

## Sports Medicine & Movement Laboratory

School of Kinesiology, Auburn University

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# EMG Analysis of Dynamic Warm-up Exercises for Overhead Sports

Portia Williams, Jeff Barfield, and Gretchen Oliver

## ABSTRACT

**Purpose:** Objectives: In overhead throwing sports, traditional pre-throwing programs have focused primarily on the upper extremity. However, training the total body and utilizing both the lower and upper extremity in dynamic overhead movements is becoming more popular and advised. Thus, it was the purpose of this study to examine muscles about the lumbopelvic-hip complex (LPHC) and scapula during selected exercises that could possibly be utilized in a pre-throwing conditioning program.

**Methods:** Twenty-one healthy, active individuals ( $171.1 \pm 13.0$  cm;  $75.5 \pm 14.8$  kg;  $25.3 \pm 5.5$  years), regardless of sex, volunteered. Surface EMG was utilized to measure muscle activation of the biceps femoris, semitendinosus, bilateral gluteus medius, gluteus maximus, erector spinae, latissimus dorsi and lower trapezius while performing four total body exercises (lungeW, kettlebell swing, kettlebell deadlift, gluteal/hamstring raise).

**Results:** A nonparametric Friedman Test revealed significantly different muscle activations as a factor of exercise for the biceps femoris ( $\chi^2_{(3)} = 21.18$ ,  $p < .001$ ), gluteus maximus ( $\chi^2_{(3)} = 39.17$ ,  $p < .001$ ), right gluteus medius ( $\chi^2_{(3)} = 21.21$ ,  $p < .001$ ), left gluteus medius ( $\chi^2_{(3)} = 11.02$ ,  $p = .012$ ), erector spinae ( $\chi^2_{(3)} = 28.47$ ,  $p < .001$ ), and lower trapezius ( $\chi^2_{(3)} = 29.84$ ,  $p < .001$ ).

**Conclusion:** The four exercises successfully elicited moderate to high muscle activation in all musculature, except the lower trapezius. These results imply that these four exercises could be utilized as a warm-up/pre-throwing protocol to achieve LPHC as proximal scapula muscle activation.

***This abstract is a brief overview of a manuscript that was submitted for publication in the Journal of Sports Sciences.***

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# The Relationship Between Hip Isometric Strength and Hand Velocity in Female Softball Hitting

Jessica Washington, Wendi Weimar, and Gretchen Oliver

## ABSTRACT

**Purpose:** The purpose of this study was to examine the influence of bilateral hip isometric strength to performance indicators in female softball hitting, specifically hand velocity.

**Methods:** Twenty-seven female, collegiate softball athletes ( $20.41 \pm 1.78$  years;  $167.47 \pm 21.27$  cm;  $74.97 \pm 15.28$  kg) executed bilateral hip isometric strength tests, both internal and external rotation, followed by three maximal effort swings at nine strike zone locations. Correlation and multiple regression analyses were conducted to examine the relationship of stride hip internal rotation isometric strength and load hip external rotation isometric strength to hand velocity at ball contact, as these are the primary hip movements executed during the softball swing.

**Results:** No significant relationship was found between stride hip internal rotation isometric strength and hand velocity at ball contact ( $r = -0.129$ ,  $p = 0.264$ ), nor between load hip external rotation isometric strength and hand velocity at ball contact ( $r = -0.120$ ,  $p = 0.279$ ).

**Conclusions:** Results from the current study indicate a potential inverse trend between isometric strength of the hips and hand velocity. This could be, most notably, a consequence of differences in hip position during isometric testing versus that which is executed during the swing in addition to the differences in movement characteristics, such as open versus closed chain tasks. Future research should examine hip rotational strength using different methodology, with a participant standing in the hitting stance position and executing transverse pelvis rotation in closed chain, to better analyze this question of hip strength influence.

*This abstract is a brief overview of a manuscript that will be submitted for publication.*

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# Relationship of Pelvis and Torso Separation to Performance Indicators in Female Softball Hitting

Jessica Washington and Gretchen Oliver

## ABSTRACT

**Purpose:** The purpose of this study was to investigate the degrees of pelvis and torso separation in female softball athletes, as well as, the influence this value has on performance indicators in hitting, specifically maximum hand velocity.

**Methods:** Twenty-seven female, collegiate softball athletes ( $20.41 \pm 1.78$  years;  $167.47 \pm 21.27$  cm;  $74.97 \pm 15.28$  kg) executed three maximum effort swings from a stationary hitting tee at the middle 'strike zone' location. Pelvis and torso separation was defined as the maximum difference in degrees of axial rotation between the pelvis and torso.

**Results:** Pearson product-moment correlation analyses were conducted to examine the relationship between pelvis and torso separation and maximum angular hand velocity at ball contact. A significant, negative correlation was found between pelvis and torso separation and hand velocity at ball contact ( $r = -0.351$ ,  $p = 0.039$ ).

**Conclusions:** Evidence of an inverse relationship in the current study may indicate that the value of pelvis and torso separation itself is not indicative of hand or bat velocity, but the timing at which maximum pelvis and torso separation occurs may be more influential.

*This abstract is a brief overview of a manuscript that will be submitted for publication.*