Effects of an intensified competition period on neuromuscular function in youth rugby union players

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Headline

Playing rugby union matches causes a number of fatigue responses, including reduced lower body neuromuscular function (NMF) (commonly measured by counter movement jump (CMJ))(1). The time course of this response following match play is well established in professional (2) and academy (3) level rugby union players, who take at least 60 hours for NMF to recover. No data exist for high school level rugby union players, but these players are often exposed to multiple game tournaments and festivals (2 games in 3 days, or 3 games in 5 days) within their competition structures.

Aim. The aim of this case study is to document the NMF response to playing three rugby union matches within five days. This will provide useful information to practitioners who must manage fatigue and recovery of youth rugby union players who play multiple games within short time periods.

Methods

Athletes. Fifteen male rugby union players (age 17.2 ± 0.8 years; height 178 ± 8 cm; body mass 87.1 ± 15.2 kg; 1 repetition maximum (RM) Bench Press 105 ± 20 kg; 5RM Squat 139 ± 24 kg; 40 m sprint 5.5 ± 0.2 s) competing in a high school rugby festival over a 5-day period volunteered to take part in the study. Ethics approval was granted by Leeds Beckett University, and permission to use the previously collected data was granted by the players' school.

Design. A within-group repeated measures design was used to examine the magnitude of change in NMF throughout the festival. The players participated in three 70-minute rugby matches over the course of five days. The matches kicked off at 13:15 on match day 1, and at 15:00 on match days 2 and 3. Tactical substitutions were not employed, and players were only substituted in the case of injury. As a result, the starting fifteen players played the majority (>90%) of the playing time available. Immediately after each match players performed a combined cold-water immersion and active recovery protocol. Players entered a waist deep swimming pool (approx. temp. 10 °C) and spent approximately 5 minutes walking or jogging in the water. A single recovery day was scheduled between each match. Low intensity training sessions, consisting of 35 minutes of stretching, walking, jogging and skill execution (catch/pass etc.) activity took place at 11:00 each morning on the days between matches. NMF was measured by determining CMJ flight time each day two hours prior to competition or one hour prior to training. Two players were injured during the second match and were unable to take further part in the study. As such, the data set for the final two days if for just 13 players.

Methodology. The CMJ's were performed on an electronic timing mat system (Just Jump System, Probotics, Inc., Huntsville, AL). CMJs were conducted according to the procedures described by Twist et al. (2012) (4). Players were familiar with this methodology as they regularly performed counter movement jumps in pre-season testing sessions and during training. The between day reliability of the CMJ flight time measure in this population was acceptable (CV = 2.14%).

Statistical analysis. Changes in group CMJ flight time were analysed for practical significance using magnitude-based inferences5. The threshold for change considered to be practically important (the smallest worthwhile change; SWC) was set at 0.2 x between subject standard deviation (SD), based on Cohen's d effect size (ES) principle. The probability that the magnitude of change was greater than the SWC was rated as <0.5%, almost certainly not; 0.5-5%, very unlikely; 5-25%, unlikely; 25-75%, possibly; 75-95%, likely; 95-99.5%, very likely; >99.5%, almost certainly4. Where the 90 % Confidence Interval (CI) crossed both the upper and lower boundaries of the SWC (ES±0.2), the magnitude of change was described as unclear (5). Individual changes in CMJ flight time were considered clearly meaningful if the individual mean change ± the typical error of measurement (TEM) clearly exceeded the SWC (6). Individual TEM was calculated as the within-subject standard deviation (7).

Discussion

Rugby union is a physically demanding sport (8). Full recovery of NMF following match participation requires at least 60 hours(2,3). The effects of training or competing again within

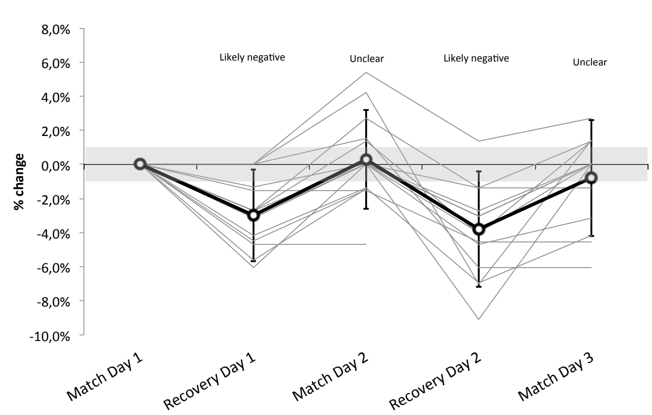

Fig. 1. Percentage change in counter movement jump flight time over a five-day rugby festival. Bold lines indicate group mean with 90% confidence intervals. Grey lines indicate individual participant scores. Greyed out area indicates the thresholds for smallest worthwhile change. Analysis indicates that there were likely negative effects of match participation on flight time on recovery day 1 and recovery day 2. However, 48 hours following the second game the effects were unclear.

this 60-hour window are unclear. Preliminary results suggest that high training loads within the recovery period extend the time required for full recovery (9,10).

