaching should be carefully monitored when planning strength and conditioning programs, and (b) volleyball programs should include ballistic-type training.

Using molecular classification to predict gains in maximal aerobic capacity following endurance exercise training in humans.

Timmons JA, Knudsen S, Rankinen T, Koch LG, Sarzynski M, Jensen T, Keller P, Scheele C, Volllaard NB, Nielsen S, Akerström T, MacDougald OA, Jansson E, Greenhaff PL, Tarnopolsky MA, van Loon LJ, Pedersen BK, Sundberg CJ, Wahlestedt C, Britton SL, Bouchard C.: *Journal of applied physiology* (Bethesda, Md. : 1985), 2010-06 108(6):1487-96.

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A low maximal oxygen consumption (VO₂max) is a strong risk factor for premature mortality. Supervised endurance exercise training increases VO₂max with a very wide range of effectiveness in humans. Discovering the DNA variants that contribute to this heterogeneity typically requires substantial sample sizes. In the present study, we first use RNA expression profiling to produce a molecular classifier that predicts VO₂max training response. We then hypothesized that the classifier genes would harbor DNA variants that contributed to the heterogeneous VO₂max response. Two independent preintervention RNA expression data sets were generated (n=41 gene chips) from subjects that underwent supervised endurance training: one identified and the second blindly validated an RNA expression signature that predicted change in VO₂max ("predictor" genes). The HERITAGE Family Study (n=473) was used for genotyping. We discovered a 29-RNA signature that predicted VO₂max training response on a continuous scale; these genes contained approximately 6 new single-nucleotide polymorphisms associated with gains in VO₂max in the HERITAGE Family Study. Three of four novel candidate genes from the HERITAGE Family Study were confirmed as RNA predictor genes (i.e., "reciprocal" RNA validation of a quantitative trait locus genotype), enhancing the performance of the 29-RNA-based predictor. Notably, RNA abundance for the predictor genes was unchanged by exercise training, supporting the idea that expression was preset by genetic variation. Regression analysis yielded a model where 11 single-nucleotide polymorphisms explained 23% of the variance in gains in VO₂max, corresponding to approximately 50% of the estimated genetic variance for VO₂max. In conclusion, combining RNA profiling with single-gene DNA marker association analysis yields a strongly validated molecular predictor with meaningful explanatory power. VO₂max responses to endurance training can be predicted by measuring a approximately 30-gene RNA expression signature in muscle prior to training. The general approach taken could accelerate the discovery of genetic biomarkers, sufficiently discrete for diagnostic purposes, for a range of physiological and pharmacological phenotypes in humans.

Myocellular basis for tapering in competitive distance runners.

Luden N, Hayes E, Galpin A, Minchev K, Jemioło B, Raue U, Trappe TA, Harber MP, Bowers T, Trappe S.: Journal of applied physiology (Bethesda, Md. : 1985), 2010-06 108(6):1501-9. Human Performance Laboratory, Ball State University, Muncie, IN 47306, USA.

The purpose of this study was to examine the effects of a 3-wk taper on the physiology of competitive distance runners. We studied seven collegiate distance runners (20 \pm 1 yr, 66 \pm 1 kg) before and after a 3-wk taper. The primary measures included 8-km cross-country race performance, gastrocnemius single muscle fiber size and function (peak force, shortening velocity, and power), baseline and exercise-induced gene expression 4 h after a standardized 8-km run, citrate synthase activity, and maximal and submaximal cardiovascular physiology (oxygen consumption, ventilation, heart rate, and respiratory exchange ratio). Race performance improved by 3% following taper ($P=0.08$). Conclusion: Altogether, prolonged exercise at given percentages of $\dot{V}O_{2\max}$ leads to inhomogeneous metabolic strain as indicated by the large variability of La responses. This holds true even in subgroups of similar aerobic capacity. Thus, intensity prescription for endurance training and study purposes should not be solely based upon percentages of $\dot{V}O_{2\max}$ when a comparable metabolic strain is intended.

Physiological determinants of Yo-Yo intermittent recovery tests in male soccer players.

Rampinini E, Sassi A, Azzalin A, Castagna C, Menaspà P, Carlomagno D, Impellizzeri FM

European Journal of Applied Physiology, 201001 108(2):401-9. Human Performance Laboratory, MAPEI Sport Research Center, Castellanza, Varese, Italy.

The physiological determinants of performance in two Yo-Yo intermittent recovery tests (Yo-YoIR1 and Yo-YoIR2) were examined in 25 professional ($n = 13$) and amateur ($n = 12$) soccer players. The aims of the study were (1) to examine the differences in physiological responses to Yo-YoIR1 and Yo-YoIR2, (2) to determine the relationship between the aerobic and physiological responses to standardized high-intensity intermittent exercise (HIT) and Yo-Yo performance, and (3) to investigate the differences between professional and amateur players in performance and responses to these tests. All players performed six tests: two versions of the Yo-Yo tests, a test for the determination of maximum oxygen uptake ([Formula: see text]), a double test to determine [Formula: see text] kinetics and a HIT evaluation during which several physiological responses were measured. The anaerobic contribution was greatest during Yo-YoIR2. [Formula: see text] was strongly correlated with Yo-YoIR1 ($r = 0.74$) but only moderately related to Yo-YoIR2 ($r = 0.47$). The time constant (τ) of [Formula: see text] kinetics was largely related to both Yo-Yo tests (Yo-YoIR1: $r = 0.60$ and Yo-YoIR2: $r = 0.65$). The relationships between physiological variables measured during HIT (blood $\text{La}(-)$, $\text{H}(+)$, $\text{HCO}_3(-)$ and the rate of $\text{La}(-)$ accumulation) and Yo-Yo performance (in both versions) were very large ($r > 0.70$). The physiological responses to HIT and the τ of the [Formula: see text] kinetics were significantly different between professional and amateur soccer players, whilst [Formula: see text] was not significantly different between the two groups. In conclusion, [Formula: see text] is more important for Yo-YoIR1 performance, whilst τ of the [Formula: see text] kinetics and the ability to maintain acid-base balance are important physiological factors for both Yo-Yo tests.

