# Editorial

This edition of The South African Journal of Sports Medicine is devoted to the biennial SASMA Conference. Its contents consists of over 65 abstracts that represent the free communications that have been presented at the Conference. Publication of all the free communications in this Journal is a first for the Journal, as well as the South African Sports Medicine Association (SASMA). A number of important points come to mind.

Firstly, this is the largest number of free communications yet presented at a SASMA Conference. This indicates that South African Sports Scientists and Sports Medicine Practitioners are willing and able to conduct and present there research. For any growing organization this surely is a healthy sign that there is interest and ability despite many constraints, including financial support for research which unfortunately seems to dwindle.

Secondly, the Journal was in a position to publish the proceedings for the first time. This means that a research abstract can now be referenced in a scientific Journal. I am sure that this will encourage research and presentations at future SASMA Conferences.

Thirdly, tribute must be paid to the investigations who will present their research findings at the Conference for their high quality research. It is encouraging to page through the abstracts and come across many high quality research projects that surely will stand their ground in any International meeting. Many of these studies document novel concepts, treatment modalities and scientific findings. My congratulations to all those who spent endless hours in laboratories and clinics.

This effort must rate as one of the best ways to promote this country to the somewhat 15 International scientists who will attend the Conference. I am indeed proud to be a member of SASMA, and one of the many South African Sports Medicine practitioners.

**Dr M P Schwellnus**
**Co-Editor: South African Journal of Sports Medicine**

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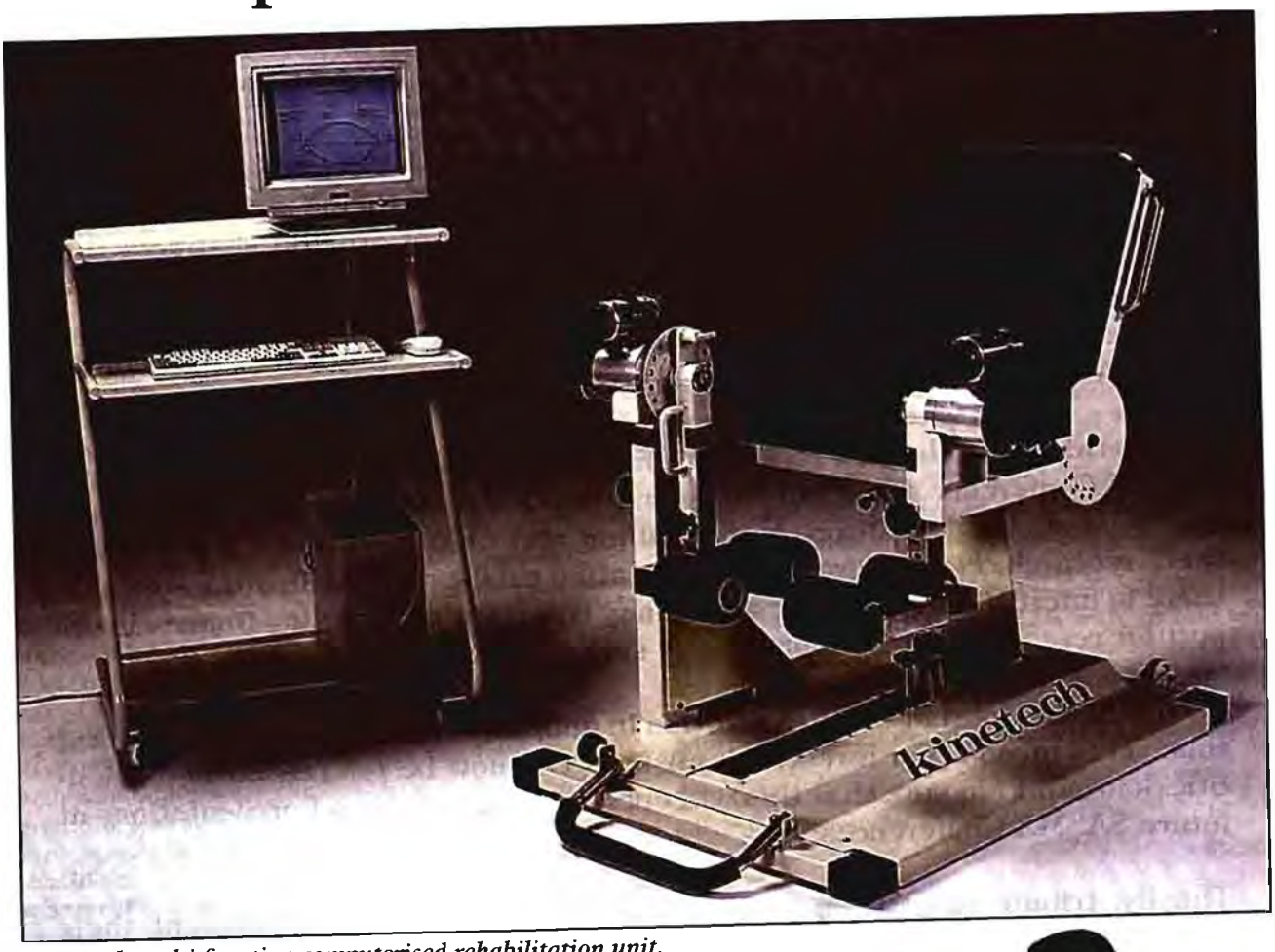


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## 1 PERSONALITY AND MOOD STATES IN ADDICTED AND NON-ADDICTED RUNNERS AND NON-EXERCISERS

CJ Basson, SJ Anderson, K Geils, R Farman. University of Natal, Psychology Department, Pietermaritzburg, South Africa.

The research aimed to examine differences in personality and mood states in groups of negatively addicted and non-addicted marathon runners, using nonexercisers as a control group. Opportunity sampling was used to select 49 regular marathon runners, and 34 non-exercisers. Runners were assigned to a non-addicted and addicted group based on their scores on the Negative Addiction Scale of Hailey and Bailey. All subjects were required to complete a biographical questionnaire, the POMS and the MCMI. Data was analysed using ANOVA, and discriminant function analysis. The results indicated the following: The POMS Vigour sub-scale (a measure of energy and positive affect), revealed a group difference, with non-exercisers displaying less vigour than the two exercise groups. Global mood was found to be more disturbed for the non-exercisers than for the non-addicted runners. Although negatively addicted runners suggested a trend towards higher mood disturbance, this failed to reach statistical significance. The scores on the MCMI revealed group differences for a number of personality dimensions (avoidant, dependent and schizotypal), as well as for clinical symptom dimensions (anxiety and dysthymia). Taken together the results suggest that runners with high negative addiction to running may manifest a tendency towards discrete personality trait pathology that may contribute to their not having the positive mood benefits of running and exercise. Implications for intervention in sport psychology aimed at modifying and accommodating such personality traits are discussed, as are suggestions for more refined research in the area of negative running addiction.

## 2 STERNOCLEIDOMASTOID MUSCLE: MIMIC OF MIGRAINE TYPE HEADACHES, DIZZINESS AND NEUROLOGICAL FALLOUT IN POST TRAUMATIC ATHLETES

Dr Brad Beira M. Tech: Chiropractic

In the absence of hard neurological and orthopaedic findings in patients who present with migraine type headaches with associated visual disturbances, nausea and dizziness following a fall of any sporting nature, the reader is well advised to palpate the sternocleidomastoid muscle (SCM) for myofascial trigger points. The SCM has both a sternal and clavicular division. Pain referred from active trigger points in the sternal division may radiate downwards over the upper part of the sternum. Homolateral distribution arching over the cheek, into the maxilla, over the supraorbital ridge and deep within the orbit originate from the midbelly of this division. Discomfort may be experienced into the external auditory meatus on the ipsilateral side. The quality of this pain is described as a deep ache. Retropharyngeal pain may also be reported. Trigger points in the upper portion of the sternal division refer pain into the occipital ridge behind the ear, to the vertex of the scalp with associated scalp tenderness. In addition to the nociceptive stimuli, excessive lacrimation, reddening of the conjunctiva, apparent ptosis with normal papillary size and reactivity and visual disturbances occur on the homolateral side as a result of autonomic reactivity of this muscle division. Visual disturbances include not only blurring but also dimming of perceived light intensity and sometimes maxillary sinus congestion. Myofascial trigger points in the mid level of the clavicular division refer pain that extends across the forehead to the other side. The upper part of this division refers pain deep into the homolateral ear and the posterior auricular region. Poorly localized pain may be experienced in the ipsilateral molar and cheek. Spatial disorientation, postural dizziness and less often vertigo result from proprioceptive myofascial feedback in this division. Syncope following sudden turning of the head may result. Disequilibrium may occur separately from or be associated with the postural dizziness. Sudden falls or ataxia may result. Nausea is common but vomiting is infrequent. Trigger point examination including methods of palpation may be covered. Interventive measures include ischaemic compression, ice and stretch techniques, intramuscular injection. The indications and contraindications of each technique may be covered. Exercises, both in treatment rooms and at home, postural modifications and activity stress procedures to conclude.

## 3 APPLIED KINESIOLOGY FOR SPORTSMEN

V Boston, Johannesburg South Africa

My goal was to find the best techniques for both patient and practitioner in the treatment and prevention of sport's injuries. I used Applied Kinesiology (AK) to achieve this goal. AK is the most holistic system of healing I have come across, as it combines the energy balancing methods of Chinese Medicine (acupuncture or acupressure), with the structural balancing methods of Osteopathy and Chiropractic, plus some specialised techniques of its own. Also included is Cranial Osteopathy because the brain is attached to the sacrum via the dura mater. AK is the science of muscle testing to give the practitioner feedback of what corrective methods are required to the patient. Muscle testing again confirms the success or failure of the technique just applied. This is because each of our muscles are connected to an organ and hence one of the 14 acupuncture meridians. Thus every muscle in the body can be accessed via the acupuncture meridians and other specialised techniques. This is also true for ligaments, tendons and bones. I have been using the above techniques for a year and have found that I am much more successful in treating injuries than previously with conventional techniques. Also the injuries don't re-occur as with previous methods. Proof of this is the fact that previously, trigger points would come back, but now after eliminating them in conjunction with the above methods they don't. In conclusion both my patients and I have found the above methods superior to conventional methods used by me previously, as we have had quicker, more permanent results, and the treatment are not at all painful, unlike some conventional methods. Also, some injuries only respond to the above methods and it is the only system that could clear reactivity. (Reactivity is the phenomena of a tight muscle "bullying" a week muscle thus preventing the weak muscle from strengthening. This is spectacular to witness). Other advantages are no equipment needed and AK is not restricted to injuries only-it can be used for any medical and emotional problem with out side effects; or just to balance up an athlete for optimum performance.

## 4 ARE ASTHMATICS FIT TO SCUBA DIVE?

Dr AS Branfield - General Practice - Randburg - R.S.A

To propose that under certain clearly defined criteria (i.e. effective treatment and control of exercise - induced asthma), well controlled asthmatics can dive. To present an approach to recognizing asthma, assessing its severity, and providing effective treatment specifically in divers, both novice and experienced. To present methodology and a clinical approach currently used in South Africa as well as the way asthmatic divers or potential divers are approached in other countries. To present clear and concise recommendations and a clinical approach to both the novice divers with asthma and experienced divers with asthma. To present acceptable treatment (both acute and preventative) for asthma in a hyperbaric environment. To present international standards and approaches to asthma and diving.In conclusion, the key to assessing the asthmatic diver is to exclude exercise or cold air induced bronchospasm and not simply excluding air trapping. A fall in mid expiratory flow within half-an-hour of stopping exercise is a more sensitive indicator of asthma than a fall in peak expiratory flow or forced expiratory volume in one second, although the forced expiratory volume on one second is a more practical parameter to measure. Asthmatic divers should have an annual diving medical that must include adequate pre and post strenuous exercise pulmonary function test. Only inhaled corticosteroids (rather than the less practical sodium cromoglycate) can be used long term preventative medication in asthmatic divers. Asthmatic divers should be encouraged to maintain adequate levels of fitness, warned that asthma may be induced under water and told to avoid physically demanding dives.

5 INTRAVASCULAR DEHYDRATION AND CHANGES IN BLOOD PRESSURE SEEN DURING ULTRADISTANCE MARATHON RUNNING

AJ Buntman, R Carter and G Mitchell. Department of Physiology, University of the Witwatersraud, Medical School, Johannesburg, South Africa

Exercise associated collapse (EAC) is caused by post-exercise hypotension. The Hypotension is traditionally thought to result from either intravascular volume depletion or venous pooling. To assess these possibilities 8 male athletes (age 41 ± 7; mean ± SD) were evaluated before and after an ultradistance marathon for changes in blood and plasma volumes and changes in systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP). Change in blood and plasma volume was estimated using changes in haematocrit and haemoglobin concentration. SDP, DBP and MAP were significantly lower after the race compared to pre-race values (131.3 ± 10,5 vs 106,4 ± 12,2 mmHg, 75,3 ± 7.4 mmHg vs 62,8 ± 11,2 mmHg and 91,8 ± 6,8 mmHg vs 76,6 ± 9,6 mmHg; P<0.05). Neither plasma volume nor blood volume was significantly changed (plasma volume increased by 1,4 ± 12,8%; blood volume decreased by 1,9 ± 3,98%). Mean cell volume was significantly decreased (88 ± 2,5 fl vs 87,1 ± 2,3 fl; p< 0.05), indicating an intra-cellular to extra-cellular volume shift. Total body water (TBW), body mass and body mass index (BMI) were all significantly lower after the race. Serum osmolality remained unchanged. There were no statistically significant correlations between changes in plasma volume or in blood volume, and changes in blood pressure. This study indicates that athletes who collapse at the end of ultraendurance races do so as a result of post-exercise hypotension secondary to venous pooling, and not as a result of intravascular volume depletion.

6 MODEL FOR THE PREDICTION OF OPTIMAL STROKE MECHANICS IN SWIMMERS

Dr Roderick Carter. Department of Physiology; University of the Witwatersrand, Johannesburg, South Africa

The speed of forward propulsion in any medium is determined by the product of stroke/stride frequency (SF) and stroke/stride length (SL). SF and SL are inversely related. Individual swimmers attain optimal swimming speed through unique combinations of SF and SL, dependent on both physical and physiological factors. Most swimmers select this combination subconsciously. It may be advantageous for both training and competition to be able to determine the optimal combination of SF and SL for an individual swimmer. A mathematical model is proposed in which the results of simple field tests may be used to predict the ideal combination of SF and SL which result in peak swimming speed (PSS). Maximum effort sprints at variable SLs and SFs are timed over a known distance. A regression equation is determined for the SF:SL relationship (the "performance line") describing the swimmers unique biomechanical characteristics. A line of equal gradient (the "peak performance line") is constructed through the data point with the greatest positive deviation from the "performance line". Differentiation of the equation defining the area of a rectangle subtending the "peak performance line' to maximise the area of the rectangle yields the individual swimmer's PSS, and hence the optimal combination of SF and SL. The proposed model may be of value in providing swimmers with guidelines for determining their unique optimal stroke mechanics.

7 CARDIAC DRIFT DURING INCREMENTAL ROWING TESTS

I Chantler and R Carter. Department of Physiology, University of the Witwatersrand, Johannesburg, South Africa

Traditionally, laboratory rowing tests utilise incremental protocols with workloads varying between 1 and 8 minutes. The heart rates achieved in the tests are used to provide training guidelines for the athletes. Inaccuracy in determining training heart rate zones may arise if insufficient time elapses during each step for a physiological plateau to be attained. Thirteen elite rowers (ten males and three females) underwent an incremental test on a Concept II ergometer at 4 different workloads (low intensity, low-moderate intensity, moderate intensity and high intensity). Each workload lasted 6 mimutes and heart rate was recorded throughout. The 3 minute and 6 minute heart rates were significantly different at all 4 exercise intensities (P< 0.05). There was no significant increase in heart rate from the fourth to the sixth minute during the low and high intensity workloads (P< 0.05), suggesting that the heart rate may be approaching a physiological plateau. Subsequently, 5 elite rowers (4 males and 1 female) underwent an incremental rowing test on a Concept II ergometer at 3 stages of moderate to high intensity work, each workload lasting for 8 minutes. Significant differences between the heart rates at 3 minutes and at 6 minutes, and between heart rates at 3 minutes and at 8 minutes were confirmed (P<0.05). However, for each of the 3 workloads, no significant difference was found between heart rates at 6 minutes and at 8 minutes (P< 0.05). This study has confirmed the phenomenon of cardiac drift during steady-state rowing tests lasting between 3 and 6 minutes. However, no significant further drift in heart rate occurs between the 6th and 8th minutes of an 8-minute stage, indicating a physiological plateau.

