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437 THE INJURY PATTERN IN VOLLEYBALL: A COMPARATIVE STUDY.

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The aim of this study was to analyse the pattern of injuries in volleyball players, by comparing elite (EV) and non-elite (NEV) players, female (FV) and male (MV) players. Furthermore, comparisons were made between players of indoor (IV) and beach (BV) volleyball - a new and rapidly growing activity. Questionnaires were distributed to 33 teams in four different competition leagues before the beach season 1993 and the indoor season 1994. Replicies were received from 205 players with a mean age of 27.5 years (range: 18-40) and a volleyball experience of 10.6 years (range: 2-33). A total of 1035 injuries were reported. The incidence of injuries in BEV/NEV (p<0.05), IV/MV, 4.3/4.9 in FV/MV, and 4.2/4.9 in IV/BV. Most injuries in IV were in the upper extremity (53%), whereas lower extremity injuries (51%) were dominant in BV. There was a higher risk of shoulder injuries (p<0.05) in BV. In IV most injuries occurred in field defence (38%), which were more than expected (p<0.05), while most injuries in IV occurred during spiking (34%). Spiking was the cause of most injuries in EV and in NEV, in FV and in MV. There was a higher risk of ankle injuries (p<0.05) in EV compared to BV. We conclude, that the injury pattern is different in IV compared to BV, while there are minor differences between EV and NEV and no evident differences between FV and MV. The injury risk is higher in NEV than in EV.

438 ADVERSE RESPIRATORY HEALTH EFFECTS OF COMPETITIVE SWIMMING: THE PREVALENCE OF SYMPTOMS AND ILLNESSES IN A COHORT OF 738 SWIMMERS.

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The purpose of this study was to estimate the prevalence of respiratory symptoms and illnesses in a cohort of 738 competitive swimmers. Each of the swimmers completed a respiratory health questionnaire that was modified to ask specific information about their medical history, the occurrence of respiratory symptoms during exercise, and the amount of training they did. The overall prevalence of the 738 swimmers was 13.6%. There was, however, a significant difference among the three groups of competitive swimmers that we identified. This included 10.6% of Age Group Swimmers, 11.7% of University Level Swimmers, and 20.1% of International Level Swimmers. The prevalence of swimming-related symptoms included sneezing (45.0% of participants), difficulty breathing (39.4%), coughing (36.4%), sore eyes (36.6%), headaches (35.9%), sore throats (27.1%), wheezing (24.3%), chest tightness (24.8%), and chest congestion (22.8%). All of the symptoms, except for sore eyes, were strongly associated with a swimming-related exposure. We also identified a number of gender- and age-related differences for several of the swimming-related symptoms. Female swimmers were more likely to cough, feel congested, have difficulty breathing, and experience headaches. They were also less likely to have recurrent, sneezing, wheezing, have chest tightness, or difficulty breathing, sore throats, and headaches. A majority of the swimmers reported that their symptoms were more severe, less noticeable, or absent if they spent several days away from the swimming pool.

439 PREDICTING STRESS FRACTURES DURING RIGOROUS PHYSICAL TRAINING USING SIMPLE MEASURES OF PHYSICAL FITNESS AND ACTIVITY.


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Predicting stress fractures (SF) in military trainees is the first step in reducing the significant impact of these injuries on military training programs. The purpose of this study was to determine if a simple score of physical fitness and activity profile can be used to predict subsequent SF based on the incoming fitness and activity profile of enlistees. The study population included 1438 recruits undergoing basic training. During a two week period all recruits were classified based on their physical fitness (Hx520) were asked to participate; 1136 consented. A short 10 item questionnaire was administered querying the recruits asked to participate; 1136 consented. A short 10 item questionnaire was administered querying the recruits about their symptoms and activity prior to entering basic training. Based on this information as well as a 3.5 mile run, the recruits were assigned to a priori high (18.7%) or low (81.3%) risk category. Using Path Analysis in 43 subjects (incidence 3.8%) developed SF as diagnosed by clinical presentation and confirmed by radiograph and/or scintigram by physicians blinded to the recruit's SF risk category. SF incidence among the high risk recruits compared to 2.9% in the low risk recruits (RR=2.52, 95% CI 1.82-3.47). Our data suggest that the risk of SF during rigorous physical training is increased by poor physical fitness and low levels of physical activity prior to training.

