RELATIONSHIP BETWEEN INTERNAL TRAINING LOAD AND ASYMMETRY CHANGE FOLLOWING A FATIGUING BOUT OF EXERCISE IN COLLEGIATE SOCCER PLAYERS

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ABSTRACT

In sports performance, asymmetry refers to inter-limb differences in muscle mass, strength, and power. Due to concerns regarding injury occurrence and reductions in performance, research is warranted to examine factors that lead to changes in inter-limb asymmetries after a fatiguing bout of exercise. Further, it is unclear if increased lower body power production abilities are protective against increasing inter-limb asymmetries under fatigue. **PURPOSE:** This study aimed to investigate the relationship between internal training load and asymmetry change in response to a fixed external workload exercise protocol. A secondary aim was to explore whether baseline peak power impacted asymmetry change. **METHODS:** College soccer players (M=17, F=12; age = 21.2 ± 1.7y, % body fat = 14.2 ± 6.0%) participated in the study, completing two visits within a week. At the first visit, athletes were familiarized with the jump tests, which included bilateral countermovement jumps (CMJ) and single-leg CMJ (SLCMJ) on force plates (Hawkin Dynamics Inc., Westbrook, ME). Participants executed two attempts per jump type with 30s of rest between attempts. All jumps were performed with arms akimbo. At the second visit, each participant executed jump tests before and after a standardized 90-min simulated soccer game on a treadmill. Training load, derived from heart rate using Summated Heart Rate Zones model (Polar Team Pro, Kempele, Finland), was determined during the exercise bout to express relative demand. The fatiguing protocol was developed based on prior workload data in NCAA Division I soccer players. Asymmetry change was determined by calculating the difference between pre- to post-exercise asymmetry index derived from SLCMJ jump height. Repeated measures ANCOVA was performed to assess differences in asymmetry index pre- to post-exercise with peak power as a covariate. Pearson's r with a 95% confidence interval (CI) was used to assess the relationship between relative training load and asymmetry change from pre- to post-exercise. Statistical significance level was set at α=0.05. **RESULTS:** There was no change in degree of asymmetry found from pre- to post-exercise (P=0.763) and peak power was not a significant covariate (P=0.962). There was no relationship found between relative internal load and degree of asymmetry change (r=0.263, P=0.163, CI: -0.114-0.574). **CONCLUSIONS:** Findings from this study indicate relative training load responses to a fixed absolute workload do not correlate to the degree of change in asymmetries. Additionally, our results indicate peak power alone does not appear protective in inter-limb asymmetry after a simulated game in collegiate soccer players. Further investigation is warranted to identify what physical or physiological factors, or combination of factors, contribute to asymmetry discrepancies in high-level soccer players under fatigue and how they influence sport performance.

PRACTICAL APPLICATIONS: While inter-limb asymmetries have been proposed to contribute to injury risk, the current study would suggest that fatigue may not exacerbate these differences. However, it is possible that there is a "fatigue threshold" beyond which these asymmetries become more pronounced, and this may need to be considered when identifying potential physical factors to help protect against these changes.

INTRODUCTION

- Asymmetry refers to differences in muscle mass, strength, and power between limbs.
- Due to the concerns about injury risk and performance decrements, investigation into the factors that lead to asymmetries under fatiguing conditions is warranted.
- Soccer players may be particularly susceptible to the negative effects of asymmetries due to the emphasis on unilateral movements and the intermittent nature of the sport.
- Internal load refers to the measure of physiological stress experienced by athletes in response to training. It helps to tailor training to individual athletes' physiological responses, preventing overtraining and optimizing performance

Purpose: To investigate the relationship between internal training load and asymmetry change in response to a fixed external workload exercise protocol. A secondary aim was to explore whether baseline peak power impacted asymmetry change.