8 EXERCISE TOLERANCE AND SKELETAL MUSCLE FUNCTION IN PATIENTS WITH CARCINOMA: EFFECTS OF EXERCISE TRAINING

KL Coleman; M Emms; TD Noakes; A Smith; EW Derman UCT, Sports Science Institute of SA, Cape Town, South Africa

This study examined changes in exercise performance and skeletal muscle (SM) structure and function in 6 patients with carcinoma (Ca) following a 12wk training programme, immediately after completion of chemotherapy treatment. Prior to, and after the 12wk training programme patients underwent i) graded exercise to exhaustion on a cycle ergometer for determination of peak oxygen consumption ($V0_2$ peak) and peak work load (WLpeak) ii) isometric and isokinetic tests of SM strength and endurance iii) SM biopsies for light and electron microscopy analysis. Results were compared with those obtained from a sedentary, age and gender matched control group (C) tested on initiation of the study. Before training, $V0_2$ peak (24.24 ± 2.39 vs 33.02 ± 4.47 ml/$O_2$/kg/min; p<0.05) was lower in patients with cancer (Ca) when compared with C. However WLpeak (147.50 ± 21.33 vs 185 ± 28.25 W, p=NS) was not significantly different between groups. Peak torque generated in the quadriceps (PKTQ) corrected for lean thigh volume (LTV) (44.28 ± 4.45 vs 44.88 ± 5.24 Nm/L; p=NS) and total power (TP) in a 60 second isometric test of SM endurance (25.67 ± 3.61 vs 40.45 ± W/L; p=NS) were not significantly different between groups, however TP tended to be lower in the patients with Ca (p=0.08). SM biopsies performed on the Ca group did not show significant structural abnormalities and therefore were not repeated after training. After training, patients with Ca decreased their resting heart rate (80.50 ± 4.31 vs 72.67 ± 4.31 b/min; p=0.05) and increased their $V0_2$ peak (24.24 ± 2.62 vs 28.43 ± 1.88ml/$0_2$/kg/min) so that differences between Ca and C were no longer apparent. Patients with Ca improved WLpeak achieved (147.50 ± 23.37 vs 190.83 ± 27.82 W; p<0.05) and tended to Improve TP (25.67 ± 3.96 vs 32.45 ± 4.21 W/L; p = 0.08) after training. The results of this study suggest that patients with Ca have only mildly impaired exercise tolerance and SM structure and function compared to C, these patients show significant physiological improvements after a 12wk training programme, despite recent high dosages of chemotherapeutic agents.

9 EXERCISE INTOLERANCE AND SKELETAL MUSCLE (SM) ABNORMALITIES IN PATIENTS WITH CHRONIC OBSTRUCTIVE AIRWAYS DISEASE (COAD)

KL Coleman, R Raine; M Emms, C St Claire-Smith, TD Noakes & EW Derman UCT, Sports Science Institute of South Africa, Cape Town, South Africa

Patients with COAD commonly experience fatigue and exercise Intolerance which is thought to be due to pulmonary factors. However, few studies describe both the structural and functional status of SM in patients with COAD. This study examines 10 patients with moderate to severe COAD and 6 sedentary, healthy control subjects (C) underwent i) graded exercise test to exhaustion for determination of peak oxygen consumption ($V0_2$ peak), peak work load (WLpeak) and peak ventilation (VEpeak); ii) isokinetic tests of SM strength and endurance and ii) SM biopsy for determination of skeletal muscle structure. $V0_2$ peak (18.0 ± 1.59 vs 25.40 ± 1.15 ml/$O_2$/kg/min; p<0.05), WLpeak (88.56 ± 21.57 vs 214.17 ± 30.47 W; p<0.001), VEpeak (43.95 ± 5.40 vs 74.44 ± 8.22 L; p<0.001) and total work performed by the quadriceps muscle (TWQ) in a 60 sec isokinetic test (2113.08 ± 376.48 vs 3785.86 ± 364.19 J; p< 0.005) were all lower in patients with COAD. Furthermore, VEpeak and peak blood lactate (5.29 ± 1.25 vs 10.71 ± 0.35 p<0.001) were lower in patients with COAD when compared with C. Peak torque achieved during a 30 second isometric test was not different between groups (169.92 ± 31.82 vs 217.75 ± 24.17 Nm; p=NS) before or after correction for lean thigh volume (LTV) however, when TWQ was corrected for LTV values tended to be different between groups (766.73 ± 101.24 vs 978.80 ± 114.78 J/L; p=NS). Profound histological and ultrastructural abnormalities were found in all SM biopsies from patients with COAD. Abnormalities included: Type II fibre atrophy, Type II fibre predominance, Type I fibre hypertrophy, necrotic fibres and diffuse mitochondrial abnormalities. These data support the hypothesis that (i) severe SM structural abnormalities are present in patients with COAD (ii) functional abnormalities are present in tests of SM endurance in patients with COAD and (iii) these SM structural and functional abnormalities may play a role in exercise intolerance in patients with COAD.

10 ENDURANCE RATIOS AND TOTAL WORK: ARE THEY VALID MEASURES OF FATIGUE RESISTANCE?

Ian Cook. University of the North, Sovenga, South Africa

The purpose of this investigation was to evaluate popular methods for determining in vivo skeletal muscle (quadriceps) concentric fatigue resistance (FR) on an isokinetic dynamometer. The study was divided into two parts. Part 1: The records of one hundred and four patients (82 M, 22 F) were analysed retrospectively. All patients had been tested on a Cybex 340 dynamometer. The protocol included 4 serial repetitions at 60°/s, and 20 serial repetitions at 180°/s, for unilateral knee ext/flex. Only the results of the uninvolved limbs were analysed. Patients were placed into four categories: team sports (n = 21); endurance sports (n = 25); strength/sprint sports (n = 10); and non-participants (n = 33). The dependant variable being total work performed in the 20 repetitions (TW20). PTQ (N.m) 60°/s (P60), PTQ (N.m) 180°/s (P180) correlated significantly (p<0.01) in all groups (0.6244-0.8763 and 0.8836-0.9448 respectively). Endurance ratio (ER) did not correlate significantly (p>0.05) in any group (-0.0008-0.3919). Multiple linear regression (MLR) for pooled data found Sample 1 and 2 explained 98.70% of the variation in TW20. Part 2: Fourteen patients (7 M, 7 F) were recruited and tested according to the above protocol and an additional protocol- 10 sets of 10 repetitions @ 180°/s, with 5 seconds between sets. A logarithmic function [Joules = A + B.Log (Set number)] was used to obtain a FR measure (B; gradient) and strength measure (A; y-intercept). B and A correlated significantly (p<0.01) with P60 (0.9513 and 0.7303, respectively). Identical correlational patterns as for the retrospective analysis were found. MLR found P180, and Sample 2 (Joules) explained 99.47% of the variation in TW20. Furthermore, B and A explained 92.79% of the variation in TW20. Total work for 100 repetitions could be predicted by B and A (99.27%). These data suggest firstly that the popular measure of FR, ER, is not a valid measure. Secondly, the total work performed in 20-100 repetitions, by itself, is not a measure of fatigue resistance. Thirdly, the use of correct terminology is advocated.

11 PHYSIOLOGICAL PROFILES AND THE ESTABLISHMENT OF NORMS FOR UNDER 21 PROVINCIAL RUGBY PLAYERS IN NATAL

Coopoo Y and Govender AN. University of Durban-Westville, Durban, South Africa

This study obtained data on fitness profiles of under 21 provincial rugby players in order that normative tables could be compiled for the forwards, backs and the combined team. The study also provided an insight into the fitness demands of under 21 provincial rugby players on the basis of the two major playing units in a rugby game, the forwards and the backs. It further established physiological readiness for senior rugby. The test battery evaluated body composition, flexibility, explosive strength, dynamic strength, cardio-respiratory endurance,anaerobic capacity and agility at the beginning of a regular season. Data from 112 players were categorised in three groups: forwards (57), backs (55) and the combined team (112) and were statistically analysed. Means and standard deviations were computed for all tests. The t-test was applied to the means of both the forwards and backs for each test to establish the differences. Normative tables were established for the forwards, backs and the combined team. In the assessment of the fitness demands of the under 21 provincial rugby player, no significant differences were found between backs and forwards, except for percent body fat, lean body mass and grip strength (p<0.05). The fitness demands for backs and forwards appeared to be uniform, suggesting that a single set of fitness norms will suffice for the whole team. The comparison of the two sets of norms for three similar tests indicated that the under 21 provincial norms compare favourably with senior norms. The implications of the findings on a descriptive basis indicated that the under 21 provincial player is physiologically ready to participate at senior level. With careful guidance and mentoring, and of course, effective training, the potential for participation at national level is evident.

12 THE EFFECT OF SCHEUERMANN'S DISEASE ON THE TOTAL BODY BIOMECHANICS

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During my research to determine whether palpation is useful in diagnosing Scheuermann's disease, I realised the devastating effects of this disease. Early recognition and diagnosis is therefore absolutely imperative in order to limit and/or treat the effects it has on the biomechanics of the body. The pathology of Scheuermann's includes hypomobility of 3 to 5 consecutive vertebrae of the thoracic and/or thoraco-lumbar spine. The wedge shape of the vertebrae and the resultant kyphosis are clearly visible on X-ray. This paper will discuss the consequences of Scheuermann's disease on the body's biomechanics. This wedge-shaped, hypomobile area in the thoracic spine results in changes of the head-on-neck and neck-on-thorax positions resulting in the following problems: tempero-mandibular dysfunction, headaches and atrophy of the deep neck flexors. The kyphosis leads to weakness of the scapular muscles and hypomobility of the glenohumeral joint. Full range of movement at the glenohumeral joint requires normal mobility of the thoracic vertebrae. The kyphosis displaces the glenoid which results in glenohumeral joint dysfunction. The above plays an important role in the impingement syndrome with instabilities of the glenohumeral joint. The centre of gravity is displaced more anteriorly as a result of the kyphosis, which affects one's balance in an upright position. Disturbance of balance leads to a decrease in proprioception. In conclusion, it is therefore essential to diagnose Scheuermann's disease as early as possible in order to maintain optimum functional biomechanics of the body.

13 MEDICATION USE AND ABUSE PRIOR TO INTERNATIONAL SOCCER COMPETITION.

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Despite publicity of the side effects and possible dangers of various medications on the athlete during prolonged vigorous exercise, it is believed that medications are still widely prescribed immediately prior to sporting events. The purpose of this study was to determine the patterns of prescribing medications by team physicians during the 1996 African Cup of Nations Soccer Tournament. As part of the FIFA & IOC drug testing procedure, the team physicians of the 15 teams were asked to complete a questionnaire prior to each match. Each of the 16 squad members was listed and any prescribed medication or supplement ingested, injected or taken per rectum in the 72 hr period preceding the match was declared by the physician. 32 matches involving 544 player/match exposures occurred during the tournament. Non-steroidal anti-inflammatory medications (NSAIDS) were the most commonly prescribed medications with 31% of players having ingested these agents in the period prior to the match. Of the NSAIDS diclofenac was the most common (19%), followed by ibuprofen (5.6%), indomethacin (3.3%), piroxicam (2.7%) & aspirin (0.7%). 11% of players ingested paracetamol and 2% ingested polycomponent analgesic preparations in the pre match period. 3.8% of players were ingesting antibiotic medications. Vitamin and mineral supplementation was also very common with 30% of players ingesting a multivitamin, 11.7% ingesting creatine, 4% ingesting magnesium supplementation, 5.8% ingesting inosine, 3% ingesting guarana, 1% ingesting alpha-keto glutamate, 0.7% ingesting iron supplementation, & 0.2% chromium picolonate. Other medications declared included nasal decongestants (1.8%), anti-diarrhoea medication (1.3%), laxatives (0.4%), anti-histaminics (0.4%) and hydrocortisone cream (0.4%). At four occasions diclofenac and paracetamol was prescribed for the entire squad twice daily, for the three day period between matches. At seven occasions more than one NSAID was prescribed for a player. These results suggest i) prescribing habits vary greatly prior to competition; ii) NSAID and analgesic use/abuse is very common during international soccer competition. As these medications are not without significant side effects, improved dissemination of knowledge regarding the use of these agents should be directed at both the team physicians and players.

14 COMPARATIVE EFFECTS OF ZOPICLONE AND LOPRAZOLAM ON HAND-EYE CO-ORDINATION & PHYSICAL PERFORMANCE IN ATHLETES.

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Benzodiazepines are commonly used by athletes, due to frequent international travel, pre-competition anxiety and insomnia. However, little is known about their effects on exercise performance. In double blind, placebo (P) controlled, cross-over trial, the effects of zopiclone (Z) and loprazolam (L) on physical performance in 12 active individuals were studied. Subjects ingested either P, Z (7.5mg) or L at 22h00 on three occasions with a one wk washout period between trials. Eye-hand co-ordination tests (Accuvision 1000), a 30m sprint test, a T-test and a graded exercise test to exhaustion was performed 10 hrs after administration. There was a significantly greater hangover effect 10 hours after ingestion of L (8/11 subjects) than after ingestion of Z (3/11; $p<0.001$). Subjects were significantly more alert after ingestion of P (9/11) and Z (9/11 subjects) than after L (4/11 subjects; $p<0.001$). The 30m sprint time, time to complete a T-test and the peak oxygen uptake during graded incremental exercise to exhaustion were not different following ingestion of P, Z, and L. However, both the number of correct responses during the Accuvision 1000 test (87±10; 87±7; 80±18: P vs Z vs L), and the time to fatigue during graded exercise (705±54; 680±38; 669±50; sec P vs Z vs L) tended to decrease following ingestion of L compared to Z and P. The time to complete a turntable test tended to be increased following ingestion of both L and Z compared to P. These results suggest: (i) Ingestion of L leads to hangover effects 10 hrs after ingestion. Ingestion of Z however, is without these effects: (ii) athletes experience significantly greater alertness following ingestion of Z compared with L: (iii) Whilst exercise performance following ingestion of either Z or L was not significantly altered, time to fatigue during incremental exercise and the number of correct responses during visual-motor tests tend towards impairment following ingestion of L compared with Z and P; (iv) Hand-eye coordination however, tends to be impaired following ingestion of both L and Z.

15 THE EFFECTS OF ACEBUTELOL ON EXERCISE TOLERANCE, SKELETAL MUSCLE RECRUITMENT AND FUEL SUBSTRATE UTILIZATION DURING EXERCISE OF VARYING INTENSITIES

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Previous research has indicated that ingestion of beta-blockers adversely affect the exercise performance tolerance of physically active hypertensive patients. It has been postulated that this effect is due to altered metabolic response to prolonged submaximal exercise. The effects of acebutelol (A), a beta1-selective blocker with intrinsic sympathomimetic properties, on exercise tolerance, skeletal muscle function and metabolism during prolonged exercise are unknown. In a double blind placebo (P) controlled trial, we determined the effects of A (400 mg daily for 7 days) in 7 healthy volunteers on i) cardiorespiratory, ii) plasma lactate [La], glucose [G], and free fatty acid concentrations [FFA] and iii) skeletal muscle electromyographic activity (EMG) during incremental submaximal exercise at 30, 50, and 70% of their relative Peak Power Output (PPO) at 15, 30, and 45 minutes respectively. Thereafter workload was increased every minute by 15 Watts to exhaustion to measure PPO. During submaximal exercise, subjects showed significant differences in heart rate (HR) and systolic blood pressure (SBP) ($p < 0,01$; A vs P). Following ingestion of P, subjects achieved significantly ($p<0,05$) higher PPO in contrast to A. [La] concentrations between treatments were not different, however lower concentrations of [G], ($p < 0.01$) (3,3 ± 0.2 vs. 4.5 ± 0,2 mmol/l) were found at rest and during exercise, [FFA] concentrations at rest, 12 min; and 21 min were similarly lower following ingestion of A ($p < 0.05$; vs P). No significant difference was found in total carbohydrate (CHO) oxidation, glucose oxidation, and estimated muscle glycogen. Changes between treatments were observed in rate of perceived exertion and integrated EMG activity after 30 minutes of submaximal exercise. These findings suggest that i) A is effective in decreasing SBP and HR during submaximal exercise, ii) exercise tolerance is decreased following ingestion of A, iii) [G] and [FFA] are lower during exercise following ingestion of A, iv) EMG and RPE are increased during exercise following ingestion of A. However, CHO oxidation during exercise is unaltered following ingestion of A.

