081 SPIKES IN EXTERNAL TRAINING LOAD ARE ASSOCIATED WITH SHOULDER INJURIES IN COMPETITIVE ADOLESCENT TENNIS PLAYERS – THE SMASH COHORT STUDY

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Background Few studies have examined the association between the acute:chronic workload ratio (ACWR) and complaints/injuries in young tennis players. Primary aims: to investigate if accumulated external workload 'spikes' in ACWR of tennis training, match-play and fitness training, and if high or low workload/age ratio, were associated with the rate of shoulder complaints/injuries in competitive adolescent tennis players. Additional aims: to report the incidence of complaints/injuries stratified by sex and level of play, and describe shoulder injury characteristics.

Hypothesis Rapid increases in external workload are associated with the incidence of shoulder complaints and injuries.

Study design Cohort study.

Level of evidence 3

Methods At baseline 301 adolescent competitive tennis players, 13–19 years, were screened and followed weekly for 52 weeks with questionnaires, in years 2018–2019.

Information about time varying accumulated external workload spikes (uncoupled ACWR >1.3), and workload/age ratio, in 252 uninjured players were used in Cox regression analyses with the outcomes shoulder complaints (≥20) and injuries (≥40) (Oslo Sports Trauma Research Center Overuse Injury Questionnaire).

Results For each additional workload spike in tennis training/match-play the Hazard Rate Ratio (HRR) was 1.26 (95% CI: 1.13 − 1.40) for a shoulder complaint, and 1.26 (95% CI: 1.15 − 1.39) for a shoulder injury. The HRR for fitness training was 1.11 (95% CI: 1.02 − 1.20) for a shoulder complaint, and 1.18 (95% CI: 1.09 − 1.27) for a shoulder injury. Workload/age ratio was not associated to the rate of shoulder complaints or injuries.

Conclusion Accumulated external workload spikes of tennis training, match-play and/or fitness training are associated with a higher rate of shoulder complaints and shoulder injuries in competitive adolescent tennis players.

Clinical relevance Consistency in training load on a weekly basis is most likely more beneficial for adolescent tennis players regarding shoulder complaints/injuries than a training schedule comprising rapid increases (i.e. spikes) in workload.

082 TRAINING LOAD AND OTHER RISK FACTORS FOR SOFT TISSUE INJURY RISK IN PROFESSIONAL RUGBY UNION: A 13 TEAM, 2-SEASON STUDY OF 383 INJURIES

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Background The risk of injury in professional rugby union is high compared with other sports. Modifiable risk factors such as training load provide an attractive target for risk management.

Objective To explore the influence of training load and other known risk factors on soft tissue injury risk.

Design Observational cohort.

Setting Thirteen professional (English Premiership) rugby clubs over two seasons.

Patients (or Participants) During two seasons, 433 and 569 players were recruited, resulting in 1002 player-seasons from 696 unique players.

Interventions (or Assessment of Risk Factors) Training load metrics (session Rating of Perceived Exertion), previous injury, previous concussion, match minutes, age and position.

Main Outcome Measurements Soft tissue injury hazard (daily risk).

Results Age and position were unclear risk factors for injury (p-values: 0.20–0.49 for age and 0.40–0.97 for position). Players without a previous injury were at the lowest risk of subsequent injury, while the greater the number of previous injuries, the greater the risk for subsequent injury. Playing 'moderate-high' and 'high' match minutes was associated with a lower risk of injury than players with 'low' match minutes. Unexpectedly, having a previous concussion was associated with a lower risk of injury than players without a previous concussion. For training load measures, 3-day acute load showed no clear relationship with injury risk, while moderate-high 14-day chronic loads (248–337 daily AU) demonstrated a 'likely' harmful effect on injury risk (Relative Risk: 1.4, 95% CIs:1.1–1.8).

Conclusions Clear associations between injury risk and chronic training load measures were identified, as well as associations with previous injury, previous concussion and match minutes. These findings support the need for careful individualised load management and athlete profiling to include other risk factors (e.g., previous injury, previous concussion and match minutes). This should be undertaken to inform risk management decisions in athlete training programmes.

083 WORKLOAD WEIGHTED FOR TISSUE DAMAGE RESULTS IN HIGHER ACUTE:CHRONIC WORKLOAD RATIO FOR INJURED VS. UNINJURED ATHLETES

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Background Risk of overuse injury is often monitored through the acute:chronic workload ratio (ACWR), where workload is the quantity or magnitude of loading cycles. However, weighting the loading magnitude by raising it to a power equal to the slope of the stress-life curve for the tissue may give a better estimate of the damage accumulated due to workload.

