The Effect of Baseball Pitching Performance on Physiological Measures of Fatigue

Andrew Wolfe, Micheal Luera, Ruth Caddell, Gillian Braden, Cheyenne Lavender,
Jackson Maynard, Emma Thornton, Zane Badmaev
Tarleton State University , Stephenville, TX
Kinetic Performance Laboratory

Abstract

INTRODUCTION: The strength and conditioning industry defines sport science as a mechanism and process of modulating workload and performance based on subjective and objective physiological outcomes/data assessed before, during, and after performance. These titrations in training yield optimal physiological adaptations, ideal performance readiness, as well as mitigate injury potential of players. Specific to Baseball, pitchers inherently succeed when these three sport science outcomes are achieved. Perceived recovery status (PRS) scale (subjective) and force production measures via hand dynamometer grip strength (GS) (objective) are two simplistic assessment that deliver a global perspective of physiological readiness. Moreover, GS, specifically the effective contractile function of the flexor carpi ulnaris muscle, significantly contribute to minimizing medial condyle separation, ulnar collateral ligament stress, and ulnar nerve irritation. PRS has previously displayed promise as a valid subjective predictor of performances during intermittent training modes (i.e., sprints, resistance training, etc.). Analogous to PRS, perceived fatigue is shown to significantly increase as pitchers progress through innings during simulated and live gameplay. These finding, furthermore, conceivably support PRS as an authentic metric of pitching readiness. However, no studies have examined the effect of pitching on PRS and GS of collegiate pitchers. **PURPOSE**: The aim of the current investigation was to identified the effect of pitching (simulated gameplay) on PRS and GS. **METHODS**: Thirteen collegiate Division I baseball pitchers (mean ± SD, age = 21.1 ± 1.8 yr, 183.7 ± 4.88 cm, 89.8 ± 7.21 kg) completed 2 simulated gameplay bullpen sessions separated by 72 hours rest. Session 1 consisted of 2 simulated 15 pitch innings separated by 10 mins passive recovery. Session 2 consisted of 2 simulated 20 pitch innings separated by 10 mins passive recovery. PRS was collected 1 min prior to the beginning of each simulated inning. Using the Jamar Hydraulic Hand Dynamometer, pitchers completed 1 attempts to exert maximal GS in kilograms (kg) using dominate/throwing hand in the following arm position: 90° shoulder abduction, 120° elbow flexion, with 85° supination. GS was assessed 1 min before the start of each simulated innings and immediately after the completion of each simulated inning. Session Rate of Perceived Exertion (sRPE) was obtained 30 mins after bullpen sessions. Paired sample t-test was employed to assess PRS and GS difference between and within sessions. Difference in RPE was assessed using an Independent Sample t-test. Alpha level set at p <.05. **RESULT**: Significant differences were identified between pre- and post-test results for PRS t(12) = 2.391, p = 0.025. However, statistical significant was not realized for GS t(12) = 1.498, p = .160. Average Perception of difficulty (sRPE) for the administered bullpen was "fairly easy" (4.31 ± 1.25). **CONCLUSION**: These results suggest the demand/stimulus of pitching greatly affect internal (PRS) and external (GS) measure of physiological stress, showcasing promise as in-game monitoring tools. Further research should investigate the effects across extended innings and seasonally performance. Additionally, while PRS and GS serves as fatigue indicators, future studies are needed to develop fatigue threshold models based on pitching specific performance metrics (i.e., pitch velocity, spin rate, spin angle, etc.). However, these findings provide coaches and sport scientists a novel methods for analyzing pitcher fatigue for foundational training and in-game pitch count/throwing volumes.

Introduction

Job of Sport Scientists:
- Optimal physiological adaptations,
- Ideal performance readiness,
- Mitigate injury potential

Internal/External Stress Monitoring Systems:
- Perceived recovery status (PRS) scale (Internal & subjective)
- Grip Strength (GS) (External & Objective)
- Deliver a global perspective of physiological readiness.

Grip Strength
- Flexor carpi ulnaris muscle
  - minimizing medial condyle separation,
  - ulnar collateral ligament stress, and
  - ulnar nerve irritation.