16 KNOWLEDGE ATTITUDE, AND NUTRIENT INTAKE OF ELITE SPORTSMEN AND -WOMEN (19-25 years old) IN POTCHEFSTROOM

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Little is known about knowledge, attitude and nutrient intakes of South African sportsmen and woman, while nutrient supplementation usage is suspected to be high. In a cross sectional study including 143 subjects, knowledge and attitude were investigated by means of validated questionnaires. Nutrient intakes were measured by means of a validated food frequency questionnaire. Nutritional status was determined by the physical activity index as well as anthropometric measurements. A pilot study (n=10) was conducted to determine the reliability of all instruments used. The results indicated that 80% of the subjects reflected inadequate diet-related knowledge; only 3.5% subjects reflected a positive attitude towards sports nutrition while the rest showed a highly positive attitude towards supplementation. Most of the subjects did not meet their recommended diet allowances. Their nutrient intakes were characterized by elevated protein, fat and cholesterol intakes, as well as inadequate carbohydrate intakes. This dietary pattern was related to inadequate micronutrient intakes. Anthropometric deviations from published normal ranges occurred more frequently among male sports participants. Therefore, this study indicated that elite young sportsmen and women manifested inadequate nutritional status based on inadequate knowledge and negative attitudes towards sports nutrition. The prominent "compensatory" role of supplements, underlined the highly underutilized role of dietitians and the high risk of suboptimal performance and health hazards, even among elite sportsmen and women in this study.

17 THE CARNITINE STATUS OF ATHLETES PREPARING FOR AN ULTRAMARATHON OF 90 KM

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Carnitine supplementation before or during exercise failed to show any improvement in exercise performance in humans. A deficiency (48%) in rats did not affect their exercise performance. Although data is available for normal subjects and resting athletes none is available for athletes training for a running endurance event of 90 km. The aim of this study was to assess the carnitine status of such athletes over a 45-week period. Ten athletes volunteered for the assessment. A group of 10 sedentary individuals served as controls. Blood samples for total carnitine, acyl carnitine, free carnitine, cholesterol, triglycerides and rheological parameters were collected every 8 weeks up to 2 weeks prior to the event. Body mass index and percentage body fat were also measured. Questionnaires reflecting medication, disease and training were collated weekly. The percentage body fat of two athletes with the highest kilometre training distance decreased with 12 and 13% respectively. The bound carnitine (acyl carnitine fraction) remained constant in the control group. In the training group the acyl carnitine levels increased steadily from baseline 12,48 ± 3,68,μM to reach a maximum of 23,01 ± 0,01 μM ($p< 0,001$) at week 30 and thereafter decreased to 16,53 ± 3,16 μM, 2 weeks before the event, with a corresponding decrease in free carnitine from 46,82 ± 10,49 at baseline to 39,28 ± 4,82 at the interval of biggest change. The decrease in free carnitine and increase in acyl carnitine reflect the demands on the metabolic system to transport acyl groups formed during β-oxidation. It is concluded that monitoring carnitine levels could be used to ascertain the demands on acyl transport during β-oxidation, but it is unclear which degree of carnitine deficiency would impede endurance performance.

18 THE FORCE ABSORPTION AND REBOUND CHARACTERISTICS OF CRICKET BATTING PADS

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Impact injuries in cricket, although not reaching alarming proportions, are on the increase. The cricket player needs maximum protection against impact injuries from the ball when batting, while still maintaining mobility and reducing the risk of being dismissed, particularly to bat-pad decisions. A study was conducted to compare the efficiency to absorb impact forces, as well as the rebound characteristics of four types of cricket batting pads (P1, P2, P3 and P4) at four impact velocities: Slow-medium (S1), Fast-medium (S2), Fast (S3) and Express (S4). The impact forces were measured using the drop test (Nigg 1990) where a weighted ball was dropped vertically onto the surface of the batting pads with the vertical forces measured by a Kistler piezoelectric multicomponent force platform type 9281 A11. The rebound characteristics were determined by measuring the horizontal distance (m) the ball rebounded off the pad when delivered from a bowling machine at the four velocities. A two-way analysis of variance, with Tukey's method of multiple comparison, was used to test for significant differences ($P<0.05$) between the pads at the four impact velocities. When evaluating the impact forces it was found that P1 provided significantly less protection than all the other pads at the four velocities with the exception of similar results to P4 at S2. Further, at S1 and S3, P2 was significantly better than P3 and P4 and P2 was significantly better than P4. At S2, P2 was significantly better than P2 and P3, while P3 was significantly better than P4. At S4, P2 and P3 showed similar results which were, significantly better than P4. When comparing the rebound characteristics, the results showed significantly smaller rebound distance for P1 at all the velocities. The differences in the force absorption and rebound characteristics were as a result of the differences in the structure and composition of the protective part of the batting pads. The results show an inverse correlation between the ability to absorb force and the rebound distance after the ball has struck the pads, something that the manufacturers need to address.

19 THE EFFECT OF A LOW INTENSITY AEROBIC EXERCISE PROGRAM ON PATIENTS USING ANTIDEPRESSANTS

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Determining the effectiveness of aerobic exercise in the control of the adipose tissue of subjects utilizing antidepressant medication is due to the common complaint of undesired mass gain caused by pharmacological treatment for major affective disorders (Garland, Remick and Zis, 1988, Russ and Ackerman, 1988; Rang and Dale, 1991 and Stimmel, 1992). The aerobic exercise program for the subject on antidepressant medication must be manageable with regards to intensity, frequency and duration as exceeding the capabilities of the subjects is a certain path to nonadherence (Brownell, 1984). Factors such as insulin, cholesterol levels and metabolic rate which effect body composition were taken into consideration, while the skinfold, circumference and mass measurements were monitored to determine the effectiveness of aerobic exercise. The intensity of the exercise program was determined according to the workload corresponding to a respiratory quotient of just below 0.85. The duration of the aerobic exercise session was 35 minutes and performed 3 times per week over a period of 12 weeks. The heart rate decreased consistently ($P<0,05$), while the blood pressure remained relatively stable. The mean insulin levels of the experimental group decreased though insignificantly 30 minutes after glucose ingestion over the 12 weeks, but the corresponding insulin levels of the control group increased. All the patients exhibit higher than normal total cholesterol and LDL levels. The study was of benefit since the exercise group had a mean loss of 0.086 mmol/l for cholesterol and 0.007 mmol/l for LDL while the non-exercise group had a mean increase of 0.940 mmol/l cholesterol and 0.64mmol/l LDL. Over 12 weeks the control group displayed a constant increase in skinfolds for the triceps, subscapula and medial calf. This emphasizes that the mass gain is an increase in adipose tissue. The non-exercising group also showed an increase of 4.26cm around the waist over this period. The waist-to-hip ratio increased consistently from 0.94 to 0.97 in the non-exercising group while the waist-to-hip ratio for the exercising group remained constant. This emphasizes the positive effects of low intensity aerobic exercise for patients utilising antidepressants.

20 POLLUTION, WATER CONTACT AND "DUSI GUTS"

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The Msindusi canoe marathon has always been associated with post race illness, "Dusi Guts". Severe flooding in Pietermaritzburg in the week preceding the 1996 race raised faecal coliform counts in the river to high levels. There appeared to be a higher than usual incidence of race associated illness and infection. The aims of this study were to determine the incidence of illness and infection, the relationship of water contact with illness, and to provide guidelines for participants of future Dusi's raced in flood years. Four weeks after the race, a questionnaire was sent to all competitors (n = 1302). 652 participants replied (50.1%), of whom 46% were ill at some stage during or after the race with diarrhoea (149) and infected wounds (113) being most common. 20% of all respondents required treatment by a doctor. There was no difference in the incidence of illness or infection between those who fell out of their canoes during the race and those who did not, nor was there a relationship between the number of times a paddler fell out and subsequent illness. Relative canoeing experience and competitive grading were also not related to illness. While the A grade paddlers fell out significantly less often than the E grade paddlers ($P< 0.0001$) there was no difference in the incidence of illness in the grades. The faecal coliform levels on the race days were up to 30 times higher than the level deemed high risk, in South Africa and 150 higher than the levels set by the European Economic Community. *E. coli* counts repeated at the same sites during the race showed large daily variation. The accepted maximum illness index for recreational use of water in the USA is set at 8 illnesses per 1000 swimmers. For this race the index was 460/1000 participants, and 606/1000 competitors who fell out during the race. In summary, in flood years, there is an almost 50% chance of suffering some form of illness when participating in Dusi and a 20% chance of requiring medical treatment. The pollutant and washing out effect of rain during the race makes pre-race prediction of pollution levels very difficult. Further studies are required to compare these findings with non flood year races.

21 LOW POST-RACE MARKERS OF LIPID PEROXIDATION IN ULTRAMARATHON RUNNERS WITH HIGH ANTI-OXIDANT STATUS.

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Previous studies conducted by our group have shown a significantly reduced post-race infection incidence following supplementation with anti-oxidant nutrients during the three weeks prior to participation in the 90km Comrades Marathon. Ten successful participants (9 men, 1 Woman. X age: 43.4±9.44 yrs) in the 1996 Comrades Marathon were monitored 18hrs before and within 1 hour following completion of the 90 km running event in order to establish their post-race anti-oxidant status and relate this to markers of immediate post-race free radical production and the incidence of infection symptoms occuring during the post-race fortnight. Twenty-four hour pre-race dietary recalls and analyses of intake nutritional supplements revealed a mean total daily Vit C intake of 430(±378.4)mg on the day preceding the race, while plasma Vit C levels rose significantly ($p>0.05$) from 16.5 (±2.9) pre-race to 21.9 (±5.0)ug.ml$^{-1}$ post-race. Pre-race plasma Vit E levels (X=8.89 ±1.3)ng.ml$^{-1}$ failed to show a consistent rise or fall following completion of the 90 km event, whereas pre-race beta-carotene levels (X=241.6±78.5ng.ml$^{-1}$) dropped significantly ($p>0.05$) to 231.1 (± 82.8)mg.ml$^{-1}$. Despite an absolute post-race neutrophilia (X=86.3%) in each of the subjects, quantification of lipid peroxide levels by colorimetric measurement of methylene blue in serum samples revealed little evidence of the accumulation of free radicals post exercise. This marker of lipid peroxidation rates did not rise significantly ($p>0.05$). The significant, but small rises in C-Reactive Protein (from 1.3±2.4 mg.l$^{-1}$ pre-race to 3.4± 2.2mg.l$^{-1}$ post race) indicate lesser inflammatory response than previously reported in the literature. Only one subject reported symptoms of Upper Respiratory Tract Infection during the post-race fortnight. This study reveals a possible protective effect of high pre-race plasma anti-oxidant status against previously reported free radical damage following participation in prolonged competitive running events.

22 EFFECTS OF HIGH INTENSITY EXERCISE ON LYMPHOCYTE DNA AND PLASMA VITAMIN C.

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Hartmann et al. recently described a chance observation of DNA strand breaks in lymphocytes following short duration, high intensity exercise to exhaustion in 1 of 3 subjects of differing fitness levels. If this is a consistent finding in trained individuals it may provide further insight into changes in immune status with overtraining. The aim of this study was to determine the relative frequency of DNA strand breaks in lymphocytes in trained individuals following a single bout of exercise to exhaustion, and to examine associated changes in plasma vitamin C concentration. Eleven subjects in regular training were subjected to a ramped treadmill run to exhaustion. They were asked not to exercise for 48 hours preceding the test and for 48 hours after the test. Venous blood samples were collected before and immediately after exercise, and 24 hours and 48 hours after exercise. Vitamin C concentration was determined by the 2,4 dinitrophenylhydrazine method while the single cell gel electrophoresis (SCGE) assay was carried out on all blood samples to determine DNA strand breaks. Immediate post exercise samples showed DNA damage in lymphocytes of all subjects as evidenced by fluorescent strands of DNA outside the cell. No DNA strand breaks were observed in subsequent samples. In the pre-exercise sample, DNA was visualised as a central core whereas in all samples taken after exercise, DNA was found located around the periphery, or confined to one pole of the cell. Vitamin C levels showed a non significant decrease immediately after exercise which returned to baseline levels after 48 hours. This did no correlate with DNA damage. In summary exhaustive high intensity exercise produced changes in DNA in lymphocytes lasting 48 hours in all subjects. The different pattern of DNA distribution observed in lymphocytes following exercise has not previously been reported. Further studies are required to determine the fate of the lymphocytes, do they die or do they undergo a reparative process, and is this damage the same in all lymphocyte subsets?

23 A CONSERVATIVE APPROACH OF GRADE II & III LATERAL LIGAMENT ANKLE INJURIES.

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Research project over a three year period was done on grades II and III lateral ligament injuries of the ankle. The aim of the study was to establish a standardized, dynamic, conservative multi-disciplinary rehabilitation regime. The program followed consisted of standard treatment and covered the phases from the onset of the injury until the patient returned to competitive sport. The study included 216 patients, 156 male and 60 female, of ages varying between 16 and 40 years with the mean age 22,7 years. Sports background: hockey, rugby, squash, netball, cricket, track and field. Criteria of acceptance: first injury, no fractures, Brustrom grades II-III, intact inferior tibiofibular joint, medial ligament intact, injury seen by the medical team-within 48 hours. After thorough initial examination the aim during the first 48 hours was to address swelling, immobilize the ankle and relieve pain. Rehabilitation by means of both physiotherapy and biokinetics was divided into a six week period. The treatment was divided in three phases for both physiotherapy and biokinetics. During the first phase we mainly addressed swelling, pain and activity. In the second phase the emphasis was on mobility. The aim of third phase was to clear the injured joint and to prepare the patient to return to competitive sport. At the end of the third phase the patient had to pass a sport-specific fitness test. During the study the following complications one noted: 11 gutter syndromes and four medial tarsal syndromes. Ten weeks post-injury the patients underwent a final examination where six patients still complained of pain in the ankle during exercise. They were all referred to an orthopaedic surgeon and eventually all underwent ankle orthroscopy. Of the six, four were diagnosed as suffering from medial tarsal syndromes and two from gutter syndromes. The most important outcome of this study was the fact that 97.2% of the patients returned to competitive sport after six weeks.

24 DELAYED MUSCLE SORENESS IN SPRINT ATHLETES

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In this study the appearance of delayed muscle soreness was determined after repetitive sprint events in male and female athletes. The effect of post-exercise sports massage on the athletes' lower limbs was also evaluated. Kinesiology studies were done on day 1 and 5 after the events by making use of the "Akron" isokinetic apparatus as well as the Busco Padana to evaluate torque, explosive power and reaction time. Flexibility studies were also done with the stretch apparatus. Delayed muscle soreness was established in a mild form, but only in specific muscle groups, namely the prime movers in sprint running. Sports massage was advantageous, but also more to the prime movers. The massage technique as applied in this study seems to be advantageous to sprint athletes in improving their performance.

25 EFFECT OF CARBOHYDRATE SUPPLEMENTATION ON MUSCLE GLYCOGEN CONTENT AND UTILISATION DURING ONE HOUR CYCLING PERFORMANCE

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This study compared the effects of supplementing the normal diets of 6 trained cyclists with additional carbohydrate (CHO) on muscle glycogen utilisation during a 1 h cycle time-trial (TT). Using a random crossover design, subjects consumed either their normal diet (NORM) for 3 d (426 ± 137 g•d$^{-1}$ CHO [5.9 ± 1.4 g•kg$^{-1}$ bodymass, BM]) or additional CHO (SUPP) to increase their intake to 661 ± 76 g•d$^{-1}$ [9.3 ± 0.7 g•kg$^{-1}$ BM]. SUPP elevated muscle glycogen content from 459 ± 83 to 565 ± 62 mmol•kg$^{-1}$ d.w. ($P<0.05$). However, despite the increased pre-exercise muscle glycogen stores, there was no difference in the distance cycled during the TT (40.41 ± 1.44 vs. 40.18 ± 1.76 km•h$^{-1}$ for NORM and SUPP respectively). During NORM, muscle glycogen declined from 459 ± 83 to 175 ± 64 mmol•kg$^{-1}$ d.w., whereas with SUPP the corresponding values were 565 ± 62 and 292 ± 113 mmol•kg$^{-1}$ d.w. Accordingly, both muscle glycogen utilisation (277 ± 64 vs. 273 ± 114 mmol.•kg$^{-1}$ d.w.) and total CHO oxidation (169 ± 20 vs. 165 ± 30g•60 min$^{-1}$ for NORM and SUPP respectively) were similar. The results of this study show that when well-trained subjects increase the CHO content of their diet for 3 d from 6 to 9 g•kg$^{-1}$ B.M. there is only a modest increase in muscle glycogen content. As supplementary CHO did not improve TT performance, we conclude that CHO loading has no benefit to performance for athletes who compete in intense, continuous events lasting 1 h. Furthermore, the substantial muscle CHO reserves at the termination of exercise indicate that muscle glycogen depletion does not determine fatigue at this exercise intensity and duration.

