



The Effect of a 6-Week Weighted Ball Throwing Program on Pitching Velocity, Arm Stress, and Injury Rates

Mike Reinold, PT, DPT, SCS, CSCS






EliteBaseballPerformance.com






SABERMETRICS, SCOUTING AND THE SCIENCE OF BASEBALL

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Baseball Pitching Injuries Rising at an Alarming Rate



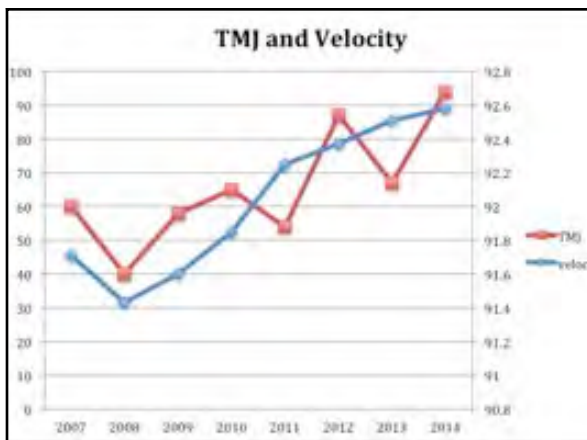



**Emphasis on Velocity**

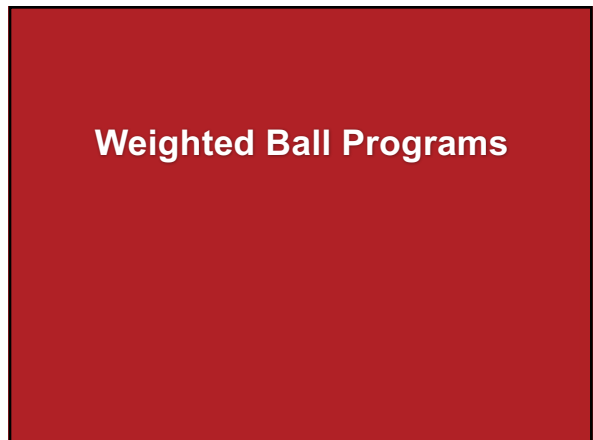


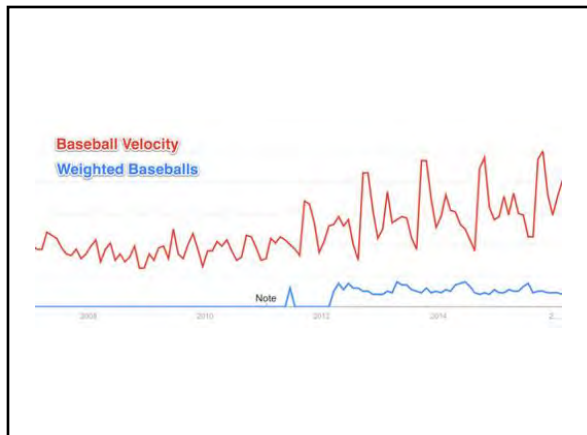
### Velocity and Elbow Stress

- Correlation between velocity and elbow stress has been shown
- High School
  - Hurd: Sports Health '12
- Professional
  - Bushnell: AJSM '10



**Training Focused on Velocity Development**





**Do Weighted Balls Work?**



- Past Studies**
- Several studies have documented a significant increase in velocity
    - DeRenne: SCJ '09
    - Escamilla: Sports Med '00
  - Balls ranging from 4 – 17 oz
    - Most common 4-6oz (20%)
  - Both under and overload effective

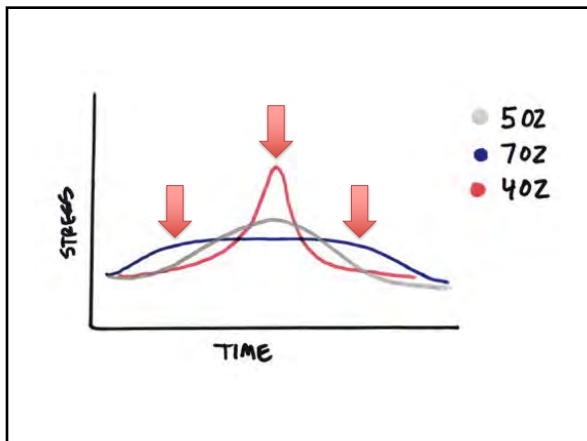
- Enhance Velocity**
- 6 weeks of dumbbells = 1.7% increase
    - Escamilla: JSCR '12
  - 4 weeks of tubing = 4% increase
    - Escamilla: JSCR '10
  - 6 weeks of plyometric drills = 2% increase
    - Escamilla: JSCR '12
  - 7 week core stability and power program = 6% increase
    - Palmer: JAT '12
  - 6 week med ball program = 14%
    - Raeder: JSCR '15
  - 18 week total body strength = 2.6%
    - Ramos Veliz: JSCR '14
  - 6 week core stability program = 4.9%
    - Saeterbakken: JSCR '11

### Problems

- WB appear effective at enhancing velo
- Do not know
  - Mechanism of velocity increase
  - Kinematic changes
  - Kinetic changes
  - Safety – short and long term
  - Dosage
    - Frequency
    - Loads 2 oz – 5 lbs
    - Duration

### Past Studies


- Fleisig et al: '16
  - Biomechanical analysis
  - 4 – 7 oz balls
  - Underload had significant increase in peak stress
  - Overload had decrease in peak stress



## Study


### Methods

- 44 male youth baseball pitchers 13-18 yo
  - WB group, control group
  - Added 10 subjects from last year
- Exclusions:
  - Current injury to the throwing arm
  - Past surgery to the throwing arm