Rugby union injuries occur most frequently in the final quarter of matches (11) indicating that fatigue may be a risk factor for rugby injury. Research in professional football indicates that injury risk is higher when players have less than 5 days recovery between matches (12). Youth rugby players are often exposed to multiple game tournaments and festivals (2 games in 3 days, or 3 games in 5 days) within their competition structures. Youth rugby players also often play for multiple teams (e.g. schools, clubs and academies) leading to multiple match exposures within the same week across different competition structures (13). Therefore it is important to understand how participation in periods of intensified competition may affect fatigue indicators. To the author's knowledge, this is the first study to examine the effects of an intensified competition period on NMF in youth rugby union players.

The results of this case study indicate that the majority of players did not display any residual neuromuscular fatigue 48 hours following participation in the first match. Furthermore, no clear group effect of playing two matches in three days was evident 48 hours following participation in Match 2 (Figure 1). This is similar to previous research that showed that NMF returned to baseline 24 hours after playing five games in four days in junior rugby league players (14). However, there was a great deal of variability in fatigue response between players, and four players displayed clearly reduced NMF on match day 3 (Figure 2). This demonstrates that at least some players were meaningfully fatigued as a result of the intensified competition exposure. The fatigue response results from the metabolic stress of repeated high-intensity actions, the mechanical trauma of repeated collisions, or a combination of both (2). Therefore the observed variability in fatigue response may be the result of both differing positional requirements (8), and differences in individual within match playing involvements (number of tackles, ball carries etc.). Due the likelihood of reduced match performance (14,15) and possibly increased injury risk (11), this phenomenon warrants close monitoring in the applied setting.

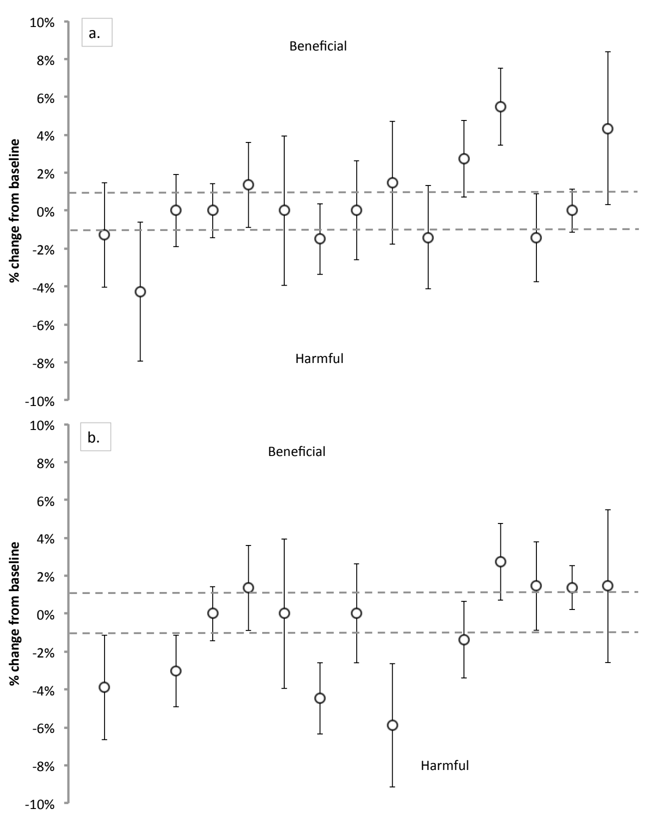

Fig. 2. Individual change from baseline in counter movement jump flight time on match day 2 (a) and match day 3 (b) of a five day rugby festival. Error bars indicate individual typical error of measurement. Dashed grey lines indicate the thresholds for smallest worthwhile change. Between subjects responses were highly variable. On match day 2 (Figure 2a) no clearly negative changes were apparent, while one player had substantially improved his jump flight time. On match day 3 (figure 2b), four players displayed clearly reduced jump flight time from pre-tournament values.

Practical Applications

- CMJ testing can be used to determine which individual players are exhibiting signs of neuromuscular fatigue during periods of intensified rugby union competition.
- Provides reference data regarding the magnitude and time course of changes in NMF for players involved in periods of intensified competition.
- Illustrates the importance of implementing between game recovery strategies for players involved in periods of intensified competition.

Limitations

- Fatigue is multi-factorial in nature16, and this research has only measured one indirect indicator of fatigue (NMF). Future research should aim to include a range of fatigue measures including biochemical markers of muscle damage, perceptual fatigue and upper body NMF.
- No measure of internal or external load was collected, making it impossible to link NMF outcomes to physical exertions.
- It would have been better to use a force plate rather than a timing mat to measure NMF. Mean power and peak force are demonstrably more sensitive measures of NMF (7), and the inclusion of these may have revealed more meaningful group effects.
- The effect of the recovery methods employed in this study cannot be quantified because no control group was available.

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Dataset

Dataset available on SportPerfSci.com

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