26 PROFILE OF INJURIES AT THE DUZI CANOE RACE

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The Duzi Canoe race is a three day endurance event over 120 km. The medical support consisted of a medical tent at the end of each stage and 3 field stations on the route next to the river. The main objective of this study was to describe the type of injuries sustained by the participants during this event. A prospective descriptive study was undertaken at the 1997 Duzi. Each participant who reported to the medical tent or field station were included in this study. Over the 3 days 220 participants were treated, 128 the first day, 74 the second day and only 18 on the last day. The most frequent encountered problems were: 1) abrasions on the hands, arms and legs (n = 55) 2) muscle spasms of the neck, shoulders and back (n = 44) 3) tendinitis (n = 14) 4) cramps n = 13) 5) ankle ligament injuries (n = 11). The most serious injuries were a suspected ankle fracture and a big laceration over the popliteal area. The treatment most frequently used were 1) massage of painful muscles (66) and 2) cleaning of wounds/abrasions. Over the 3 days 4 participants were treated for heat exhaustion and dehydration and 1 for heatstress (temp = 38.5°C). The only explanation for the 128 participants treated on the first day was that on the first day the temperature was 35°C, the second day was overcast and rainy and the last day partially overcast.

27 THE RESPONSE OF HEART RATE AND BLOOD LACTATE CONCENTRATION TO CONTINUOUS INCREMENTS IN RUNNING SPEED

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The relationship between heart rate and blood lactate concentration in response to incremental increases in running speed, was determined in 10 elite endurance runners. Starting at 16.5km/hr or 17.5km/hr the athletes ran continuously, until exhausted, on a treadmill increasing the speed every 400 meters by 0.5km/hr to reach a sub maximal speed, depending on ability. Heart rate was recorded every 15 seconds with a polar 3000 sport tester. Blood was taken for lactate analysis after the athletes had been running at each speed for 60 seconds. All the athletes showed a linear increase in heart rate with increases in running speed. No heart rate deflection point was identified for any athlete. The coefficients of determination, $r^2$, ranged from (0.81-0.98). The lactate concentration increased as a quadratic function with increase in running speed. No lactate balance point was identified for any athlete. The coefficients of determination, $r^2$, for the 10 runners ranged from (0.90-0.98). These results were used to link heart rate and lactate through a simple quadratic equation. Lactate = a(heart rate)$^2$ +b(heart rate) + c, where a, b and c are constants which vary from athlete to athlete. A simple analysis of variance showed that the lactate and heart rate relationship can be reliably reproduced using this protocol.

28 ANNUAL INCIDENCE AND RISK FACTORS FOR ROCK CLIMBING INJURIES IN SOUTH AFRICA

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The aim of this study is to determine the composition of the climbing population in South Africa, the prevalence of injury amongst this population and some of the possible risk factors for injury. Data collection, by means of a self-administered questionnaire, addressed the climbers' personal details, grade/experience of climbing; the hours of climbing done; climbing style/technique; training sessions; and warm-up and stretch activities. Climbers also reported on any injuries sustained during the period January 1992 to December 1992 that could be attributed to their climbing.Two hundred and seven climbers (male 87.4% and female 12.6%) responded (response rate 21%). The annual incidence of injury was 41.7%.Bivariate analysis of injured climbers (1) versus non-injured climbers (N) indicated a significant difference ($P<0.05$) in those who climb at grades >26 (1 = 8, N = 21 climbers); climb more days per month ((1 = 9, N = 6 days); climb more hours per day on weekdays (1 = 2, N = 1 hrs); do more hard rock (sport) climbing (1 = 50, N = 32%); do more overhang climbing (1 = 31, N = 18%); do more hours per month on formal training (1 = 18, N = 11 hrs); do more outdoor training on rock (1 = 31, N = 11%); and spend more time on warm-up (1 = 7, N = 4 min) and stretching exercises (1 = 8, N = 4 min). Discriminant analysis identified four variables that could distinguish between the injured and non-injured groups: grade of climbing < 20 (Wilkes' $\lambda = 0.847$, $p = 0.0000$), formal training on outdoor rock face (Wilkes' $\lambda = 0.783$, $p = 0.0000$), days per month spent climbing (Wilkes' $\lambda = 0.744$, $p = 0.0000$), and percent of time spent on hard rock (sport) climbing (Wilkes' $\lambda = 0.721$, $p = 0.0000$). These four variables correctly classified climbers as having sustained injuries in 72.8% of cases. In conclusion we have found the annual incidence of South African climbing injuries to be 41.7% a figure in keeping with other highly competitive sports. More experienced climbers, climbing at higher grades, more often per week and per month, on more off-the-vertical, overhanging outdoor rock walls are more likely to sustain injury.

## 29 ANATOMICAL DISTRIBUTION AND NATURE OF ROCK CLIMBING INJURIES IN SOUTH AFRICA

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The aim of this study was to investigate the anatomical distribution, nature, mechanism and severity of injuries in rock climbers. Questionnaires were mailed to eighty-five climbers who had indicated in an initial survey that they had sustained injuries attributable to a climbing activity. Fifty-one climbers (60%) reported on a total of 85 injuries. The anatomical distribution of these injuries was as follows: digits (42%); elbow (11%); shoulder and ankle (7% each); arm, foot and back (4.7% each); forearm (3.5%); vertebral column, pelvis, thigh, knee, wrist and hand (2.4% each). The nature of these injuries was of sudden onset in 60% of cases and of gradual onset in 40% of cases. Very few sudden onset injuries represented fractures (8%) or dislocations (5.5%). These bony injuries were sustained during falls from the climbing surface. The majority of injuries were reported as muscle strains and tears, ligament sprains, and tendonitis. Sixty seven percent of climbers with sudden injury indicated that a specific climbing move could explain the mechanism of injury. Severity of these injuries, as assessed by climbing days lost, averaged 52 days (std = 84, range = 0 - 400 days). We conclude that injuries sustained whilst climbing affect mainly the upper limb (73%) with the digits (42%) and the elbow (11%) predominating. They are more likely to be acute than chronic injuries and more commonly involve soft tissues than bones. In most cases of sudden onset injury, the mechanism of injury can be explained by a specific climbing manoeuvre. The range of injury severity is very wide with most injuries averaging 7 weeks in lost climbing days. This figure is in keeping with time to healing for most soft tissue injuries.

## 31 THE EFFECT OF STATIC STRETCH DURATION AND FREQUENCY ON HAMSTRING MUSCULOTENDINOUS FLEXIBILITY

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A study was undertaken to investigate the effect of different durations and frequencies of static stretch on hamstring musculotendinous flexibility. Ten subjects were studied under two conditions with one limb having the experimental stretch procedure performed on it, while the opposite limb acted as the control. The duration of static stretch was determined by comparing the effect of 10, 20, 30, 60, 90, 120 and 240 second duration stretches on hip joint range of motion (ROM). The end point of ROM was determined using a previously validated technique which defines the end point by a sudden increase in surface EMG activity. The number of stretch repetitions (frequency) was determined by comparing the effect of 1, 2, 3, 4, 5, 7 and 9 repetitions of a 30 second stretch each on hipjoint ROM. A significant ($p<0.01$) increase in hip flexion ROM from baseline (measured 5°) was documented after all the durations of stretch except in the 10 second static stretch duration (0.9 ± 2.8°). No significant differences ($p>0.05$) were observed between the 30, 60, and 90 seconds durations, but these durations resulted in significantly ($p<0.05$) larger increases in ROM than the 120 and 240 second durations. A significantly ($p<0.01$) larger increase in ROM was observed after 2 repetitions (9.8 + 2.3°) compared with 1 repetition (6.5 + 2.0°). A significantly ($p<0.01$) larger increase was also observed with 3 repetitions (12.8 + 1.8°) compared with 2 repetitions (9.8 + 2.3°). There were no differences ($p>0.05$) between 3, 4, 5, 7 and 9 repetitions. In conclusion, these studies indicate that the ideal static stretch session consists of a stretch of 30 to 90 seconds duration, repeated more than 3 times.

## 30 ELECTROMYOGRAPHIC ANALYSIS OF UPPER LIMB MUSCULATURE DURING ROCK CLIMBING

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The aim of this study was to determine the electromyographic activity profiles of six forearm muscles commonly used during sport rock climbing. Six intermediate (>grade 20) male climbers volunteered for the study. Two indoor artificial climbing walls were erected - one on the vertical and one angled at 30° off the vertical. Climbers were tested on the two walls using four different handhold types most commonly used by climbers : an open grip, cling (crimp) grip, two-finger pocket grip and an undercling grip. Electromyographic (EMG) data were recorded during a 30 second period using an EM8 EMG unit linked to a personal computer with custom written software. Two groups of three muscles each were chosen for analysis: group 1 = brachialis (B), flexor digitorum superficialis (FDS) and pronator quadratus (PQ); group 2 = flexor carpi ulneris (FCU), brachioradialis (BR) and extensor digitorum (ED).The table below summarizes the EMG results obtained:

| | Vertical wall | | | | Overhang wall | | | |
|---|---|---|---|---|---|---|---|---|
| Muscle | open | crimp | pocket | undercling | open | crimp | pocket | undercling. |
| B | 71±36 | 61±30 | 71±33 | 66± 39 | 28±17 | 57±22 | 69±30 | 51±36 |
| PQ | 59±34 | 53±40 | 71±37 | 58±40 | 46±31 | 41±31 | 34±29 | 54±35 |
| FDS | 51±31 | 54±29 | 75±36 | 57±20 | 41±17 | 56±25 | 85±30 | 52±23 |
| FCU | 82±23 | 82±20 | 47±30 | 45±30 | 66±22 | 80±16 | 59±34 | 46±22 |
| BR | 47±33 | 46±35 | 66±24 | 65±23 | 41±32 | 50±29 | 68±38 | 58±12 |
| ED | 59±37 | 57±34 | 41±30 | 44±21 | 50±38 | 50±31 | 36±42 | 11±11 |

Multiple linear regression analysis was done to determine whether or not significant relationships existed between the grip type and level of muscle activity and the type of wall (overhang or vertical) that was climbed. In the first analysis climber 1 on wall 1 (vertical) using muscle 1 (brachialis) on grip 1 (open grip) was established as the constant dependent variable. The four independent variables were: wall (2 levels); climber (6 levels); muscle (6 levels) and grip type (4 levels). The four variables, without any interaction terms included, accounted for 28% ($r=0.53$) of the variance of the dependent variable ($F=7.57$, $df=14$ and 287, $p<0.001$). When the climber-muscle interaction (25 terms) was added to the model, 46% ($r=0.678$) of the variance of the dependent variable could be accounted for ($f= 5.44$, $df=39$ and 287, $p<0.001$). This suggests that differences in technique between different climbers are possible even when the same grip is used. When muscle-grip interaction (54 parameters) was also added to the model, 56% ($r=0.749$) of the variance of the dependent variable could be accounted for ($F=5.44$, $df=39$ and 287, $p<= 0.001$). The interaction between muscle and wall made no meaningful improvement to the model. In conclusion, high levels of electrical activity were found in the forearm muscles under all conditions tested. The regression analysis revealed that forearm muscle EMG in rock climbing is influenced by the type of grip used, the muscle being sampled, the individual climber and the wall.

## 32 THE EFFECT OF A SINGLE STATIC STRETCHING SESSION ON HAMSTRING MUSCULOTENDINOUS FLEXIBILITY OVER 24 HOURS

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The aim of this study was to determine the retention of increased range of motion (ROM) over 24 hours after a single static stretching session of 30 seconds duration and repeated 3 times. Hip joint ROM (in degrees), using surface EMG activity to determine the end-point, was measured before the stretching session, immediately after the stretching session, and at 1, 2, 3, 4, 5, 6, 12 and 24 hours after the stretching session. Analysis of results showed a significant difference ($p<0.05$) between the pre-stretch ROM (92 ± 12°) immediately after (106 ± 12°) and at 1 (105 ± 12°), 2 (104 ± 13°), 3 (104 ± 11°) and 4 hours (103 ± 11°) post stretch. A significant difference ($p<0.05$) was also found between the immediate post stretch ROM (106 ± 12°) and the 12 (94 ± 12°) and 24 hours (93 ± 12°) post stretch measurements. These findings indicate that increased ROM after the optimum static stretching session was retained for only 4 to 6 hours. In conclusion, this study indicates that after a static stretch session (30 seconds x 3 repetitions) the increased ROM is retained for up to 6 hours only. Stretching programs, using the static stretching technique, should therefore be modified so that stretching sessions are conducted 3 to 4 times per day.

## 33 EFFECTS OF SUSTAINED HIGH INTENSITY INTERVAL TRAINING (HIT) ON EXERCISE PERFORMANCE, SKELETAL MUSCLE AND CARDIAC FUNCTION IN CARDIAC REHABILITATION PATIENTS

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This study compared the effects of the addition of a 10 wk HIT program of cycle ergometer training @ 80-90% $V0_{2max}$ (HIT; n=9), to continued conventional aerobic exercise @ 50-70% $V0_{2max}$ (CONT; n=8) on maximal (MAX) and submaximal (SMX) exercise performance, skeletal muscle strength and resting cardiac function, in 17 aerobically trained patients participating in a cardiac rehabilitation program. Before and after intervention both groups performed: i)graded exercise to exhaustion, for determination of $V0_{2max}$ and peak power output (PPO); ii) a six minute walk test (6WT) for distance covered; iii) tests of isometric and isokinetic skeletal muscle function (SMF) & iv) echocardiography for determination of ejection fraction (EF) and left ventricular mass (LVM). At baseline, all parameters were similar between HIT and CONT groups. After intervention, PPO increased by 17% (130 ± 12 vs 156 ± 12 W; [mean ± SEM], $P<0.005$) in the HIT group but was unchanged in the CONT group (140 ± 14 vs 136 ± 14 W). Similarly $V0_{2max}$ increased by 18% after HIT (24.5 ± 1.9 vs 29.7 ± 1.9; $mlO_2$ kg $min^{-1}$; $P<0.05$) in the HIT group but was unchanged in the CONT group (23.3 ± 2 vs. 24.2 ± 2.3 $mlO_2$ kg $min^{-1}$). Distance covered in the 6WT increased after HIT (11%; 635 ± 27 vs. 713 ± 27 m; $p<0.01$), but was unchanged in the CONT group (584 ± 45 vs. 577 ± 28 m). EF, LVM and SMF did not change in either HIT or CONT groups. These results suggest that HIT resulted in improved MAX and SMX exercise performance, which could not be attributed to enhanced resting cardiac function or SMF. These adaptations exceed those seen in the healthy athletic population performing HIT.

## 34 INTEGRATED ELECTROMYOGRAPHIC (IEMG) ACTIVITY AND CARDIOVASCULAR RESPONSE IN PATIENTS WITH LOWER BACK PAIN (LBP): EFFECT OF SLEEP SURFACE.

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We have recently shown that patients with chronic LBP have decreased IEMG activity of the erector spinae muscles, lower heart rates (HR) & increased perception of comfort (ROC) when lying on a locally designed, triple density, contoured, lumber body support (LBS) compared with a regular flat surface mattress (CM). In order to determine a mechanism for these effects, we studied patients with LBP after an acute, random order, 30 min exposure to 4 sleep surfaces: LBS, CM, a low density, flat, Egg Box Foam Mattress (EBM) and a Polystyrene Shape Mould (PM), identical to the shape of the LBS. Patients ware divided into 2 groups: i) LBS, EBM & CM (n=10) & ii) LBS, PM & CM (n=10). Each patient acted as his/her own control. Recordings of IEMG activity, HR & ROC were measured at 5 min intervals for each patient. At baseline, patients were included only if deep palpation of the erector spinae musculature elicited pain. After acute exposure to the LBS, average HR ↓ by 13 b/min over the 30 min period (58.72 ± 3.87; b/min; $P<0.05$), but was unchanged for the EBM and CM groups (62.83 ± 4.02; b/min) & (62.89 ± 3.78; b/min). Average ROC reported after acute exposure to the LBS was significantly improved (1.86 ± 0.33; $P<0.05$), compared to ROC after exposure to the EBM (4.22 ± 0.43) & CM (4.6 ± 1.67). Average IEMG measurements were significantly reduced on the LBS (3.88 ± 0.76; mv; $P<0.05$) compared to the CM (13.81 ± 2.16; mv) and EBM (16.44 ± 2.86; mv). ii) In the second group, HR ↓ significantly after exposure to the LBS, (60 ± 2.3; b/min; $P<0.001$), while there was no significant change for PM (66 ± 2.9; b/min) & CM (68.15 ± 2.97; b/min). ROC was significantly improved on the LBS (1.83 ± 0.18, $P<0.01$) vs PM (5.6 ± 0.78) & CM (4.13 ± 0.56). Average IEMG measurements were significantly reduced on the LBS (3.83 ± 0.72; mv; $P<0.05$) vs CM (14.35 ± 5.66; mv) & PM (27.6 ± 9.24; mv). These results suggest that patients with LBP have ↓ IEMG & HR measurements & Improved ROC when lying on a LBS compared with a CM; EBM and PM. These findings indicate that the effect of the LBS is likely due to a combination of both its density and contour features.

