

## **Erin Pletcher – Abstract**

### **The Effects of Consecutive Softball Windmill Pitches on Coordination Patterns and Variability, Muscular Strength, and Pitching Performance**

Upper and lower extremity musculoskeletal injuries occur at a similar rate in softball pitchers. Most of these injuries can be considered chronic in nature, which may result in symptoms being treated instead of considering the underlying mechanism for injury. Previous literature has primarily focused on discrete values such as joint ranges and kinematic peaks. The primary purpose was to examine inter-segmental and intra-limb coordination of the softball windmill pitch throughout a simulated game of softball and to determine if variability of these patterns change throughout multiple pitch counts. The secondary purpose is to identify if a difference between pre-pitching and post-pitching strength can be detected to determine if muscular fatigue, as defined by the inability to sustain the expected power output around a joint, has occurred. Additionally, pitching performance defined as pitch velocity and accuracy were assessed. A total of 14 softball pitchers ( $17.9 \pm 2.3$  years,  $166.4 \pm 8.67$  cm,  $72.3 \pm 12.6$  kg) successfully completed all strength assessments and pitching. Concentric, isokinetic strength and time to peak torque of knee, hip, trunk and pitching arm flexors and extensors and trunk rotators were assessed at baseline and immediately after pitching and recorded as percent body weight. Pitching sequence consisted of 105 fastballs divided into 15 pitches in each of 7 innings. Vector coding was used to measure coordination and variability of Drive Leg Thigh v Pelvis, Pelvis v Torso, Pelvis v Humerus and Humerus v Forearm. Paired t-test or Wilcoxon Signed Ranks test was used to determine change in muscular strength. One-way repeated measures analysis of variance was performed to establish if differences in pitch velocity, accuracy or ground reaction force varied between innings. Dissimilarities in coordination patterns, amount and timing of variability was seen between pitchers. Significant increase in stride leg knee extension and trunk flexion peak torque, as percent body weight, was seen after consecutive pitches. Differences were seen in pitch velocity but not accuracy across innings. This is one of the first studies to investigate whole body coordination during the softball windmill pitch and associated measures of performance. While this study did not demonstrate the negative effects of consecutive pitching that were expected, results can provide a foundation for future research into windmill pitch mechanics to assist with injury prevention and performance optimization.