437 THE INJURY PATTERN IN VOLLEYBALL: A COMPARATIVE STUDY.
A. Haagsma* and U. Jorgensen*, Dept. of Orthopedic Surgery, Unit of Sports Traumatology, University of Copenhagen, Gentofte Hospital, Copenhagen, Denmark.

The aim of this study was to analyze 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 32 teams in four different competition leagues before the beach season 1993 and the indoor season 1993/94, Replies were received from 205 players with a mean age of 27.6 years (range 18-40) with a volleyball experience of 10.6 years (range 2-29). About 310 injuries were reported; 194/166 in EV/NEV, 131/179 in FVM/IV and 26/24 in BV. The overall injury incidence was 4.5 per player season (sp). The risk for ankle injuries (p<0.001) in NEV compared to BV. We conclude, that the injury pattern is different in IV and EV compared to BV, where 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.
J. Poiss, S. Veda, D.C. McKenzie, and P.D. Paré, Faculty of Medicine, The University of British Columbia, Vancouver, B.C.

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 was asked to complete 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 738 swimmers was 13.5%. There was, however, a significant difference among the three groups of competitive swimmers that we identified. This included 10.6% of Age Group Swimmers, 11.2% of National Swimmers, and 20.1% of International Level Swimmers. The prevalence of swimming-related symptoms included sneezing (45.0% of participants), difficulty breathing (39.5%), coughing (36.4%), sore eyes (36.6%), headaches (38.5%), sore throats (39.9%), wheezing (52.9%), chest tightness (24.8%), and chest congestion (22.8%). Of all 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. Males were more likely to feel restless, sneeze, wheeze, have chest tightness, or difficulty breathing, sore throats, and headaches. A majority of the swimmers reported that their symptoms were less severe, last noticable, 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.

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 provide evidence that will enable SF incidence and injury risk can be predicted. All military recruits undergoing basic training. During a two week period all were entering basic training and 1238 were asked to participate; 1136 consented. A short 10 item questionnaire was administered quasing the recruits about their medical history, smoking status, chemical history, and accidents prior to entering basic training. Based on this information as well as a 1.5 mile run, the recruits were assigned a priori to high (38.7%) or low (81.3%) risk for SF incidence. As a result of this preliminary training, 45 subjects (incidence 3.8%) developed SF as diagnosed by clinical presentation and confirmed by radiograph and/or pathologic biopsy. SF incidence by SF risk category. SF incidence among the high risk group compared to the low risk groups (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.

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 still showed a normal force twitch contraction after a series of isometric twitch contractions (1Hz). However, twitch force dropped quickly to 30%, after 5 twitches (1Hz) or to 5% after 9 contractions (9Hz), whereas force stabilization and even slight increase (Van Deusen et al.; Cell 74: 621-631, 1993). To test this theory for 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 voluntary contraction of 3s duration (stimulation frequency 100Hz; 35°C), and series of 20 repeated maximal contractions within 5s, either isometric (150 ms) or dynamic (60 ms). Surprisingly, the time for the force decay during the 3s continuous contraction was higher in the CK deficient and control muscles. In the series of repeated contractions the time of the contractions muscle died away slowly from the 10th and the 20th contraction in 85% (isometric) and 85% (dynamic). In contrast in the control mice the force remained more or less the same and did not decrease. We conclude that the CK-system seems important in maintaining a higher level of contractile output during the start of exercise.

441 FATIGUE IN MALIGNANT HYPERTERMIC (MH) AND NORMAL (N) FORCING SKELETAL MUSCLES.
N. Ennamo, E.M. Ising and S.E. Gallant*, Department of Veterinary Pathology and Physiology, Univ. of Minnesota, St. Paul.

Excitation-contraction coupling (ECC) of MH muscle 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 examined the fatigue characteristics of 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 inactivated in a similar manner (time for peak tetanic tension (PF) to fall to 75% of control: 1.6 ±0.19 min in N and 1.25±0.13 min in MH). Full recovery of both twitch and tetanic in both MH and N muscles occurred in a similar manner (time to 25% decrease in Pf for MH (52±3 min) was significantly longer than for N (49±11 min). Times to 25% decrease in Pf for fast fatiguing bundles were not different for MH (156±1 min) and N (107±5 min). Time to recovery in <15 min. The possibility that the basis for the difference in time of fatigue of the fast and slow fatiguing groups was a difference in fiber type composition of bundles is being investigated. The more rapid fatigue in MH muscles may be due to differences in cellular Ca2+ regulation. Supported by NIH AR41270.

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

Needle EMG studies have documented a decreased firing rate of 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 quadriiceps weakness (strength deficit 40%, P<.01) prior to undergoing the second maximal isometric contractions. In addition, 7 control subjects without weakness (so% P<.05) were compared. The 7 patients were divided into two groups: 1) those that fatigued in <45 s, and 2) those that required >15 min. In the slowly fatiguing groups, time to 25% decrease in Pf for MH (52±3 min) was significantly shorter than for N (49±11 min). Times to 25% decrease in Pf for fast fatiguing bundles were not different for MH (156±1 min) and N (107±5 min). Time to recovery in <15 min. The possibility that the basis for the difference in time of fatigue of the fast and slow fatiguing groups was a difference in fiber type composition of bundles is being investigated. The more rapid fatigue in MH muscles may be due to differences in cellular Ca2+ regulation. Supported by NIH AR41270.