Yo-Yo intermittent recovery test versus the Université de Montréal Track Test: relation with a high-intensity intermittent exercise.

Dupont G, Defontaine M, Bosquet L, Blondel N, Moalla W, Berthoin S.: Journal of Science and Medicine in Sport / Sports Medicine Australia, 201001 13(1):146-50.

Laboratory of Human Movement Studies, Faculty of Sports Sciences and Physical Education, Artois and Lille 2 Universities, France.

The first Purpose of this study was to determine whether the peak velocity (V(Yo-Yo)) achieved during the Yo-Yo intermittent recovery test (Yo-Yo) and the maximal aerobic velocity (MAV) determined from the Université de Montréal Track Test (UMTT) could be used interchangeably. The second Purpose was to check that the V(Yo-Yo) is related to the intermittent exercise performance, which consisted of repeated 90 m distance runs in 15s performed until exhaustion, alternated with 15s of passive recovery (15/15). Fourteen amateur soccer players performed, in a random order, the 15/15 and two incremental field-tests: the Yo-Yo and the UMTT. The results of this study showed that MAV was significantly correlated to the V(Yo-Yo) ($r=0.79$, $p 0.05$). Results showed that VO₂max may be considered a competitive-level dependent physical variable in futsal. VO₂max values of or above 60 mLxkgxmin are advisable to play futsal at the professional level.

Aerobic and explosive power performance of elite italian regional-level basketball players.

Castagna C, Chaouachi A, Rampinini E, Chamari K, Impellizzeri F.: Journal of Strength and Conditioning Research / National Strength & Conditioning Association

, 23(7):1982-7, 2009.

Faculty of Medicine and Surgery, School of Sport and Exercise Sciences, University of Rome Tor Vergata, Rome, Italy.

The aim of this study was to examine the aerobic fitness and lower-limbs explosive-power abilities of Italian regional-level amateur basketball players. Participants were basketball players playing successfully at a senior (S, $n = 11$) and junior (J, $n = 11$) regional level. Players maximal

oxygen uptake (VO₂max) was assessed with them wearing a portable gas analyzer (K4b, COSMED, Rome, Italy) during an exercise mode-specific multistage fitness test (yo-yo endurance test [Yo-Yo]). Knee extensors and plantar flexors explosive power was assessed with countermovement jump (CMJ) and stiff-leg jumps (SL), respectively. Jumps were performed using a switch mat connected to a computer (Muscle Lab, Bosco System, Rome, Italy). Jumps' fly (FT) and contact times (CT) were used for jump performances calculations. Stiff-Leg FT versus CT ratio (SL/CT) was considered as representative of lower-leg explosive power, whereas SL/CMJ.100 was considered as sign of the explosive-power balance between lower and upper leg muscles. Players' VO₂max was 60.88 +/- 6.26 and 50.33 +/- 3.98 mLxkgxmin for J and S, respectively (p 0.05). Lower-leg explosive power showed to be positively related to distance covered during Yo-Yo. Study results showed that 50 mLxkgxmin is a sufficient VO₂max value for competing at a regional level. Calf explosive power should be considered to improve sport-specific running performance in basketball using plyometrics and whole body lifts.

Walking skill can be assessed in older adults: validity of the Figure-of-8 Walk Test.

Hess RJ, Brach JS, Piva SR, VanSwearingen JM.: Physical therapy, 9

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Background: The Figure-of-8 Walk Test (F8W) involves straight and curved paths and was designed to represent walking skill in everyday life. **OBJECTIVE:** The purposes of this study were to validate the measure in older adults with walking difficulties and to explore correlates of the curved-path walking measure not represented by a straight-path walking measure.

Design

: Fifty-one community-dwelling older adults with mobility disability participated in 2 baseline visits as part of an intervention study.

Methods

: The F8W time, steps, and smoothness and measures of gait (gait speed, modified Gait Abnormality Rating Scale [GARS-M]), physical function (Late Life Function and Disabilities Index [LLFDI], Survey of Activities and Fear of Falling in the Elderly [SAFFE], Gait Efficacy Scale [GES], Physical Performance Test [PPT], and fall history), and movement control and planning (gait variability, Trail Making Test B [Trails B]) were recorded in each test session. Bivariate correlations for the F8W with each variable were conducted to examine concurrent and construct validity. Adjusted linear regression analyses were performed to explore the variance in mobility explained by F8W independent of gait speed.

Results

: Figure-of-8 Walk Test time correlated with gait (gait speed, $r=-.570$; GARS-M, $r=.281$), physical function (LLFDI function, $r=-.469$; SAFFE restriction subscale, $r=.370$; PPT, $r=-.353$), confidence in walking (GES, $r=-.468$), and movement control (step length coefficient of variation, $r=.279$; step width coefficient of variation, $r=-.277$; Trails B, $r=.351$). Figure-of-8 Walk Test steps correlated with step width variability ($r=-.339$) and was related to fear of falling ($t=-2.50$). All correlations were significant (P