## 35 METABOLIC COST OF TRAMPOLINE EXERCISE IN RELATION TO TREADMILL EXERCISE AT COMPARABLE HEART RATES

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Exercising on the mini-trampoline has become increasingly popular particularly in the home environment. However quantification of exercise intensity is difficult. One possible method would be the use of heart rate but the relationship between heart rate (HR) and oxygen consumption ($VO_2$) during mini-trampoline exercise is not clear. Therefore the aim of the current study was to elucidate the relationship between HR and $VO_2$ during mini-trampoline exercise and to compare the same relationship during treadmill running over a comparable range of heart rates. An additional aim was to investigate the effect of the height of leg lift at a given, commonly used step rate. Subjects (n=17) were male (age range 18-30) and all had undertaken a familiarisation session prior to completing the test. Workloads on the trampoline were 100, 120, 160 and 200 steps/ min with a 15cm leg lift and a final workload at 120 steps/min with a 90° leg lift, with pace maintained by metronome. The first workload was maintained for 5 mins and all subsequent workloads for 3 mins, with recordings made for analyses in the last 30 sec of each workload. Five treadmill workloads were selected for each subject to give a similar range of heart rates to those achieved on the mini-trainpoline. Immediately after the 5th workload on the treadmill, subjects continued to exhaustion for determination of peak $VO_2$. The relationship between $VO_2$ and HR on the treadmill was linear as described elsewhere, with the equation $VO_2$=20.2HR - 1070, whilst the equation of the relationship between $VO_2$ and HR for trampoline exercise was exponential ($VO_2$=441$e^{0.0008HR}$) showing a pronounced elevation in HR*prior* to an elevation in $VO_2$. The mean $VO_2$ whilst stepping at 120 steps/min with a leg lift of 90° was significantly higher than with a leg lift of 15 cm (2.10 l/min vs 1.97 l/min, $p< 0.001$). The results of this study indicate the heart rate is not an accurate method of monitoring exercise intensity during trampoline exercise and that the degree of leg lift is crucial in prescribing exercise intensity during such exercise.

## 36 FUSAFUNGINE REDUCES SYMPTOMS OF UPPER RESPIRATORY TRACT INFECTIONS (URTI) IN RUNNERS AFTER A 56KM RACE

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The effect of Fusafungine, a topical anti-inflammatory/anti-bacterial nasal/oral spray, on the incidence of symptoms of upper respiratory tract infections (URTI) in the 9 days following a 56km running event was studied. Male runners (n=96) with a 42km time of <3hrs, with no history of allergy, and with daily intakes of i) < 1000mg Vitamin C, ii) < 18mg Beta carotene, and iii) < 400 IU Vitamin E were recruited. Prior to the race, subjects were instructed on the proper use of the medication (4 sprays into each nostril and the throat 4 times daily) and then randomly allocated to either a group receiving Fusafungine (F:n=48) or a placebo (P:n=48) in a double blind manner. Subjects completed a daily logbook detailing symptoms [runny nose (RN), blocked nose (BN), all nasal symptoms (N = RN+BN), sore throat (ST), and all URT symptoms (URTS = RN+BN+ST), in the 2 days before the race, the first 3 days after, and the 4-9 days after the race. All the symptomatic subjects underwent medical evaluation. Throat swabs and viral gargles for culture were taken. No athlete with symptoms had a positive bacterial or viral culture. The incidence of symptoms (%) in the F and P group was as follows:

| | BN | | RN | | N | | ST | | URTS | |
|---|---|---|---|---|---|---|---|---|---|---|
| | F | P | F | P | F | P | F | P | F | P |
| Day -2 to -1 | 10 | 11 | 12 | 3 | 19 | 23 | 12 | 15 | 21 | 33 |
| Day 0 to 3 | 6 | 17 | 6 | 15 | 9+ | 23 | 14 | 21 | 17* | 40 |
| Day 4 to 9 | 11 | 15 | 11 | 8 | 17 | 21 | 22 | 17 | 28 | 27 |

There was a decreased incidence (%) in URTS in the F group (F=17%; P=40%: *:p<0.05) in the period Day 0-3 after the race, with a tendency for the nasal symptoms to be lower (F=9%; P=23%:+:p=0.08) in the same period. In summary, post-race URTS are not of infective origin (viral or bacterial) and their incidence can be reduced by a topical anti-inflammatory agent. Hence post-race URTS are likely the result of an inflammatory and not an infective process. Supported by Servier Laboratories SA (Pty) Ltd.

## 37 THE EFFECTIVENESS OF A MENTAL SKILLS TRAINING PROGRAMME FOR EASTERN PROVINCE ACADEMY CRICKETERS

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A major doctrine of Sport Psychology is that sport performance is strongly determined by mental skills. This study evaluated the effectiveness of a mental skills training programme on the self-reported 'knowledge of', 'importance placed on' and 'use of' six mental skills: goal-setting, concentration and attention, arousal and anxiety control, visualization and imagery, confidence, and pre-, during- and post-game activities, i.e., ideal performance state (IPS), in a sample of male cricket academy players (n = 14). Selected non-academy players formed a comparison group (n = 12). The Academy players participated in a six-week mental skills training programme, which involved one of the six mental skills each week. During each session the particular skill was defined and explained, as were the principles and implementation that applies to that specific mental skill, followed by a practical exercise, where the players were guided through the application of the skill. The players also completed assessments before and after the programme. The comparison group members did not participate in the programme, but also completed assessments on two separate occasions. Overall, the results suggest that the programme was instrumental in changing the 'knowledge of' ratings most consistently across the mental skills, but was less consistent in changing the cricketers' 'importance placed on' and 'use of' ratings. Knowing more about the mental skills and even acknowledging their importance in cricket, may not necessary be sufficient in order to lead to enhancement in performance. Therefore, cricketers need to be encouraged to practice using and improving their mental skills consistently and regularly. It may prove beneficial to integrate the mental skills with the physical and technical practice, in order to increase the 'use of' mental skills in cricket performance. The comparison group did not show any significant increase in any of the ratings for any of the mental skills, which suggests that it was the programme that was instrumental in changing certain ratings.

## 38 THE PREVALENCE OF ANABOLIC STEROID USE IN ADOLESCENTS IN SOUTH AFRICA

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Twenty-six schools were randomly selected from all the schools in 2 geographical regions (A and B). A questionnaire was administered to 2912 adolescents (17-19 years) from these schools to determine the prevalence of anabolic steroid (AS) use and to test their knowledge on AS (assessed by a score obtained in response to 8 questions on AS). Complete data were obtained from 2836 (97.4%) adolescents in the 2 regions (A, n=1361; B, n=1475). The prevalence of AS use in all the adolescents was 1.4%. The prevalence of use was higher in region B (2.2%) compared to region A (0.6%) ($p<0.005$) and in boys (2.8%) compared to girls (0.07%)($p<0.001$). When the group was subdivided, the highest prevalence of AS use occurred in boys who competed in the first team (3.8%). The score (maximum of 8) obtained by all sports participants in the knowledge test (mean ± SD) was low (2.7 ± 1.6). The score was higher in boys (2.9 ± 1.6) than girls (2.3 ± 1.5) ($p<0.05$) and sports participants (2.7 ± 1.6) compared to non-participants (2.2 ± 1.6) ($p<0.01$). In conclusion, this study highlights the problem of AS use in schoolboys, shows regional differences in AS use and a poor knowledge of AS in all the groups.

## 39 ISOKINETIC STRENGTH TRAINING OF THE QUADRICEPS FEMORIS BY MEANS OF ELECTRICAL STIMULATION

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The primary aim of the study was to investigate the strengthening of the quadriceps femoris muscle group by means of an isokinetic NMES training programme. 21 subjects, with an average age of 22.55 years, participated in the study. A Cybex 340 dynamometer was used to measure extension torque at $0^{\circ}.s^{-1}$ (60° knee flexion), 60, 180 and $240^{\circ}.s^{-1}$ before and after the NMES training period consisting of 10 sessions. The subjects were divided into groups: Group A (who received isokinetic NMES training) and Group C (who served as a control group). In addition, each individual had a designated "treatment" and "control" leg; the "control" leg served as an extra control for determining the effect of the isokinetic NMES training programme. Independent and dependent t tests revealed that 10 sessions of isokinetic NMES training of the quadriceps femoris, resulted in statistically significant knee extension torque improvements in Group A (for the treatment leg), at $0^{\circ}.s^{-1}$ (18.2%), $60^{\circ}.s^{-1}$ (20.7%), $180^{\circ}.s^{-1}$ (17.4%), and $240^{\circ}.s^{-1}$ (13.2%), respectively. However, Group A's control leg also showed statistically significant improvements of 2.6 and 2.0% at 0 and $60^{\circ}.s^{-1}$, respectively. Additionally, Group C's "treatment" leg showed a significant ($p<0.05$) improvement in the post-treatment condition of 6.2%, even though it received no NMES treatment. In the present study, a safe method of isokinetic NMES was developed which proved to be viable as a strength training modality for the quadriceps femoris muscle group. The isokinetic NMES training programme at $60^{\circ}.s^{-1}$ resulted in significant improvements in both isometric and isokinetic knee extension torque ($p<0.05$).

## 40 THE ENERGY COST OF RUNNING IN FIELD HOCKEY IS GREATER WHEN DRIBBLING A BALL

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The physiological demands of field hockey, which employs a unique posture while playing the ball, have mainly been inferred from studying athletes running in the upright posture. In this study, resting pulmonary function was assessed in both the upright and the semi-crouched dribbling posture in eleven male and ten female elite field hockey players. In addition, the players completed a 4 minute run on the treadmill at 10, 12 and 14 km/hr for the men, and 8, 10 and 12 km/hr for the women, whilst both dribbling a ball at the end of a hockey stick and during normal running. The metabolic and ventilatory responses to normal running and to dribbling a hockey ball in the semi-crouched position were evaluated in order to establish the additional physiological strain imposed by this compromised posture. The semi-crouched posture significantly reduced resting pulmonary function in both the men and the women (FVC 6.0 ± 01.2 vs 6.3 ± 1.21 in males, and 4.1 ± 0.6 vs 4.2 ± 0.6 in females; PEF 11.1 ± 2.2 vs 11.8 ± 2.7 l/s in males, and 8.7 ± 1.7 vs 9.1 ± 1.6 l/s in females; $P<0.05$). Dribbling increased energy expenditure above levels observed in normal running, for both the men and women at each speed (e.g. 52.2 ± 1.9 vs 47.6 ± 2.3 $ml.kg^{-1}.min^{-1}$ in males, and 43.9 ± 2.0 vs 39.8 ± 2.3 $ml.kg^{-1}.min^{-1}$ in females at the high speed; $P<0.001$). Heart rate was significantly higher while dribbling at each speed (e.g. 190 ± 6 vs 177 ± 7 beats/min in males, and 189 ± 11 vs 178 ± 12 beats/min in females, at the high speed; $P<0.001$). Minute ventilation was significantly higher while dribbling relative to orthodox running at each speed (e.g. 150 ± 25 vs 107 ± 15 l/min in males, and 109 ± 14 vs 82 ± 13 l/min in females, at the high speed; $P<0.001$). This study has shown that the compromise in pulmonary function detected in the dribbling posture at rest does not impair the physiological performance of hockey players executing dribbling skills on the treadmill. Furthermore, running in the dribbling posture is far more physiologically costly than is orthodox running. The additional strain that the players experience in this peculiar posture must be incorporated in predictions of the energy cost of competitive match-play hockey.

## 41 MOOD AND PERFORMANCE OF CRICKETERS DURING AN INTERNATIONAL TOUR

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Objectives: An attempt was made to determine whether the mood state of cricketers and the team as a whole could contribute to the extremely variable performance which was noted on previous occasions. Methods: A modified questionnaire based on the Profile of Mood States (POMS) was administered by interview with each player individually on most mornings of a six-week cricket tour. Categories assessed were Anxiety, Confusion, Depression, Fatigue, Vigour, Relaxation, Soreness, Homesickness, Boredom and Frustration. Results: Anxiety scores showed short-term trends and were match-related. Higher scores were associated with better performance. Confusion scores appeared to reflect the state of leadership and success on tour, rather than predict performance. Depression scores were also more a result of events than a predictor. Fatigue was also related to match history. Vigour did not mirror fatigue, but was low on rest days. Relaxation scores were higher during rest periods, but also at the end of one match when performance was lower. Soreness scores did not increase during the tour, but individual variation was evident, due usually to injury. Homesick scores showed a rising trend, exacerbated on the rest days. Boredom was lowest at the beginning and highest on rest days. Some individual Frustration scores were very high at certain times, and the team score was high during a period of poor performance and prior to another period of poor performance. Conclusions: Teams touring abroad face stresses that are different from what they and their management are used to at home. This study highlights some of the general problems such as rest days and motivation which can be taken into account when planning tours in general. Certain scores of mood relate more to the result of events, and need to be taken into account in managing team morale and strategy on a particular tour. Other scores may predict performance and give early warning of a dip in form.

## 42 COMMUNITY BASED CARDIAC REHABILITATION PROGRAMMES - A PILOT PROJECT.

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In the South African Indian population over 45 years of age, approximately 50% of deaths "from all causes" are due to diseases of the circulatory system. In a large random survey of Durban's Indian population, 48% of people over the age of 15 years were found to have ECG changes. Coronary heart disease accounts for 24% of all deaths in the medical wards of one of Durban's major hospitals. With increasing intervention surgery and angioplasty there are a large number of patients who are candidates for cardiac rehabilitation programmes. A review of the rehabilitation programmes in the Durban Functional Region revealed that there are about 35 Indians attending. Analysis of the reasons for the low attendance, revealed the following factors: lack of knowledge of the medical practitioners of the benefits of rehabilitation and of the services available, practitioners' fear of "losing' the patient, family pressure on the patient to not exercise as it is considered dangerous, inappropriate siting and timing of rehabilitation programmes, and the fear of losing disability grants if rehabilitated. With this in mind, discussions were initiated with the local community leaders in Phoenix. After initial scepticism, a partnership was entered whereby the community would provide facilities, and volunteers to run a tertiary rehabilitation programme. The local doctor's guild was invited to participate, and although supportive of the idea, they did not offer their time. The volunteers underwent training in CPR, exercise prescription and monitoring, and programme management. General community interest was raised by phone in programmes on the community radio, Radio Lotus, and equipment was donated by the public. The service is free, and there is no budget. All incidental costs such as printing etc have been borne by donation from the local community. The programme has been running for 3 months and is growing. There are requests from other Indian communities to start similar projects in their areas, and project committees are being established.

## 43 INFRA-RED LASER: AN IN VITRO DOSIMETRY STUDY.

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Low intensity laser therapy is a popular treatment modality used to enhance wound healing. A commonly used commercially available low intensity infra-red laser is the superluminous diode based Gallium Aluminium Arsenide laser, 830nm. There is however little scientific evidence to support both its efficacy and optimal dosage. The literature on the use of laser is confounded by a lack of standardisation of terminology with respect to dosage which has been expressed in terms of power, power density or energy density. There are few dosimetry studies using infra-red laser directly on fibroblasts. The aim of this pilot study was to investigate the effect of different doses of infra-red laser on fibroblast activity in cell culture. Human fibroblasts were cultured, and confluent fibroblast cells were trypsinized and resuspended in culture medium to give a measured cell count of $11 \times 10^3$ cells/ml. 100ml of cell suspension and 200ml of culture medium were titrated into each well of a 96 well microtiter plate. The plate was then incubated 37°C until confluent. Ten of the twelve eight well channels were irradiated on three consecutive days at energy densities of 0.2, 0.4, 0.6, 0.8, 1, 1.5, 2.3, 3, 4 and 5 $J.cm^{-2}$. Each well was irradiated individually. The two end channels of eight wells each were not irradiated and served as controls. On the day after the last treatment, cell viability was measured using the MTT assay, which is an indicator of mitochondrial enzyme activity. The optical density of each well was measured spectrophotometrically at a wavelength of 595 nm with a reference wavelength of 630nm. Analysis of variance showed a significant difference between fibroblast activity at different doses ($P=0.004$). Post hoc testing revealed significant differences between the controls and those cells treated with the low dose 0.4 $J.cm^{-2}$ and the highest dose 5 $J.cm^{-2}$. Previous studies have not used doses as low as 0.4 $J.cm^{-2}$ and increased activity at this dose is a novel finding. The increased activity at 5 $J.cm^{-2}$ is in keeping with other dosimetry studies. The information gained in this study on dose efficacy will be used to evaluate a new in vitro model of wound healing.