Perceived Recovery Status
- Valid subjective predictor of performances during intermittent training modes (i.e., sprints, resistance training, etc.).
- Perceived fatigue is shown to significantly increase as pitchers progress through innings during simulated and live gameplay.

However, no studies have examined the effect of pitching on PRS and GS of collegiate pitchers.

Purpose Statement

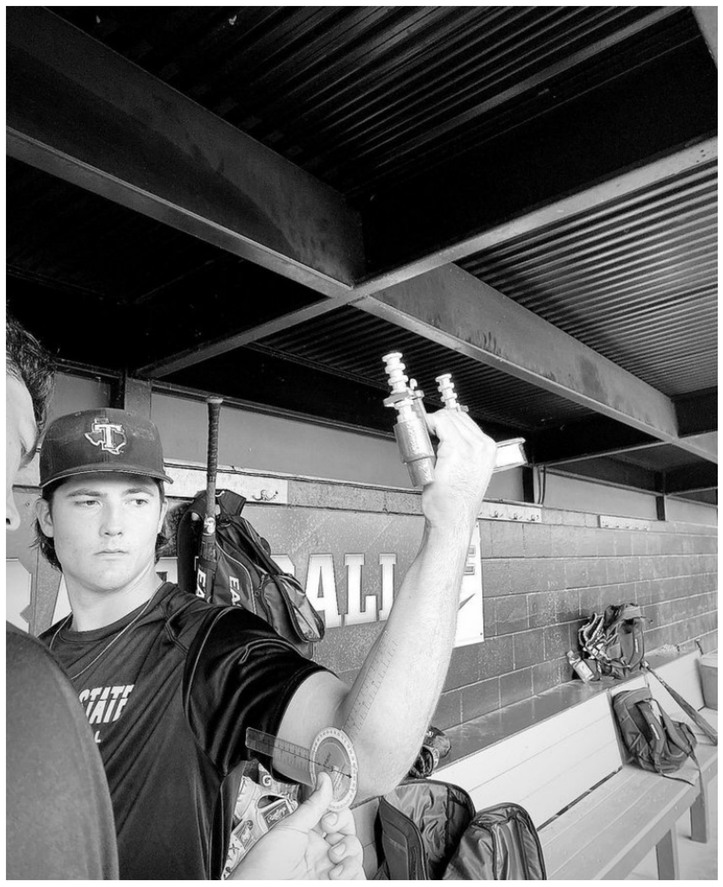
The aim of the current investigation was to identified the effect of pitching (simulated gameplay) on PRS and GS.

Methods

Participants:
- 13 Division I Baseball Pitchers
- age = 21.1 ± 1.8 yr, 183.7 ± 4.88 cm, 89.8 ± 7.21 kg

Measures:
- Anthropometrics
- Perceived Recovery Status (PRS)
- Grip Strength (GS)
- Session Rate of Perceived Exertion (sRPE)

Statistical Analysis:
- Paired Sample t-test
  - PRS
  - GS
    - Alpha $p < 0.05$
- Descriptive Statistics
  - sRPE



