

## **Strength and Range of Motion Differences at the Hip, Thoracolumbar, and Glenohumeral Joints Between Division I and Division III Baseball Players**

Lewis EJ\*, Tucker WS†, Laudner KG‡, Snyder Valier AR§, Decoster LC\*, Hollingworth AT\*, Matthews LW\*, Huxel Bliven KC§: \*New Hampshire Musculoskeletal Institute, Manchester, NH; †University of Central Arkansas, Conway, AR; ‡University of Colorado Colorado Springs, Colorado Springs, CO; §A.T. Still University, Mesa, AZ.

### **Context:**

Range of motion (ROM) and strength of the hip, spine and glenohumeral joints are measurable variables that have been linked to risk of injury. Level of play may result in increases in training intensity that cause players in some divisions to incur more risk of injury than others. These variables have not been examined between the different NCAA divisions in collegiate baseball players and may reveal risk factors for injuries specific to these similar yet unique populations. The purpose of this study was to explore hip, thoracolumbar, and glenohumeral (GH) ROM, and hip and GH strength between NCAA Division I (DI) and Division III (DIII) collegiate baseball players.

### **Methods:**

This prospective study included 169 collegiate baseball players from four universities. Division I (n=101, age: 20±1.4, height: 183.8±6.1 cm, weight: 89.1±10.2 kg, years played: 13.2±3.0) and Division III (n=68, age: 20±1.6, height: 182.3±6.5, weight: 85.3±11.2 kg, years played: 13.8±2.8) players from a sample of convenience were tested during the preseason. Throwing (dominant) and non-throwing ROM were obtained using digital and bubble inclinometers (±1 degree) for the following measurements: passive prone hip internal rotation (IR), external rotation (ER), and total (IR+ER) ROM; thoracolumbar rotation using two bubble inclinometers placed at C7 and S2; and passive GH IR, ER, total ROM, and horizontal adduction (HAdd) on throwing side only. Bilateral strength using a hand-held dynamometer was measured for resisted side-lying hip abduction (Abd) strength and resisted supine GH IR and prone ER strength. Strength measures were normalized to bodyweight (%BW). Four investigators performed the same measurements on all participants (ICC<sub>≥</sub>.75). One-way ANOVAs were used to analyze differences in ROM and strength between groups ( $p < 0.05$ ).

### **Results:**

Means (± standard deviation) of measurements are presented in Table 1. Division III players displayed greater ROM than Division I players for stance hip ER ( $p < 0.001$ ) and total ROM ( $p < 0.001$ ), lead hip ER ( $p < 0.001$ ) and total ROM ( $p < 0.001$ ), throwing GH ER ( $p = 0.001$ ) and total ROM ( $p = 0.001$ ). Division I players displayed greater thoracolumbar rotation ROM toward the dominant side ( $p = 0.016$ ) and greater GH strength than Division III players for throwing GH IR ( $p < 0.001$ ) and ER ( $p < 0.001$ ), and non-throwing GH IR ( $p < 0.001$ ) and ER ( $p < 0.001$ ).

### **Conclusions:**

Differences exist in thoracolumbar rotation, and hip and GH ROM and strength between collegiate DI and DIII baseball players. These results provide insight into the different physical characteristics between collegiate players, which should be considered in the prevention, diagnosis and rehabilitation of baseball related injuries. Further research should explore whether these ROM and strength differences impact the risk of injury of athletes playing in different divisions.

Table 1. Range of motion and strength at the hip, glenohumeral joint, and thoracolumbar region between NCAA Division I and Division III baseball players (mean  $\pm$  standard deviation)

Measurement	NCAA Collegiate Level	
	Division I	Division III
<b>Range of Motion (degrees)</b>		
<b>Hip</b>		
Stance leg IR	26.5 $\pm$ 7.6	28.2 $\pm$ 8.4
Stance leg ER	34.8 $\pm$ 6.9	42.0 $\pm$ 10.6**
Stance leg total ROM	61.3 $\pm$ 10.5	70.2 $\pm$ 11.7**
Lead leg IR	26.2 $\pm$ 7.0	27.5 $\pm$ 7.3
Lead leg ER	34.1 $\pm$ 6.6	40.8 $\pm$ 9.0**
Lead leg total ROM	59.6 $\pm$ 11.9	68.3 $\pm$ 10.4**
<b>Glenohumeral Joint</b>		
Throwing IR	36.3 $\pm$ 11.0	38.9 $\pm$ 11.8
Throwing ER	107.3 $\pm$ 10.3	112.6 $\pm$ 9.7**
Throwing total ROM	142.1 $\pm$ 19.1	151.4 $\pm$ 14.3**
Throwing HAdd	12.8 $\pm$ 9.8	10.9 $\pm$ 10.7
Non-throwing IR	50.1 $\pm$ 10.1	51.9 $\pm$ 10.2
Non-throwing ER	101.8 $\pm$ 11.9	104.1 $\pm$ 13.0
Non-throwing total ROM	150.4 $\pm$ 21.8	156.0 $\pm$ 12.8
<b>Thoracolumbar</b>		
Rotation to throwing side	36.4 $\pm$ 9.8*	33.0 $\pm$ 6.8
Rotation to non-throwing side	37.6 $\pm$ 9.2	37.4 $\pm$ 7.6
<b>Strength (%BW)</b>		
<b>Hip</b>		
Stance leg ABD	0.35 $\pm$ 0.12	0.43 $\pm$ 0.06**
Lead leg ABD	0.36 $\pm$ 0.12	0.45 $\pm$ 0.06**
<b>Glenohumeral Joint</b>		
Throwing IR	0.25 $\pm$ 0.04**	0.21 $\pm$ 0.05
Throwing ER	0.23 $\pm$ 0.05**	0.19 $\pm$ 0.04
Non-throwing IR	0.23 $\pm$ 0.05**	0.18 $\pm$ 0.04
Non-throwing ER	0.21 $\pm$ 0.05**	0.16 $\pm$ 0.03

Footnotes: Internal Rotation, IR, External rotation, ER, Range of motion, ROM, HAdd, Horizontal adduction, Abduction, Abd.

\* indicates  $p \leq 0.05$ , \*\* indicates  $p \leq 0.001$ .