## 44 THE RISK OF HUMAN IMMUNODEFICIENCY VIRUS (HIV) TRANSMISSION IN BOXING

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HIV disease is a fatal disease that can be transmitted through contact with blood or blood products. Sports participants that engage in contact sports such as boxing, are therefore at risk to acquire the condition. In boxing, the precise risk of transmission has not been documented. The risk of transmission of HIV in boxing is dependent upon the following four factors: i) the seroprevalence of HIV infection in boxers, ii) the risk of an open bleeding wound in a boxing bout, iii) the risk of contact between the boxers, and iv) the risk of transmission of the virus when bleeding wounds make contact. The aim of this study was to determine the risk of transmission of HIV during a boxing bout. Assuming that the risk of contact between two boxers is 100%, and that the risk of transmitting the virus when open bleeding wounds make contact is 5% (similar to that of a needlestick injury), two studies were designed to firstly determine the seroprevalence of HIV in professional boxers in South Africa, and secondly to calculate the incidence of open bleeding wounds in professional bouts in South Africa. The nature of the bleeding wounds was also studied, as well as current precautions that boxers and support staff in and around the ring take. In the first study, medical records, in particular the HIV status, in the year after compulsory HIV testing was introduced at routine annual medical examination, were obtained from all the professional boxers in South Africa (with approval of the SA Boxing Board of Control). A total of 925 boxers were registered, and the HIV positive prevalence rate was 9%. In the second study, video clips of 30 professional boxing bouts were studied. During each bout, the following data were obtained: the presence of an open bleeding wound, the type and site of injury, the amount of bleeding, contamination by the blood, and the action taken by cornermen. In 14 out of 30 bouts, an open bleeding wound was sustained by a boxer (46.7%). All the injuries were in the face/head (100%), and most injuries were lacerations (54%), followed by contusions (21%), abrasions (6.5%) and others (18.5%). The amount of bleeding was classified as mostly present but not flowing (46%), followed by fast flowing and dripping off (25%), slow flowing and not dripping (20%), and no bleeding visible (9%). The blood contaminated the following: boxing gloves (31%), towels (26%), skin (19%), ring or railing (10%), cornermen (8%), and referee (3%). Actions taken by cornermen were attempts to stop bleeding (40%), washing with water (27%), wiping but no attempt to stop bleeding (25%), and no action (8%). The risk of HIV transmission in South African boxers during one bout was therefore calculated as follows: seroprevalence (0.09) X the risk of an open bleeding wound (0.467) X the risk of contact (1) X risk of viral transmission between wounds (0,05) = 0.0021 (1 in 476 bouts). Professional boxing in South Africa therefore carries a significant risk of HIV transmission. Preventative measures to decrease the risk of HIV transmission should include education of boxers and support staff, reducing the risk of contamination, and appropriate action of contaminated material.

## 45 THE EFFECT OF LOW-DOSAGE, LONG-TERM CREATINE MONOHYDRATE SUPPLEMENTATION ON THE PERFORMANCE OF CYCLISTS

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Previous studies on creatine monohydrate concentrated on the effect of high-dosage, short-term supplementation on athletic performance. This study examined the effect of low-dosage (3g/day), long-term (12 weeks) creatine monohydrate supplementation on blood lactate accumulation, power output and fatigue. Eleven well-trained male cyclists performed repeated bouts of the 30-second Wingate anaerobic test. Finger-sample measurements for blood lactate were taken at rest and after each of the three bouts of maximal cycle ergometry. Peak power output, average power output, total work and power-drop were computed. No significant differences were reported for average power output and total work after the administration period. Creatine supplementation led to a significant decrease in power-drop during all three exercise bouts ($p_1$ = 0,003; $p_2$ 0,009; $p_3$ = 0,028) and a significant decrease (p = 0,009) in blood lactate accumulation. A significant increase (p = 0,09) in mean power output was recorded during the last 15 seconds of the exercise bouts. We therefore concluded that for well trained cyclists performing repeated bouts of maximal exercise, low dosage long-term creatine monohydrate supplementation significantly decreased fatigue and blood lactate accumulation. Funding: PPL. (Pty) Ltd.

## 46 ELECTROMYOGRAPHY AND SERUM ELECTROLYTES DURING RECOVERY FROM EXERCISE ASSOCIATED MUSCLE CRAMPING (EAMC).

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The aim of this study was to relate baseline integrated surface electromyographic (BIEMG) activity and serum electrolyte concentrations (SEC) to clinical recovery in runners with EAMC. Subjects were runners presenting with acute severe (unable to walk) EAMC after a 56 km race (E, n =11). Controls for the SEC (Cl, n = 11) were runners matched for age, gender and finishing time who completed the 56km race without EAMC. Controls for the BIEMG (C2, n = 7) were runners with no EAMC after a 35 km run. BIEMG was recorded i) in the affected muscle (quadriceps (Q), gastrocnemius (G)) of the subjects in the E group on admission (To) and after recovery (60 minutes later) (T60) during periods when the runners were not experiencing a spontaneous muscle contraction (BIEMG) and ii) in the C2 group in the Q and G muscles after the 35 km run (To) and 60 minutes later (T60). EMG data were expressed as % change in BIEMG (To to T60). The % decrease (mean (SD)) (TO vs T60) in BIEMG for the E group (52 (25)) was significantly greater (p <0.05) than the C2 group (12 (47)). The results of blood samples collected for measuring SEC (mmol/l) on admission (To) and 60 minutes later (T60) in the E and C groups are depicted in Table 1.

Table 1 : Serum electrolyte concentrations ((mean (SO)) during recovery from EAMC

| | Na+(mmol/l) | Ka+(mmol/l) | Ca++(mmol/l) | Mg++(mmol/l) |
|---|---|---|---|---|
| Ta: C1 group | 142(3) | 4.7(0.4) | 2.3(0.1) | 0.7(0.1) |
| To: E group | 142(2) | 4.3(0.5)* | 2.3(0.1) | 0.7(0.1) |
| T6O: C1 group | 141(2)** | 4.4(0.05)** | 2.1(0.3) | 0.7(0.1) |
| T60: E group | 140(3) | 4.2(0.4) | 2.2(0.1) | 0.8(0.1) |

* p<0.05, E vs C1 group at To: **p<0.05, To vs T60 for C1 group

These results indicate that i) runners with EAMC have greater BIEMG activity than control runners during the next race period ii) decreases in BIEMG activity are associated with recovery from EAMC, iii) there is no relationship between SEC and either recovery from EAMC of BIEMG and iv) that differences in serum K+ and N+ between E and C1 are not of clinical significance. Supported by the Sports Medicine Research Fund of the University of Cape Town.

## 47 SERUM ELECTROLYTE CONCENTRATIONS AND HYDRATION STATUS IN RUNNERS WITH EXERCISE ASSOCIATED MUSCLE CRAMPING (EAMC)

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The aim of this study was to determine whether acute EAMC in distance runners is related to changes in serum electrolyte concentrations (SEC) and hydration status (HS). A cohort of runners (N=44) participating in a 56 km race all with a history of EAMC were recruited. Body weight was measured and blood samples for blood glucose (BG), SEC, serum osmolality (Osm), Haemoglobin and haematocrit were collected from all the runners 30 min before the race (Tb) and immediately on completion of the race (To). Samples for SEC and Osm were also collected 60 min (T60) after the race. The cohort was divided into a group of runners (C, n=21) who suffered from EAMC during the race, and a group with no EAMC (N, n=23). Both groups had similar [(mean (SD)] age (years) [N:42(8), C:37(8)], pre-race BW (kg) [N:73(8). C:78(11)], and race finishing times (min) [N:304(36), C:309(41)]. Runners with EAMC were treated only with rest, passive stretching and oral fluids,and all had recovered by T60. SEC (mmol/l) BG(mmol/l), OSM (mosm/l) and hydration status (calculated as % change in BW (% BWC) and % change in plasma volume (%PVC) were compared in the C and N groups using ANOVA (Table 1).

Table 1. Blood glucose and serum electrolytes in the N and C group at Tb, To and T60.

| | BG | Na+ | K+ | Ca++ | Mg++ | Osm |
|---|---|---|---|---|---|---|
| Ta:N | 6.1(1.1) | 139(2) | 4.4(0.4) | 2.2(0.1) | 0.8(0.1) | 282(4) |
| Tb:C | 6.3(3.1) | 139(2) | 4.5(0.4) | 2.2(0.1) | 0.8(0.1) | 284(5) |
| Ta2:N | 6.5(2.0) | 142(2) | 4.7(0.5) | 2.3(0.1) | 0.7(0.1) | 284(10) |
| Ta:C | 6.8(1.9) | 140(3) | 4.9(0.6) | 2.3(0.2) | 0.7(0.1) | 280(16) |
| T60:N | 6.5(1.0) | 142(2) | 4.6(0.5) | 2.2(0.2) | 0.7(0.1) | 183(8) |
| T60:C | 6.3(1.0) | 140(2) | 4.7(0.5) | 2.2(0.3) | 0.8(0.1) | 284(7) |

There were no significant differences in the SEC, BG, Osm and HS between the C (% BWC: - 2.9 (1.2), %PVC: 0.2 (6.3)) and the N (%BWC : - 3.6 (1.2), % PVC : 0.7 (8.6)) group. The results of this study refute the hypothesis that EAMC is associated with changes in SEC and HS. Supported by the Sports Medicine Research Fund of the University of Cape Town.

## 48 PSEUDOEPHEDRINE IS WITHOUT ERGOGENIC EFFECTS DURING PROLONGED EXERCISE

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This study was designed to measure whether a single dose of 120 mg pseudoephedrine ingested 120 minutes before exercise influences performance during 1 hour of high intensity exercise. The effects of exercise on urinary excretion of the drug were also studied. Ten healthy male cyclists were tested on two occasions, separated by at least 7 days, using a randomly assigned, double-blind, placebo controlled, crossover design. Exercise performance was tested during a 40 km trial on laboratory cycle ergometer and skeletal muscle function was measured during isometric contractions. On a third occasion, subjects ingested 120 mg pseudoephedrine but did not exercise (Control = C). Pseudoephedrine did not influence either time trial performance (58.1 ± 1.4 vs 58.7 ± 1.5 min; Mean ± SEM: drug (D) vs placebo (P) or isometric muscle function. Urinary pseudoephedrine concentrations (114.3 ± 27,2 vs 35.4 ± 13.1 ug/ml; $p < 0.5$) were significantly increased one hour after exercise (D vs C). Peak plasma pseudoephedrine concentrations ($p < 0.05$) but not time taken to reach peak plasma concentrations nor the area under the plasma pseudoephedrine concentration vs time curve was significantly increased in the total group with exercise (D vs C). In three subjects, plasma pseudoephedrine concentrations were not influenced by exercise. Only these subjects showed increased urinary pseudoephedrine excretion during exercise. We conclude that, a single therapeutic dose of pseudoephedrine did not have a measurable ergogenic effect during high intensity exercise of 1 hour duration. But plasma drug concentrations and urinary excretion were altered by exercise. These findings have practical relevance to doping control regulations in international sporting competitions.

## 49 INSTITUTIONAL REVIEW BOARDS AND SCIENTIFIC PROGRESS

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Research into the limits of human performance has become a growth industry, and critical to investigators is a readily available supply of subjects. However, history attests that free scientific inquiry and social stability have often been at odds. Particularly when research (and the freedom to conduct it) impinges on the perceived rights of individuals or groups, a sense of alarm grows even in societies that have traditionally given free rein to such activities. As a result, there have been, and continue to be, numerous demands for the regulation of research with injurious or invasive potential. Growing acceptance of ethical principles such as autonomy, as well as public reaction to past abuses, has led to the establishment of Institutional Review Boards (IRBs). This paper examines the structure, function, and effectiveness of IRBS, and specifically focuses on the notion that the institutionalisation of these committees has created a growing bureaucracy that retards scientific progress by reducing creative nonconformity. The paper evaluates the argument that not only is ethical review endangering valuable research on human beings, but that it is also endangering the very ethic that is needed to govern such research. Future strategies and possible solutions are explored, and the paper concludes that the imperfections of the concept should not lead to the ethical review process being discarded.

## 50 RATE OF PLASMA LACTATE CLEARANCE DURING PASSIVE RECOVERY FROM HIGH INTENSITY EXERCISE

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An athlete's ability to repeatedly perform at high intensities during intermittent exercise could be related to accelerated plasma lactate removal during the recovery phase. We determined the rate of plasma lactate disappearance during passive recovery after an incremental exercise test to exhaustion on a bicycle ergometer in five trained and five untrained male subjects. Venous blood samples were taken during exercise and recovery at set intervals for the analysis of plasma lactate concentration. The endurance fitness of the subjects was characterised from the work load at the lactate turn point (LTP) and classified as maximum turn point power out (MTP) in $W.kg^{-1}$. The mean MTP of the trained group was $3.92 \pm 1.8$ $W.kg^{-1}$ and $2.1 \pm 0.51$ $W.kg^{-1}$ for the untrained subjects. From the exponential curve of percentage of peak plasma lactate vs time during passive recovery we determined the rate of lactate clearance at 5min, 10min and at the equivalent lactate concentration to that found at the LTP. We also determined the time taken to clear 30% and 50% of peak lactate concentrations, and the time to return to LTP concentration in recovery. Using Spearman rank correlation, no significant relationships were demonstrated between the recovery parameters measured from the curve and endurance fitness ($r_s$, spanning an interval of -0.042 to -0.31). Our study shows that, after exercise at equivalent relative maximal work loads, trained subjects do not have an improved ability to remove plasma lactate during passive recovery. We propose that this physiological response may be a consequence of the decrease in blood and muscle pH and the rise in circulating catecholamine concentration during high intensity exercise. Also, the low muscular energy demand during passive recovery decreases to drive to remove lactate for use as a fuel substrate. Many studies have shown that training enhances the rate of lactate removal. However, we found that training confers no advantage to the rate of lactate removal while recovering passively from exhaustive exercise.

## 51 THE EPIDEMIOLOGY OF INJURIES IN SOUTH AFRICAN SENIOR SCHOOL SOCCER PLAYERS

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The aim of this study was to document the epidemiology of injuries sustained by South African senior school soccer players. Subjects for the study were selected from all the senior schools (n=20) in Tembisa (Gauteng, South Africa). A cohort of 227 senior school soccer players, representing all the players in the Tembisa schools, was followed over one playing season. All practice and match hours were recorded and specific injury report forms were completed by all the coaches. All injured players were then referred to the principle investigator (JR) for detailed examination to document injuries. Factors such as pre-season training, warm-up, stretching, playing surface, environmental factors, and the use of protective equipment was also recorded. In this study, 63% of all the players sustained an injury during the season (seasonal incidence). The overall incidence of injuries was 9.04/1000 hours of play. The incidence of injuries in matches was 274 times higher than in practices. More than half (57%) of the injuries were classified as moderate severity. The highest incidence of injury per player position was in goalkeepers (13.7/1000 hours play). The lower extremity accounted for most injuries (88.8%), with the ankle (42.4%) and the knee (27.1%) mostly affected. The type of injury was mostly a ligamentous sprain (68%), followed by musculotendinous strains (15.8%). There were only two joint dislocations, and no fractures. All the participants in this study played on gravel pitches and on no occasion a first aid kit was available. The majority of players were not aware of appropriate stretching, warm-up, and strapping techniques that can be used to prevent injuries. None of the players engaged in any form of pre-season training. In only two of the schools (10%) the soccer coaches had any formal training with coaching certification. Although the injury rate in senior school soccer players in this study is only slightly higher than that reported by others, it is clear that scientifically based measures of injury prevention (pre-season training, warm-up, stretching, and strapping) need to be implemented in these schools. In addition, proper sports and first-aid facilities should be provided, and coaches should receive formal training.