440 DIFFERENTIAL MUSCLE FATIGUE DURING CONTINUOUS AND REPEATED CONTRACTIONS IN MM-CREATINE KINASE DEFICIENT MICE.

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The importance of the creatine kinase (CK) reaction lies in the buffering of the ATP concentration in active skeletal muscles. Skeletal muscle of mice lacking CK-1 all showed a normal resting level after a series of isometric twitch contractions (1 Hz). However, twitch force dropped quickly to 50% after 5 twitches (1 Hz) or to 85% after 9 contractions (4 Hz), whereas force stabilised and even slightly increased (Van Deusen et al., Cell 74: 621-631, 1993). To test the need for buffering of ATP by the CK-system in the present study control and MM-CK deficient skeletal muscles were fatigued in situ using different types of exercise (one continuous maximal contraction, ten repeated contractions, stimulation frequency 100 Hz) and series of repeat maximal contractions within 6s, either isometric (150 ms) or dynamic (60ms). Surprisingly, the force of the force decay during the 6s continuous contraction was similar in the control and deficient mice. In the series of repeated contractions the force of the control muscles decayed slowly between the 10th and the 20th contraction to 85% (isometric) and 55% (dynamic). In contrast, in the deficient mice the force of the force decay during the 19th and 20th contraction to 85% (isometric) and 55% (dynamic), which were more than expected (p<0.001). We conclude, that the role of the CK-system during a continuous isometric contraction seems to be small or absent, in contrast, during a series of repeated contractions, during which peak energetic fluxes are higher, the CK-system seems important in maintaining a high level of critical output during the start of exercises.

441 FATIGUE IN MALIGNANT HYPERTHERMIC MICE (MH) AND NORMAL (N) PORCINE SKELETAL MUSCLES.

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Excitation-contraction coupling (ECC) of MH muscles is abnormal in that function of the sarcoplasmic reticulum Ca2+ release channel is altered by a mutation in the ryanodine receptor gene. Since impaired ECC may play a role in skeletal muscle fatigue, we compared the fatigue characteristics of both MH and N pig muscles. Small bundles of intact fibers were fatigued using: 1) high frequency stimulation to induce action potential failure, and 2) lower frequency stimulation to induce metabolic alterations. In response to high frequency (100 ms trains, 200 Hz, 1/sec) both MH and N muscles fatigued in a similar manner (time for peak tetanic tension (P2) to fall to 75% of control: 1.54 ± 0.19 min in N and 1.32 ± 0.13 min in MH). Full recovery of both twitch and tetanic in both MH and N muscles occurred in 10 sec (1 Hz). Tetanic tension of all bundles recovered in 4 ft DIFFERENTIAL MUSCLE FATIGUE DURING CONTINUOUS AND REPEATED CONTRACTIONS (5Hz). The main conclusion from this study is that role of the CK-system during a continuous isometric contraction seems to be small or absent, in contrast, during a series of repeated contractions, during which peak energetic fluxes are higher, the CK-system seems important in maintaining a high level of critical output during the start of exercises.

442 SURFACE EMG MEDIAN FREQUENCY IS DECREASED IN WEAKENED QUADRICEPS MUSCLES.

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Needle EMG studies have documented a decreased firing rate of all motor units in skeletal muscle following inactivity. Surface EMG (SEMG) analysis of muscle weakened by injury or surgery can be analyzed for its frequency content via the Fast Fourier Transformation (FFT). The median frequency (MF) obtained describes shifts in firing rates of recruited motor units. Therefore, we examined the SEMG in 8 pain-free patients who had quadriceps weakness (strength deficit <15%, P<0.05) or prolonged side effect of maximal isometric contractions. In addition, 7 control subjects without weakness (<2%) were tested to examine the effect of dominance. The MF of the SEMG of the vastus lateralis (VL) and medial vastus (VM) was computed for second 3-5 (so chosen for peak tension without fatigue) during 3 maximal contractions. The mean of the three trials was analyzed statistically. The injured group had a significantly lower MF in the weak VM (4.4 ± 0.6 vs 4.4 ± 0.4, P<0.05) with a similar trend in the weak VL. The control group tended toward lower MF of both VL and VM in the dominant leg. The injured group had 4 dominant and non-dominant injured legs. There was a significant interaction between weakness and dominance (P<0.05). So that weakness and dominance were both associated with a lower MF during maximal contraction. In the injured leg, this may reflect loss of recruitment of high frequency motor units or a generalised decrease in firing rate of all motor units and parallels the findings in other muscle groups using needle electrodes.