RELATIONSHIP BETWEEN TRAINING MONOTONY AND NEUROMUSCULAR PERFORMANCE IN NCAA SOCCER PLAYERS

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INTRODUCTION: The purpose of a training program is to optimally develop athletes physically, mentally, tactically, and technically for the entirety of a competitive season. This is done by modifying training loads at specific times to overload the athlete and subsequently recover to produce adaptations beneficial for the sport (Halson, 2014). However, the process of applying correct loads at the correct times is a challenge during a season-long team sport. While increasing training loads may be effective during the off-season, in-season training must incorporate player fatigue and injury risk associated with increased training demands (Gabbett & Jenkins, 2011), while also controlling for training monotony (Anderson, Triplett-McBride, Foster, Doberstein, & Brice, 2003). As such, athletes must be monitored in-season both subjectively and objectively with fatigue management and the minimization of decrements in skill and ability in mind.

Foster et al. (2001) have shown that session rating of perceived exertion (sRPE) is an effective subjective measurement of training session intensity. By multiplying the RPE by the duration of the exercise bout, this method was shown to be related to both heart rate (HR) and blood lactate markers. By taking the daily mean training load (sRPE) and dividing it by the standard deviation of the previous seven days, an index called training monotony is given. Since a combination of high training load and high training monotony are both related to negative adaptations to training (Lehmann, Foster, & Keul, 1993), these values must be taken into account when guarding against player fatigue.

High training loads and high training monotony seem to be correlated not only to a larger amount of injuries, but more severe injuries on the field (Brooks, Fuller, Kemp, & Reddin, 2008) due to neuromuscular fatigue (Enoka & Duchateau, 2008) . An objective measurement of neuromuscular fatigue, static jump height, has also proven to be an effective measurement of training adaptations. Competition induces high levels of fatigue in athletes but countermovement jumps have shown to be ineffective at capturing small deviations in performance while static jumps have been shown to be sensitive enough to capture these alterations (Sams, 2014). Therefore, the purpose of this study is to investigate the relationship between training monotony and static jump height as a measure of neuromuscular performance.

METHODS: Eighteen male NCAA Division I soccer players were tested in the study. Goalkeepers were excluded from this investigation due to the differences in their on-field training. Data was collected as part of a regular athlete monitoring program. Weighted static jumps were tested using a Just-Jump System (Probotics, Inc., Huntsville, AL) four hours before the start of each game. Before jump testing commenced, all athletes passed hydration testing and completed a standardized dynamic warm up. They practiced two warm-up static jumps, one with no weight and one with an 11-kilogram barbell. The subjects then used a 20-kilogram barbell and performed a static jump at a 90-degree knee angle. Jump height was calculated using flight time.

Training monotony was derived from session RPE. Monotony was calculated as the average of RPE training load divided by the standard deviation of the seven days prior to jump testing. RPEs were taken after every training session over the course of the season and used the modified Borg scale (1 – 10) (Borg, 1982). These training sessions included weight training, conditioning, rehabilitation for injured athletes, games, and recovery sessions. Off days were given RPEs of 0.

For the statistical analysis, Pearson's r correlation coefficients were calculated. r2 was calculated as a measure of variance due to training monotony. All statistics were run in the statistical software JASP version 0.8.2.0.

RESULTS: A small, negative relationship was found between training monotony and jump height (r=-.195, p=.007). These values are statistically significant at the $p < 0.01$ level indicating reliable and consistent relationships. Training monotony was responsible for 3.8% of the variance in jump height ($r^2 = .038$).

DISCUSSION: When considering variables in a training program for NCAA division 1 soccer players, improving performance and reducing risk of injury are paramount. These variables include training workloads relating to volume and intensity on the pitch and during other training sessions such as resistance training sessions. Implementing a program that involves variable workloads to prevent a decrease in performance while also reducing the risk of injury due to overtraining are effective ways to manipulate training monotony. Monitoring pre-game jump heights as a means to track neuromuscular fatigue provides valuable insight into the effects that training has had on the preparedness of the athletes.

In the present investigation, training monotony had a small but significant negative correlation to jump height. Training monotony explained nearly 4% of the variance in jump height. This may be partly due to the nature of a periodized training program in maintaining very low training monotony values over the course of the season. Although very small values, DeWeese et al. (2015) claims that differences as small as 1.5% can have meaningful impacts on high level competition. When a significant decrease in the static jump heights of an athlete or group of athletes was observed, short term adjustments to the training program would be implemented to restore athlete preparedness. Using a periodized training may have contributed to reduced non-contact injuries and maintaining neuromuscular performance over the course of the competitive season.

Confounding variables that may impact the results of this study include effort given by the athletes during jump testing, injuries, and stress levels. The effort given on each jump must be maximal and consistent for the results to be reliable. Injuries that occur during contact drills or in competition may prevent the athletes from performing pre-game jump testing in every session. Outside stressors such as academic requirements, lack of proper recovery due to inadequate nutrition and/or sleep may also be factors that could lead to variance in jump height performance. Travel restrictions that sometimes prevent monitoring of pre-game jumps may also be a confounding variable in results of this study.

A possible limitation to this method is the fact that collecting and calculating sRPE to derive training monotony can be time consuming during a competitive season. Future considerations into this topic should consider the value of this feedback and any possible means to monitor training in a more efficient manner while providing the same or greater benefits to performance.

CONCLUSIONS: By monitoring the neuromuscular fatigue via regular static jump heights and implementing a periodized training plan, training monotony was considerably limited or avoided. Therefore, it is recommended that coaches and/or sport scientists attempt to control training monotony via regular athlete monitoring and periodization based training programs to ensure peak performance.

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