## 52 THE EFFECT OF ENDURANCE TRAINING ON HYPOTHALAMIC 5-HYDROXYTRYPTAMINE (5-HT) RECEPTOR FUNCTION

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Previous studies indicate that the serotonergic nervous system plays an inhibitory role in the central control of fatigue during prolonged exercise. Researchers have also demonstrated a down-regulation of 5-HT receptor function in elite endurance trained subjects, compared to sedentary controls. This study examines the effect of endurance exercise training on 5-HT receptor function in 7 recreational athletes (T) who underwent training and improved their 5 km time, and 6 sedentary controls (C). Prior to, and after a 5 month exercise training programme, subjects underwent a 12 hour fast and baseline blood sample was drawn for determination of serum prolactin concentration [Pr]. Subjects then ingested 60mg of Buspirone, a partial 5-HT la receptor agonist. Serial blood samples for [Pr] were drawn every 30 minutes for a period of 4 hours. The [Pr] response to Buspirone challenge was determined, thus providing an indication of 5-HT receptor sensitivity. Average AUC [Pr] concentration before training were similar in T compared to C (915±316 vs 700±258 Iu.min/L). After training [Pr] in the T group tended to increase to 1141.6±316 Iu.min/L ($p<0.1$) in contrast to [Pr] in C which remained the same (748±117 Iu.min/L). Peak [Pr] concentration was higher in T than in C both before (742.2±409 Iu.min/L vs 535.8±289.9 Iu.min/L) and after (842.6±439 Iu.min/L vs 504.5±87.4 Iu/l) the intervention. Conclusion: This study shows i) there is a trend towards an up-regulation of hypothalamic 5-HT receptor function after training in recreational endurance athletes; ii) differences seem to occur in the response of the serotonergic system to endurance training in elite, compared with recreational athletes.

## 53 ABNORMAL PATTERNS OF KNEE MEDIO-LATERAL DEVIATION (MLD) ARE ASSOCIATED WITH PATELLOFEMORAL PAIN (PFP) IN CYCLISTS

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The aetiology of PFP in cyclists is not well understood. The aim of this study was to document the relationship between PFP and abnormal patterns of knee movement during cycling. Eighteen cyclists were recruited and eight (E,n=8) fulfilled the diagnostic criteria for PFP in 12 knees (bilateral pain in 4 subjects) (KP,n=12). Twelve controls (C,n=12) were pain free in 24 knees (KC,n=24). Subjects in the E and C groups had similar age (years) [mean (SD)] [E,27(9)); C, 29(9)], height (cm) [E, 179(8); C,184(5)], and body weight (kg) [E,75(9); C,80(5)]. Using high speed two-dimensional video analysis, reflective markers placed on the knees of all the subjects were filmed during cycling (>20 revs). Subjects used their own cycling shoes and bicycles which were mounted on rollers. The movement of the reflective markers was plotted on a screen, digitised and measured. The patterns of knee movement [normal linear (NL), deviated oval (DO), deviated figure of eight (DF), deviated combined (DO+DF)] and the average medio-lateral deviation (MLD) of the knees was recorded. Prior to the study, the repeatability of this technique was established (r=0.93). The frequency of patterns of knee deviation in the KP and KC groups is depicted in Table 1.

Table 1: Frequency of patterns of deviation of the knee in the KP and the KC knees

| | NL | DO+DF | DO | DF |
|---|---|---|---|---|
| KP (n=12) | 0/12* | 12/12* | 8/12* | 4/12 |
| KC (n=24) | 17/24 | 7/24 | 6/24 | 1/24 |

*: Significantly different between KP and KC (p,0.001)

The MLD [mean (SD)] (mm) of the KP [14(5)] was greater than in the KC group [8(3)] ($p<0.001$). This study shows that PFP in cyclists is associated with non-linear patterns of knee movement and excessive MLD of the knee. Correcting non-linear patterns and decreasing the MLD may be important in the management of PFP in cyclists. Supported by the Sports Medicine Research Fund of the University of Cape Town.

## 54 CORRECTING LOWER LIMB KINEMATICS DECREASES PATELLOFEMORAL PAIN (PFP) IN CYCLISTS

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In cyclists with PFP, abnormal oval (O) or Figure-of-8 (F) patterns of knee movement during the downstroke in cycling resulting in excessive medio-lateral deviation (MLD), have previously been documented using 2D video analysis. Using 5 different methods [5mm medial forefoot wedge (MW), 5mm lateral forefoot wedge (LW), 5° internal foot rotation (IR), 5° external foot rotation (ER), a raised saddle (RS=110% previous height)], correction of abnormal knee movement (MLD> 10mm) was tested in 15 cyclists (32 ± 9 years, mean ± SD) (O=12; F=9). A significant reduction in MLD (mm; mean ± SD) was achieved by MW (18 ± 8; $p<0.0001$) and RS (19 ± 9; $p<0.0005$) but not by LW, IR, or ER. Once corrected to the most linear pattern using the most effective method of correction (lowest MLD), all 15 cyclists performed a 30m in (3X10min) cycling test at predetermined work loads (125W, 180W, 200W) after 3 training periods (T1 = 4 weeks training with no correction, T2 = 4 weeks training with correction, T3= 4 weeks training with correction removed). During each test, pain experienced was plotted every minute using a visual analogue scale (VAS: 0-10; 0 = no pain, 10= unbearable pain). Total pain (TP) (pain units) was calculated as the area under the pain vs time graph. TP (mean ± SD) was decreased after the T2 period (19 ± 23), compared to after the T1 (42±40) or the T3 (34 ± 42) period ($p<0.0004$). Cyclists also recorded daily pain (VAS: 0-10) during training in each 4 week period (T1, T2, and T3). Pain/training ride/day (PPD) was calculated for T1, T2, and T3. PPD (mean ± SD) was decreased during T2 (1.4 ± 1.2), compared to T1 (3.0 ± 1.7) or T3 (2.2 ± 1.5)($p<0.002$). In conclusion, i) cyclists with PFP exhibiting excessive MLD of the downstroke can be corrected to a more linear pattern using minor biomechanical modification, and ii) once corrected, PFP during cycling decreases. Supported by the Sports Medicine Research Fund of the University of Cape Town.

## 55 POST MATCH ECG CHANGES IN VETERAN SQUASH PLAYERS - IS IT A PROBLEM?

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Veteran's squash has a large following in South Africa. Participation in high intensity sports by competitors over the age of 45 years is considered potentially hazardous, and squash is considered to have a relatively high risk of associated sudden death during or following play. In a study by Northcote, 7/21 subjects in a group aged 23 - 43 years, showed significant electrocardiograph (ECG) changes in the hour after play. The aim of this pilot study was to determine the frequency of post match ECG changes in squash players over the age of 45 years, who participate in league squash. Eighteen volunteers were studied. Their ages ranged from 45 to 54 (mean 49 ± 3 yrs). Resting ECG's were obtained before play. During match play, heart rate was recorded using heart rate monitors. On completion of the match, subjects were immediately fitted with Holter monitors and their ECG's recorded for the hour after play. The data from the Holter monitors were downloaded by an independent technician and read by a cardiologist, blinded to the study. The matches were played at an average of 87% of predicted maximum heart rate (PMHR), with an average of 44 % of match play occurring at above 90 % of PMHR. The mean maximal heart rate achieved during play was 169 ± 14 b/min (99% of PMHR). ANOVA showed no difference between intensity of games, there was however a significant difference between the hardest and the easiest game. ($P< 0.0001$) No abnormalities were noted in the resting or post match ECG'S. This study confirms that veteran squash players play at a high intensity. The failure to demonstrate post game ECG changes may be due to the sample size, but it may also suggest that those who continue to participate actively in veteran's squash have selected themselves out as a relatively low risk group on the basis of having had no warning symptoms of cardiac problems. Further studies are required to compare exercise stress test ECG's with post match ECG changes.

## 56 CARDIAC PERFORMANCE IN VETERAN SQUASH PLAYERS AND RUNNERS DURING A ROUTINE STRESS ECG, SQUASH AND RUNNING

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The aim of the study was to assess the relationship between cardiovascular performance in a routine stress ECG and during field testing in veteran squash players and runners. Ten veteran league squash players (LSP), 10 social squash players (SSP), 10 league runners (LR), 10 social runners (SR) and 10 sedentary individuals (SED) were recruited for the study. All subjects filled in a lifestyle questionnaire, underwent a complete medical examination and performed a routine stress electrocardiogram (ECG). The sport playing groups subsequently underwent heart rate monitoring during their specific sport activity on two separate occasions. There were no differences in age, stature and medical history between the groups. The SED group had a significantly higher percentage body fat ($p < 0.05$), mass ($p < 0.01$) and resting heart rate ($p < 0.01$) than the LR group. Although there were no significant differences between the mean heart rate attained during the field test and the maximal heart rate attained during the ECG test, a highly significant difference occurred between the maximal heart rate attained in the field and maximal heart rate attained during the ECG test for all groups ($p < 0.01$). The maximal heart rate during routine exercise is significantly higher than that attained during a routine stress-ECG test. This finding was not sport specific or related to level of competitiveness of sports participants. Caution thus should be exercised when advising patients to exercise freely on the basis of a routine stress-ECG.

## 57 THE ENERGY EXPENDITURE OF A NON-CONTACT BOXING TRAINING SESSION COMPARED TO SUBMAXIMAL TREADMILL RUNNING

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The aim of this study was to determine the energy expenditure of a one hour non-contact boxing training session and to compare these results to the energy expenditure of a more conventional recreational activity such as running. Eight healthy males, accustomed to non-contact boxing training, were recruited for the study. Subjects underwent 3 tests; (i) A boxing training session in the laboratory during which energy expenditure was measured continuously using indirect calorimetry (BOXL), (ii) A boxing training session in a boxing studio during which heart rate was measured continuously (BOXS), and (iii) an incremental running test on the treadmill during which energy expenditure was measured continuously. The energy expenditure during 60 minutes of BOXL ranged between 2519 and 3079 kJ (2821±190 kJ). Seven of the 8 subjects had higher heart rates during BOXL compared to BOXS, suggesting that the subjects exercised at a slightly higher intensity during BOXL, possibly because of the "one on one" supervision. The average running speed on the treadmill at which the subjects had a similar energy expenditure was 9.2±0.8km.hr$^{-1}$.

## 58 THE HEART RATE RESPONSE OF CRICKET UMPIRES TO ON-FIELD EVENTS

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This study assessed the differences between the heart rate responses, recorded every 15 seconds, of 6 provincial and 4 international umpires to on-field events during limited-overs cricket matches. Specific on-field events including appeals, the umpires resulting decisions and any other tasks the umpire had to make such as calling a no-ball or a wide, were recorded. The results showed that the international umpires (IU) rated the on-field decisions as less stressful than the provincial umpires (PU), who showed a far greater variance with regard to LBW, catch, run-out and wide-ball decisions. Tachycardia occurred before the match resulting in a high mean (±SD) heart rate (IU - 102.0 ± 13.9 beats min$^{-1}$; PU - 97.5 ± 11.1 beats min$^{-1}$), corresponding to approximately 60% of estimated maximal heart rate. Similar mean heart rates for the first innings (IU - 101.5 ±12.5 beats min$^{-1}$; PU - 99.7 ± 13.5 beats min$^{-1}$) and second innings (IU - 99.5 ± 8.9 beats min$^{-1}$; PU - 100.2 ± 10.1 beats min$^{-1}$) were found. Differences (D = -0.7 beats min$^{-1}$) between the heart rate of IU and PU prior to the match (102.0 ± 13.9 beats min$^{-1}$) and the first session (101.3 ±12.0 beats min$^{-1}$) of the first innings was significantly less ($p < 0.05$) than the corresponding difference (D = 7.5 beats min$^{-1}$) prior to (95.3 ± 10.7 beats min$^{-1}$) and during the first session (102.8 ± 9.9 beats min$^{-1}$) of the second innings. A significant difference (IU-D = 0.0 beats min$^{-1}$; PU D = -6.0 beats min$^{-1}$; $p < 0.05$) occurred between the difference between the mean heart rate for the second (IU - 97.0 ± 6-7 beats min$^{-1}$; PU - 101.2 ± 9.2 beats min$^{-1}$) and the third (IU - 97.0 ± 5.2 beats min$^{-1}$; PU - 95.2 ± 11.4 beats min$^{-1}$) sessions of the second innings, illustrating greater variation for the inexperienced umpires. The PU showed greater, although non-significant, variations to an appeal at the time of the decision, 15s post decision and 30s post decision, with both tachycardia and bradycardia occurring. Heart rate data of an IU during an international hat-trick (three wickets in three balls) showed anticipatory tachycardia. It can be concluded that the heart rate response of the umpires to on-field events indicate that they are under tremendous psychological pressure, with international umpires, although umpiring at a higher level, better able to handle these pressures.

## 59 AN ANALYSIS OF THE HR-$VO_2$, RELATIONSHIP DURING FREE-RANGE EXERCISE IN THE LABORATORY.

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Laboratory estimates of heart rate are often used by coaches and athletes to identify field training intensities. This approach, however, assumes that the relationship between heart rate (HR) and oxygen consumption ($VO_2$) remains constant under all conditions. It has been shown that representation of field performances during laboratory testing cannot necessarily depend on this assumption, simply because the mode of exercise appear to be the same.[1] It was the aim of this study to determine the HR-$VO_2$ relationship for different modes of free-range cycling in the laboratory. Fifteen cyclists (fit and unfit) between the ages of 18 and 26 volunteered to participate in the study. They performed a 30 km time trial (TT) on a computer controlled cycle ergometer, using a laboratory simulation of field cycling. During this test the cyclist could select and change the gear ratio and pedal frequency at will. Both HR and $VO_2$ were monitored continuously and these results were compared to the cyclist's physiological responses during a progressive, incremental exercise test to exhaustion. Although there was a linear relationship between HR and $VO_2$ during simulated field cycling and the maximal exercise test, there were significant differences in the intercepts (102 ± SEM 6.6 b/min vs 66 ± SEM 3.7 b/min; $p = 0.009$) and slopes (0.02 ± SEM 0.002 vs 0.03 ± SEM 0.003; $p = 0.01$) of the 30 km TT and progressive, incremental exercise tests. These results indicate that standard laboratory exercise tests underestimate the "normal working limits" of cyclists during free-range cycling and that extrapolation of laboratory results to field exercise should be done with caution.

*(1) Kenny GP et al. A comparative analysis of physiological responses at submaximal workloads during different laboratory simulations of field cycling. Eur J Appl Phys 1995; 71: 409 - 415.*

60 EFFECT OF PROPHYLACTIC DOSE OF FLURBIPROFEN ON MUSCLE DAMAGE AND CARDIOVASCULAR VARIABLES DURING SUBMAXIMAL EXERCISE.

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Aim: To determine the effect of an prophylactic dose of flurbiprofen on muscle damage, soreness and cardiovascular variables during submaximal exercise in recreational athletes. Methods: 19 Male recreational athletes (age 28 ± 12 years; X ± SD) were recruited for the study. Subjects underwent a $VO_{2max}$ and peak treadmill running speed (PTRS) test three days before the first submaximal test and 72 hours after the induction of delayed onset of muscle soreness (DOMS). Twelve hours before the submaximal test and every 12 hours thereafter until the end of the experiment, the subjects placed patches with 40mg of flurbiprofen (TransAct; n = 10), or identical patches without drug (Placebo; n = 9), on their quadriceps muscles. Subjects ran for 15 minutes at 75% PTRS during which cardiovascular variables were measured and blood was collected. Thereafter DOMS was induced by a series of eccentric muscle contractions. The submaximal test was repeated 24 and 48 hours after DOMS was induced. Results: Pain, assessed subjectively, increased Similarly in both groups. Pain, measured with a pressure probe, was significantly higher in Placebo than TransAct at 24 and 48 hours after the induction of DOMS ($p < 0.03$). Blood CK activity increased similarly in both groups ($p < 0.05$). WCC ($p < 0.03$), neutrophil % ($p<0.04$) and lymphocyte % ($p < 0.03$) were significantly increased in the Placebo group, 2.5 hours after DOMS. Blood lactate concentration was significantly higher in Placebo after the 15 minutes submaximal test compared to TransAct, even before the induction of DOMS ($p < 0.05$). Serum cortisol concentration was not different throughout the experiment. The relative perceived exertion (RPE) during the submaximal test was higher in the Placebo group after 48 hours (2.0 ± 1.8 vs 1.0 ± 1.3; $p < 0.05$). The average heart rate increased significantly more in the Placebo group during the submaximal test compared to the TransAct group (5.1 ± .7 vs 0.3 ± 2.3 beats.min$^{-1}$; $p < 0.05$). Neither $VO_{2max}$ nor PTRS differed between groups through the experiment. Conclusions: These data show that prophylactic treatment with TransAct before the induction of muscle damage reduces the severity of DOMS.We want to thank Boots Pharmaceuticals for their financial assistance.