CONCLUSIONS & PRACTICAL APPLICATIONS

- Internal training load responses to a fixed absolute workload do not correlate to the degree of change in asymmetries.
- Peak power alone does not appear protective against inter-limb asymmetry following a simulated game in collegiate soccer players.
- These present findings suggest that fatigue does not exacerbate inter-limb differences. However, there may exist a "fatigue threshold" beyond which these asymmetries become more pronounced and may impact performance. This may need to be considered when identifying potential physical factors to help protect against these changes.
- Further investigation is warranted to identify which physiological factors contribute to asymmetries in high-level soccer players and their impact on sport performance.

METHODS

Participants:
- Twenty-nine college soccer players completed the study.
- Participants were currently playing at the college level.
- Body fatness was obtained using air displacement plethysmography (*Bod Pod®, COSMED*).

Table 1: Participant Characteristics

Measure	N (29)	Males (n = 17)	Females (n = 12)
Age (yrs)	21.2 ± 1.7	21.4 ± 1.6	20.9 ± 1.8
Height (cm)	174.1 ± 9.4	179.6 ± 6.7	166.5 ± 7.3
Weight (kg)	70.3 ± 10.3	75.6 ± 6.7	62.7 ± 10.0
Body fat (%)	14.2 ± 6.0	10.3 ± 3.1	19.6 ± 4.8
Soccer Experience (yrs)	14.8 ± 3.5	14.1 ± 3.9	15.6 ± 2.9

Data shown as mean ± SD

Experimental Protocol:
- During the first visit, participants underwent body composition assessment and were familiarized with warm-up and performance tests.
- During the second visit, each participant completed a battery of performance tests before and after a treadmill-based 90-minute simulated soccer game.
- Performance tests included countermovement jump and unilateral countermovement jump on force plates (*Hawkin Dynamics Inc*).
- Internal training load, derived from heart rate using the Summated Heart Rate Zones model (*Polar Team Pro*), was determined during the simulated soccer game.

Statistical Analysis:
- Asymmetry change was determined by calculating the difference between pre- to post-exercise asymmetry index derived from unilateral countermovement jump height.
- Repeated measures ANCOVA was performed to assess differences in asymmetry index pre- to post-exercise with peak power as a covariate (α=0.05).
- Pearson's correlation coefficient (r) with a 95% confidence interval (CI) was used to assess the relationship between internal training load and asymmetry change from pre- to post-exercise (α=0.05).

RESULTS

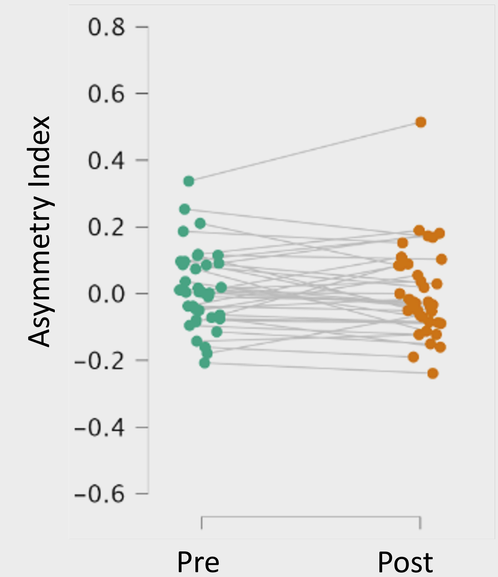

Figure 1: Comparison of asymmetry index pre- vs post-simulated soccer game

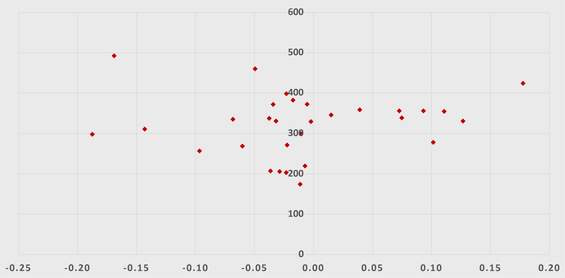

Figure 2: Pearson's correlation between workload score and asymmetry index change (r=0.263)

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