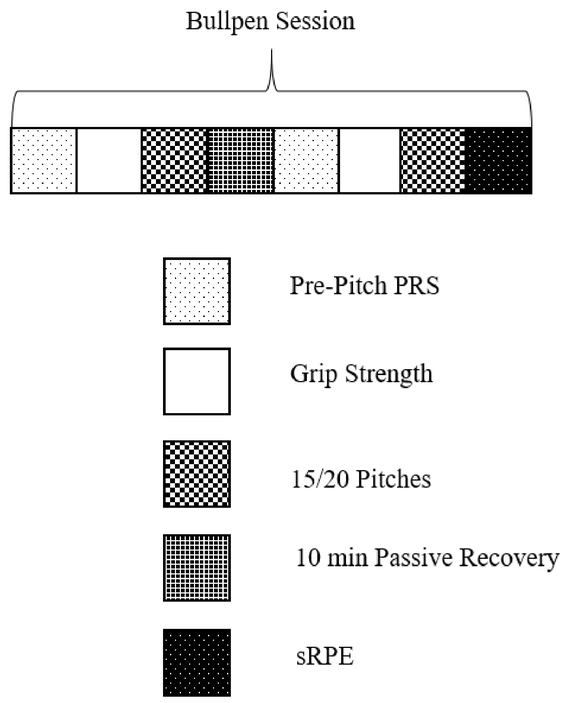
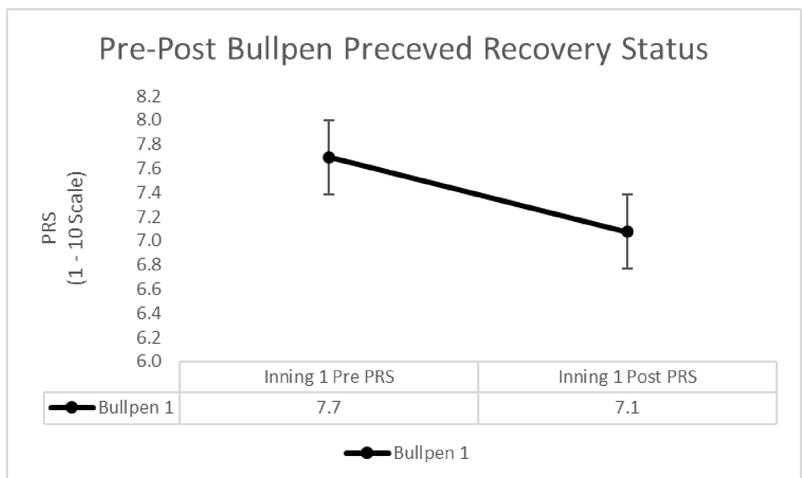
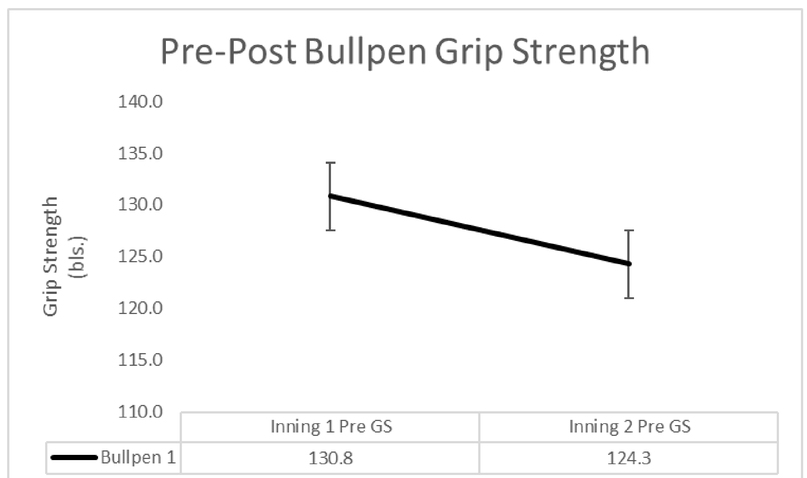


Table 2 – Schematic illustration of study protocol. PRS indicates perceived recovery status; sRPE, Session Rate of Perceived Exertion

Results

Significant differences were identified between pre- and post-test results for PRS t(12) = 2.391, p = 0.025. However, statistical significant was not realized for GS t(12) = 1.498, p = .160, with an medium effect of d = 0.32. Average Perception of difficulty (sRPE) for the administered bullpen was "fairly easy" (4.31 ± 1.25).





Discussion

These results suggest the demand/stimulus of pitching greatly affect internal (PRS) and external (GS) measure of physiological stress, showcasing promise as in-game monitoring tools.

Further research should investigate the effects across extended innings and seasonally performance.

Additionally, while PRS and GS serves as fatigue indicators, future studies are needed to develop fatigue threshold models based on pitching specific performance metrics (i.e., pitch velocity, spin rate, spin angle, etc.).

However, these findings provide coaches and sport scientists a novel methods for analyzing pitcher fatigue for foundational training and in-game pitch count/throwing volumes.

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