61 MORPHOLOGY AND INTRINSIC INJURY RISK IN SCHOOLBOY RUGBY

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Thus far epidemiological research has exposed typical extrinsic injury risks of rugby. However, well controlled studies on potential risks that are intrinsic to the individual have been absent. This study thus focussed on morphology as an intrinsic actiological risk factor in schoolboy rugby injuries. A well-defined population of high school rugby players (N=105) aged 13-17 years were monitored utilizing a prospective injury surveillance design with an injury being defined as either requiring medical referral or causing a loss of at least seven days from participation. Risk factors were subsequently identified by ANOVA, contrasting preparticipation morphological profiles of injured players with those of the non-injured controls. Results for injured vs non-injured players indicated a significantly ($p<0,05$) greater stature (176,8 ± 8,6 vs 172,0 ± 8,7 cm); body mass (69,7 ± 11,3 vs 63,9 ± 12,6 kg); lean body mass (60,0 ± 9,7 vs 52,3 ± 9,6 kg); and a lower body fat (13,9 ± 3,1 vs 17,9 ± 6,6%), respectively. Individual somatotype component variations in endomorphy (2,4 ± 0,9 vs 2,9 ± 1,5); mesomorphy (4,8 ± 1,0 vs 4,9 ± 1,2); and ectomorphy (3,2 ± 1,0 vs 3,2 ± 1,4) did not differ significantly ($p>0,05$). In conclusion the data suggests that morphological superiority among high school rugby players appears to predispose rather than preclude from injury whilst somatotype is independent from injury risk.

62 MUSCULAR "FITNESS" AND INTRINSIC INJURY RISK IN SCHOOLBOY RUGBY

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Thus far epidemiological research has exposed typical extrinsic injury risks of rugby. However, well controlled studies on potential risks that are intrinsic to the individual have been absent. This study thus focused on musculoskeletal "fitness" as an intrinsic aetiological risk factor in schoolboy rugby injuries. A well-defined population of high school rugby players (N.105) aged 13-17 years were monitored utilizing a prospective injury surveillance design with an injury being defined as either requiring medical referral or causing a loss of at least seven days from participation. Risk factors were subsequently identified by ANOVA, contrasting preparticipation musculoskeletal fitness profiles of injured players with those of the non-injured controls. Results for injured vs non-injured players indicated a significantly ($p<0,05$) greater mean grip strength (70,5 ± 8,5 vs 64,9 ± 9,9 kg/kg:$p<0,01$); muscle power (15,3 ± 1,0 vs 14,3 ± 1,4W/kg:$p<0,001$); and running agility (6,9 ± 0,4 vs 7,1 ± 0,4 sec:$p<0,001$). Gross range of motion variations in the shoulders (2,4 ± 0,3 vs 2,5 ± 0,3) did not differ significantly ($p>0,05$), but gross low-back/hamstring flexibility scores (3,5 ± 1,2 vs 2,9 ± 1,1) were significantly higher ($p<0,05$) among the exposed (injured) group. In conclusion the data suggests that superior musculoskeletal fitness among high school rugby players appears to predispose rather than preclude from injury.

63 THE EFFECT OF UPPER RESPIRATORY TRACT INFECTION (URTI) ON EXERCISE PERFORMANCE IN DISTANCE RUNNERS

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Runners suffering from URTI who return to full activity after the post infection period frequently complain of a decrease in performance. There are no scientific data to indicate whether i) there is a true decrease in performance, or ii) if such a decrease in performance is due to the effects of detraining or the infection. The aim of this study was to determine the effects of URTI on exercise performance during recovery in distance runners. Five distance runners were studied over four months. At the time of recruitment, all runners underwent a medical assessment and baseline tests consisting of: i) running performance ($VO_2$ peak in ml/kg/min), ii) total treadmill time (min), iii) quadriceps muscle strength (peak torque in Nm) and iv) quadriceps muscle endurance (total work, Joules) were performed. All the subjects continued their normal training program until they developed an URTI which was diagnosed clinically using a grading system (0 to +++) for symptoms (sore throat, headache, blocked nose, painful chest, cough, sore eyes, muscle pains) and signs (temperature, conjunctivitis, pharyngitis, rhinitis, otitis media, rhonchii, wheeze). Treatment consisted only of medication for symptomatic relief. The runners were followed up regularly until recovery (defined as free from any symptoms or signs of URTI). Recovery time was variable (min=5 days, max=13 days, mean=7.8). Following sickness (S), all the performance tests were repeated on days 0 (SO), 2 (S2), 4 (S4), and 6 (S6). Runners returned to normal training for 4 months after which they underwent a period of voluntary detraining (D) for the same period as the URTI. Performance testing was repeated on days 0 (DO), 2 (D2), 4 (D4) and 6 (D6). All parameters were compared during S and D days. There was a significantly lower $VO_2$ peak (ml/kg/min) [mean(SD)] [SO=53(8), DO=59(7)] ($p=0.026$), and longer treadmill time (min) [SO=5.2(2.5), DO=6.8(2.2)] ($p=0.03$) at SO compared to DO. There was a significantly lower $VO_2$ peak [S2=54(7)), D2=58(7)] ($p=0.04$) at S2 compared to D2. There was no significant difference in muscle strength, or endurance at any time in S and D. In conclusion, runners recovering from URTI appear to have a decrease in running performance but not muscle strength or muscle endurance which is not only due to detraining. However, this additional effect is temporary and lasts for 2-4 days after clinical symptoms have disappeared.

64. THE TREATMENT OF PLANTAR FASCIITIS AND ACHILLES TENDONITIS BY MAINTAINING ANKLE DORSIFLEXION USING A NIGHT SPLINT

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Plantar fasciitis and achilles tendonitis are the most prevalent of lower limb injuries experienced by runners, and are notoriously resistant to conventional forms if treatment. An orthotic device which maintains ankle dorsiflexion and thus tension within the plantar fascii or achilles tendon during sleep is thought to promote tissue healing at a functional length. The purpose of this study was to optimise the design of a locally manufactured anterior fitting orthotic device and to determine the efficacy of its use in treatment of these chronic repetitive strain injuries. The optimum angles of the device, were found to be 20° dorsiflexion and 15° forefoot valgus. Distance runners with plantar fasciitis (n=19) and achilles tendonitis (n=15) of Grade 3 or 4 severity of, on average, 16 months duration were admitted to the study. All had received various forms of medication, physiotherapy or both during this time. The control groups, who had lower limb injuries of equal duration and severity were treated with a placebo orthotic and non-steroidal anti-inflammatory drugs (NSAIDs). For the 14 day study period the subjects were required to wear the orthotic during the night, to refrain from training and the use of any other therapy. On days 0, 7 and 14 the severity of pain experienced on arising was recorded on a scale of 1 to 10. The presence of pain on palpation and the extent of tissue swelling were determined by the researcher on the same days. The results show that in both groups who used the night splint, there was a significant reduction ($p< 0.001$) in the pain experienced on arising on both days 7 and 14. Moreover, 36.8% of those with plantar fasciitis and 49.7% with achilles tendonitis were able to walk pain free by day 14. However, most still experienced pain on palpation of the injured site and more than half of those with achilles tendonitis continued to exhibit marked tissue swelling on Day 14. In both control groups there was no decrease in the degree of pain experienced on rising, nor in the presence of pain on palpation, by the end of the study period. The results suggest that the use of an anterior fitting night splint significantly aids recovery from chronic repetitive strain injuries of the lower limb.

65 RECOVERY TECHNIQUES: A COMPARISON OF REST, STRETCHING AND MASSAGE.

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Rapid and adequate recovery from exercise facilitates subsequent performance and reduces the associated symptoms of tiredness, fatigue and lethargy. This study compares the effects of three recovery techniques, rest, stretching and massage in delaying fatigue during repeated bouts of dynamic exercise, and investigates the relative effects of rest, massage and stretching on delayed onset muscle soreness.

**Method:** 18 male subjects were randomly allocated to one of six groups. Subjects performed 5 repetitions of as many heel raises as possible in 45 seconds. Each repetition was followed by a recovery technique used for the three minutes between repetitions. This was repeated weekly, until each group had had all three recovery techniques. A fatigue index was calculated from the decline in the number of repetitions from stage 1 to 5 and this was expressed as a percentage. Muscle soreness ratings were assessed at 12 - 36 hours after each session. An orthogonal 6 x 3 Latin square design was used to take into account possible training effect and the possible influence on the outcome of the sequence in which the recovery techniques were used.

**Results:** Based on the fatigue index, significantly more fatigue was shown when rest was the recovery technique ($P< 0.0001$). There was no difference noted between stretching and massage. Massage however associated with significantly less muscle soreness than stretching ($P < 0.000\ 1$).

Conclusions: Rest was shown to be the least effective recovery technique. While massage and stretching were shown to be equally beneficial in reducing fatigue, massage may be superior to stretching, as it is associated with less muscle soreness than stretching. Further studies are required to confirm these observations using different modes and intensities of exercise.

66 SKELETAL MUSCLE ENZYME ACTIVITIES IN AFRICAN DISTANCE RUNNERS

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African athletes dominate distance running internationally and in South Africa but to date only one study has investigated the skeletal muscle enzyme profile in these. The aim of the current study was to measure enzyme activity in the vastus lateralis muscle of African 10 km runners in comparison to Caucasian 10 km runners and sedentary controls. All subjects were seasoned runners (age range 18 - 35 yrs). 5 African and 7 Caucasians consented to undergo two exercise tests and a muscle biopsy. Runners completed a $VO_{2max}$ incremental treadmill test and on a separate day a fatigue resistance running test at four sequential high intensity workloads. On a separate day a muscle biopsy was performed. One portion was immediately frozen in liquid $N_2$ for later enzyme assays and the other embedded for later histochemistry. Citrate synthase (CS) and phosphofructokinase (PFK) were assayed in duplicate spectrophotometrically in all subjects, whilst 3-hydroxyl-CoA dehydrogenase (3-HAD), hexokinase (HK) and carnitine palmityl transferase (CPT) were assayed in 7 subjects when sufficient tissue allowed. Routine histochemistry was undertaken to determine skeletal muscle fibre type. African runners were able to exercise for 21% longer at the same percentage of their peak treadmill speed ($p< 0.01$). At submaximal workloads, the African runners had a lower [Lactate] and this was related to time to fatigue ($r = -0.63$, $p < 0.05$). CS activity was higher in the African runners ($27.9 \pm 7.2$ vs $18.6 \pm 2.1$ mmol/g ww/min, $p < 0.01$) and runners were higher than sedentary controls. 3-HAD activity was also higher in the Africans ($23.9 \pm 4.7$ vs $15.5 \pm 5.1$ mmol/g ww/min). PFK, HK and CPT were not different. CS activity was correlated with time to fatigue during the high intensity running test ($r = 0.70$, $p< 0.05$) and [Lactate] during the running test ($r = -0.73$, $p <0.01$). The findings of the current study suggest that the African distance runners studied had advantageous skeletal muscle enzyme activities for endurance performance, and that this activity is related to accumulation of lactate in the plasma and their subsequent ability to sustain exercise at a high relative intensity. The origin of this advantageous enzyme profile is not elucidated.

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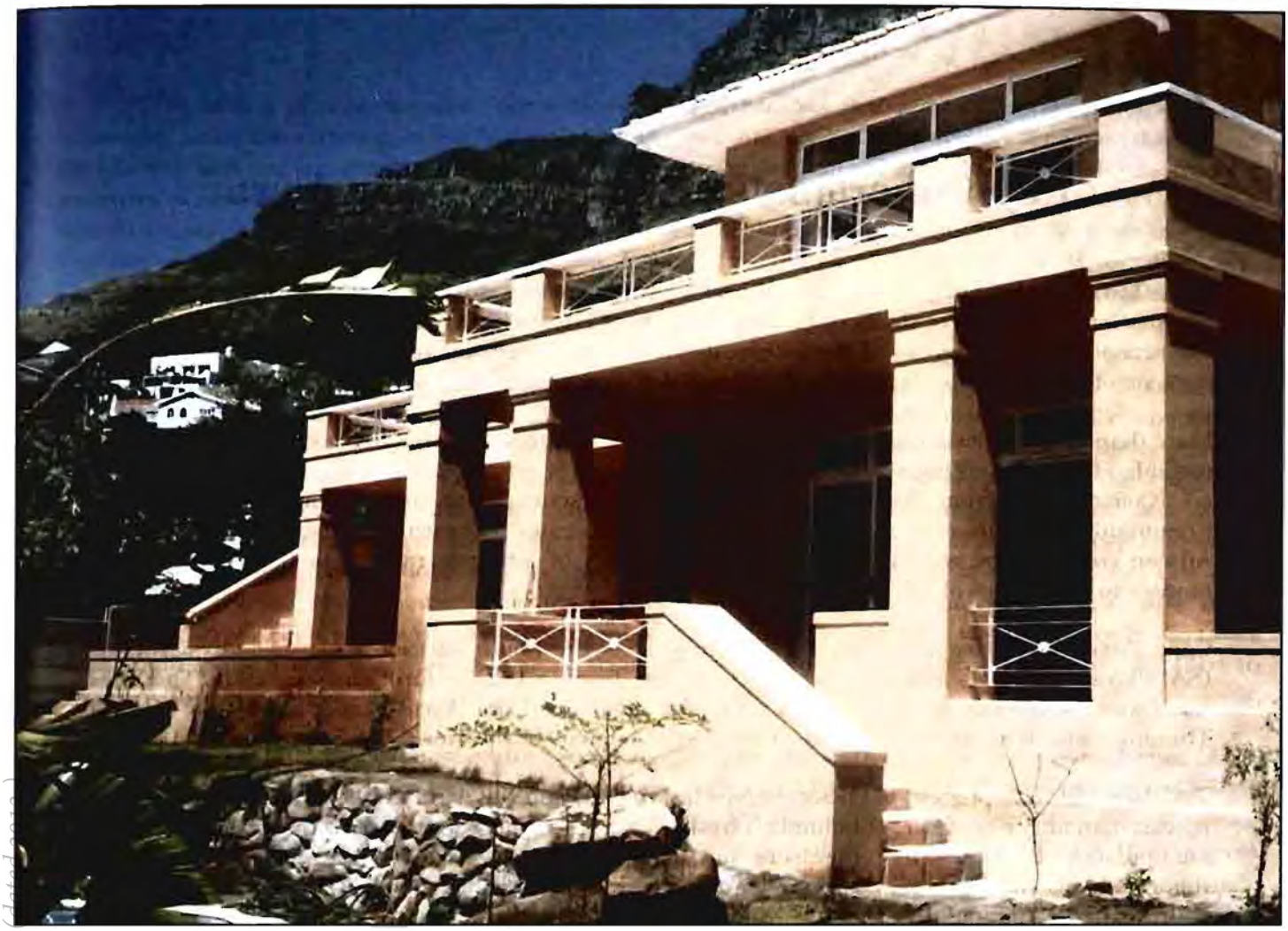

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# Physiotherapists converge on Cape Town

Cape Town will host two important international congresses during April 1997. The first is the International Congress of the South African Society of Physiotherapy, from 31 March to 3 April, and the second is the Congress of the International Private Practitioners' Association. The IPPA is a division of the World Confederation for Physical Therapy.

More than 300 physiotherapists will attend the SASP Congress, coming from countries as far afield as Finland, America, Zimbabwe, Canada and Australia. Several countries in Europe are represented. Contributors from fourteen countries will present papers on physiotherapy research. Community physiotherapy services are strongly represented in research papers by the 43 South African contributors, which also cover a wide variety of interests ranging from fetal movement studies to the causes of falling in the elderly.

Cape Town is a fitting venue for the congresses, as the South African Society of Physiotherapy (SASP) has its origins in a group who met in Cape Town in 1921 to form an association. The SASP itself was established in 1925 and is a founder member of the World Confederation for Physical Therapy. Cape Town is bidding to host the 14th Congress of the World Confederation in 2003.

The theme of the Congress is Physiotherapy in Progress and the main fields covered are education, research, quality assurance, community physiotherapy, neurological rehabilitation and orthopaedic manipulative therapy. The organisers have been fortunate in attracting five internationally renowned keynote speakers. David Butler of the University of South Australia will speak in the field of orthopaedic manipulative therapy, which relates to conditions of the vertebral column and joints. Patricia Davies, the author of several well-known books, is the guest speaker on neurological rehabilitation. Professor Ruth Grant, of the University of South Australia, and Professor Katherine Shepard of Temple University, Philadelphia, will speak on key issues in education and research respectively. The Royal Netherlands Association for Physiotherapy has sponsored the fifth keynote speaker, Joost van Eijkeren, as part of a twinning programme between themselves and the SASP which is committed to promoting quality assurance programmes in physiotherapy.

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