Effects of Lower Extremity Anaerobic Fatigue on Neuromuscular Function and Jumping Performance

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Abstract

Purpose: Although anaerobic fatigue tends to negatively impact general muscular function, the effects of anaerobic fatigue on specific muscular performances are not as well known. The aim of this study was to determine the effect of lower extremity anaerobic fatigue on neuromuscular function and jumping performance.
Methods: Performance was measured with a 3-D accelerometer (Myotest, Switzerland). Variables examined were eccentric/concentric contraction ratios (E/C), power production, force production, contact time, and maximal height. Participants included 9 male soccer players from Bethel University (age 20.1 ± 1). A familiarization session was conducted and consent provided before conducting research. Each subject completed three Countermovement Jump (CMJ) and Plyometric Jump (PJ) tests, one of each test was conducted during the pre-test session and immediately following fatigue protocols. The first fatigue protocol was the Wingate test. The second fatigue protocol was the Bosco test, consisting of maximal effort squat jumps for a minute.
Results: Statistical analysis was conducted using a paired t-test. No significance was found at the $p \leq 0.05$ level between pre-test values and post-test values for E/C (Wingate p=0.65; Bosco p=0.70), power (p=0.71; p=0.10), force (p=0.79; p=0.35), contact times (p=0.20; p=0.71), or maximal height (Wingate p=0.18). The only significance found was the decrease between pre-test (35.28 cm ± 4.00) and Bosco post-test (32.46 cm ± 3.32) values of maximal height (p=0.048).
Conclusion: The Wingate and Bosco fatigue protocols failed to stress the neuromuscular system. It is probable that the protocols inefficiently induced fatigue, as the results did not support current research (Marginson, 2005). Though little correlation was found between lower extremity fatigue and jumping performance, further research should be conducted to explore how different levels of fatigue contribute to neuromuscular function and jumping performance.

Methods

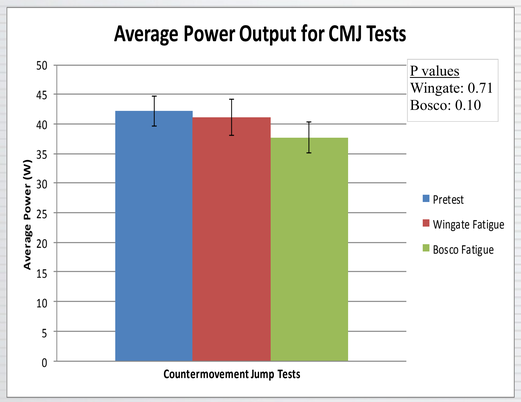
Participants included 9 male soccer players from Bethel University (age 20.1 ± 1). Each individual subject met the researchers in the Exercise Medicine and Prevention Center, where the subjects completed an informed consent and became accustomed to the Myotest (Switzerland) Countermovement Jump and Plyometric Jump tests via video display. After agreement to the research, subjects were weighed (kg) and height (cm) taken. Blood pressure was also taken. Each subject completed three Countermovement Jump (CMJ) and Plyometric Jump (PJ) tests, one of each test was conducted during the pre-test session and immediately following fatigue protocols. Variables examined were eccentric/concentric contraction ratios (E/C), power production, force production, contact time, and maximal height. The first fatigue protocol was the Wingate test. The second fatigue protocol was the Bosco test, consisting of maximal effort squat jumps for a minute.

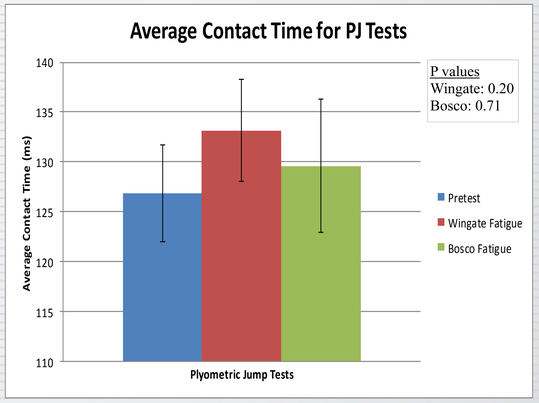
Introduction

It is no secret that athletics have gained a substantial amount of attention over the past few decades. This newfound interest has led many societies to incorporate sports as an integral part of both health-related fitness and entertainment. Analyzing the muscular function aspect of athletics has and continues to provide a great deal of insight into optimal training programs, which aid in improving performance and decreasing injury of athletes. In competitive sports, these features of athletic fitness are highly desirable.

One of the most world-wide prevalent sports seen today is soccer. Due to the nature of the sport, the lower extremities contain the primary muscles targeted during competition and training. This is also the likely reason why a majority of injuries occur in the lower extremities for soccer players. Soccer players in their youth have been found to have 74% of their injuries lower extremity related, while senior soccer athletes have been found to have 89% of injuries specific to the lower extremities (Merron, 2006). Of the senior soccer players' injuries, 24% were localized to the knee and 22% targeted the thighs (Merron, 2006). Such high rates of lower extremity injury in soccer players have provided incentive for researchers to further explore soccer injuries and their causes.

Even though some may consider soccer an endurance sport, there are bursts of anaerobic activity produced intermittently throughout a session. These high-intensity levels may only be maintained for short durations as fatigue develops quite rapidly. This fatigue may be measured by various instruments. One research group simulated soccer game conditions via a treadmill protocol and utilized multiple isokinetic dynamometer trails to measure fatigue, concluding that eccentric hamstring strength tends to decrease over the course of a soccer game (Greig, 2009). This type of research leads to discussion of concentric versus eccentric training in soccer athletes. Eccentric muscle contractions are considered to allow for greater force production over concentric muscle contractions, yet in sports like soccer the deficiency in eccentric contractions is more often than not the cause of thigh injuries (Baroni, 2011). The ratio of eccentric to concentric muscle contractions therefore appears to be a valid statistic when assessing performance of a soccer player. The current study will be considering not only this ratio, but also power production, force production, ground contact time, and maximal height, in order to determine the performance effects of lower extremity fatigue.





Results

Statistical analysis was conducted using a paired t-test. No significance was found at the $p \leq 0.05$ level between pre-test values and post-test values for E/C (Wingate p=0.65; Bosco p=0.70), power (p=0.71; p=0.10), force (p=0.79; p=0.35), contact times (p=0.20; p=0.71), or maximal height (Wingate p=0.18). Significant decrease was found between pre-test (35.28 cm ± 4.00) and Bosco post-test (32.46 cm ± 3.32) values of maximal height (p=0.048).

Conclusion

The Wingate and Bosco fatigue protocols failed to stress the neuromuscular system. It is probable that the protocols inefficiently induced fatigue, as the results did not support current research (Marginson, 2005). Giving specific attention to soccer players, it is important to point out that different positions require different levels of anaerobic training for optimal efficiency. If this research were to be repeated, the validity of the results would likely be improved by including soccer players only of a specified position (i.e. forward). Though little correlation was found between lower extremity fatigue and jumping performance, further research should be conducted to explore how different levels of fatigue in athletes exposed to anaerobic fatigue contribute to their neuromuscular function and jumping performance.

References

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