Objective To identify differences between injured and uninjured athletes for ACWR based on workload quantity, magnitude, and weighted magnitude.

Design Matched-pair cohort.

Setting Youth basketball.

Participants Fifty (25F, 25M; 16.5 years; 66.2 kg; 173.5 cm) basketball players on four high school teams.

Assessment of Risk Factors A wearable device (VERT® Classic) was used to record jump count and jump height for all participants during practices and games throughout the 17-week season.

Main Outcome Measurements Ten athletes were diagnosed with either patellar or Achilles tendinopathy, and were matched by height and weight with teammates that had no injuries. ACWRs were calculated weekly for three workload types: jump count, jump height, and jump height weighted for tendon damage. Paired t-tests compared mean ACWR of injured and uninjured athletes for each measure of workload.

Results There was no significant effect of injury status for jump count ACWR (injured mean (95% CI): 1.077 (1.011–1.132), uninjured: 1.025 (0.906–1.162); p=0.121) or jump height ACWR (injured: 1.079 (1.015–1.136), uninjured: 1.018 (0.886–1.155); p=0.081). ACWR with jump height weighted for tendon damage was higher for injured (1.075 (0.929–1.243)) compared to uninjured athletes (0.939 (0.729–1.266); p=0.045).

Conclusions Athletes with patellar or Achilles tendinopathy have a greater ACWR than uninjured athletes when workload is calculated as jump height weighted based on tendon properties. This result was not apparent when ACWR was based on the number of loading cycles or the unweighted loading magnitude. Future research into overuse injury prevention should consider the damage accumulation in biological tissue due to repetitive loading.

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084   **MONITORING WORKLOAD TO EVALUATE INJURY RISK: THE IMPACT OF MISSING DATA**

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Background The acute: chronic workload ratio (ACWR) is used to monitor workload, with both low and high ACWR associated with injury risk. Ignoring or imputing missing data points may influence ACWR calculations.

Objective To examine the effect of ignoring versus imputing missing data on ACWR.

Design Cohort, longitudinal.

Setting Youth basketball.

Participants Fifty (25F, 25M; 16.5 years; 66.2 kg; 173.5 cm) basketball players on four high school teams.

Assessment of Risk Factors Participants wore a jump counter (VERT® Classic) to record external workload during practices and games throughout the 17-week season.

Main Outcome Measurements Two datasets were created: missing data were ignored, and missing data were imputed using a machine learning algorithm based on typical jump counts for the individual, team and sex. The distribution of ACWR was compared between datasets using a two-sample Kolmogorov-Smirnov test. Pearson correlations were used to assess how the ACWR for the ignored and imputed datasets relate to the difference between the percent of missing acute and chronic data.

Results The distribution of ACWR was significantly different between the ignored and imputed datasets (D=0.164, p<0.001). The ignored dataset had 40% more cases of ACWR<0.5 and 97% more cases of ACWR>2.0 than the imputed dataset. There was a significant moderate association between ACWR and the difference between the percent of missing acute and chronic data for the ignored dataset (rho=0.617, p<0.001). When more acute than chronic data are missing, ACWR is low; when more chronic than acute data are missing, ACWR is high. There was no relationship between missing data and ACWR for imputed data (rho=0.061, p=0.147).

Conclusions When missing data are ignored, ACWR is dependent on the quantity of missing acute and chronic data. Additionally, ignoring rather than imputing missing data is likely to result in more extreme ACWR, which could influence evaluation of the relationship between workload and injury risk.

Poster Presentations

085   **THE IMPACT OF OVERHEAD SPORTS: ASSESSMENT OF SHOULDER RANGE OF MOTION IN 1ST LEAGUE PROFESSIONAL VOLLEYBALL PLAYERS**

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Background Throwing is a highly skilled movement performed at the extremes of glenohumeral motion. The constant microtrauma in the throwing shoulder challenges the physiologic limits of the surrounding tissues and leads to modifications in range of motion, due to osseous and soft tissue adaptations.

Objective We aimed to characterize the changes that occur in glenohumeral mobility in volleyball players, determining if these would be different compared to other overhead sports and if differences existed between the two shoulders.

Design This was a cross-sectional study, with clinical data collected from questionnaires and functional evaluation using a goniometer.

Setting The subject group consisted of volleyball players from the major league and/or the national team.

Participants The selection criterion was being a volleyball masculine athlete of a major competition without shoulder complaints; this enrolled a total of 66 professional males.

Interventions Bilateral range of motion (active and passive) was assessed with a goniometer, in both throwing and non-throwing shoulder. We also tested stability.

Main Outcome Measurements We measure forward elevation, extension, external and internal rotation. The specific tests were apprehension, anterior and posterior drawer, and the sulcus sign.