### Methods

- Range of Motion
  - Shoulder flexion, ER/IR @ 90, h.add
  - Elbow flexion, extension
  - Forearm pronation, supination
  - Wrist flexion, extension
- Strength
  - Shoulder ER/IR @ 90, abduction, full can




### Methods

- Warm-up
  - Theraband sequence
  - 10 throws at 45', 60', 90'



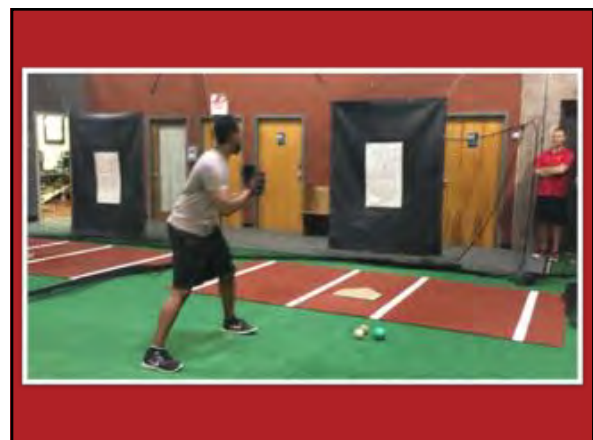
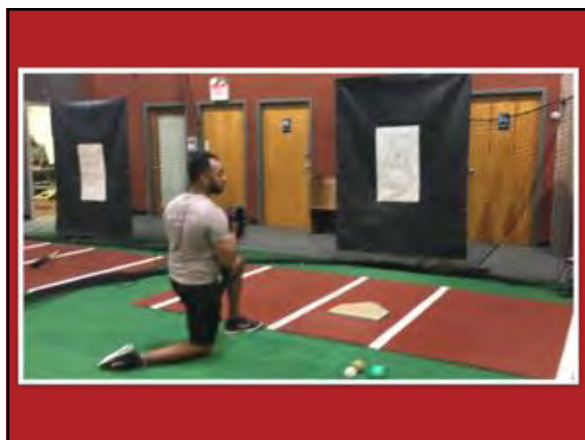
### Methods

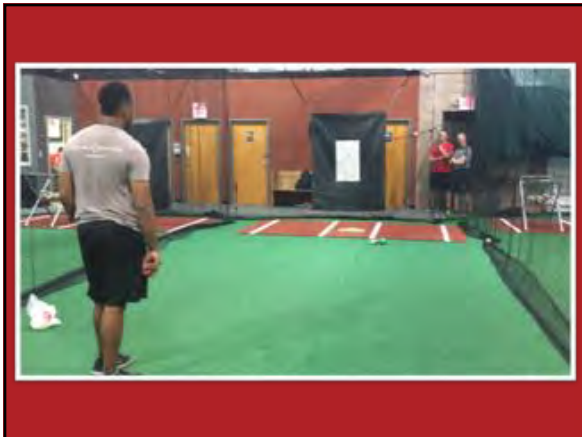
- 10 FB off mound
  - Velocity, Varus torque, Maximum shoulder IR angular velocity



### Training Program

- Weighted ball throwing program
  - 6 weeks
  - 3x per week
  - Weights of 2, 4, 6, 16, and 32 oz
- Control group
  - Only throw with standard 5 oz balls





## Gradual Ramp Up in Program

Kneeling → Rocker → Run and Gun  
Volume

	Knee	Rocker	Run & Gun	Volume
Week 1	75% x 3 each			15 throws
Week 2	90% x 3 each	75% x 3 each		30 throws
Week 3	100% x 2 each	90% x 2 each	75% x 2 each	30 throws
Week 4	100% x 2 each	100% x 2 each	90% x 3 each	35 throws
Week 5	100% x 2 each	100% x 2 each	100% x 3 each	35 throws
Week 6	100% x 2 each	100% x 2 each	100% x 3 each	35 throws

## Data Analysis

- Baseline to post-training between groups
- Two-way repeated measures ANOVA
- Post-hoc Student's t-test
- Priori significance level of 0.05

## Results

- 39/44 completed the study
  - 3 from unrelated injuries
  - 2 from elbow injury during study
  - All from WB group
- 15.3 years old, 176.8 cm, 68.3 kg
- Mean velocity 68.6 mph
- No difference between groups

## Results


- ICC
  - Velocity = 0.99 (ASMI = 0.96)
  - Valgus stress = 0.99 (ASMI = 0.99)
  - Angular velocity = 0.95 (ASMI = 0.93)
- Equally as reliable as full motion analysis

**Results**

- Velocity
  - WB group 2.3 mph increase ( $p = 0.001$ )
    - 12/15 – 80% - improved velocity (12% down)
    - Highest = 7.85 mph
  - 3.4% increase in velo
  - No difference in control group
    - 12/18 – 67% - improved velocity (14% down)
- No significant difference in valgus stress or angular velocity in either group

**Results**

- Range of Motion
  - WB group dominant ER and TRM increase of 5 degrees ( $p = 0.05$ ,  $p = 0.01$ )
    - Two injuries = + 10 deg
  - No difference in ND arm or control group



**Results**

- Strength
  - Significant increase in ER strength in control group
    - +2.73 – 13% increase

**Results**

- Injuries
  - WB group 4 injuries (24%)
    - UCL sprain
    - Tommy John Surgery
    - Olecranon stress fracture x 2
  - No injuries in control group

**What Have We Learned?**

**WB Programs Do Not Increase Arm Strength or Arm Speed**



**In Fact, May Inhibit Strength Gains**

**WB Programs are Effective at Increasing Velocity**

**But at What Cost?**

**Significant Increase in ER and TR ROM in Only 6 Weeks**



**Biomechanical Studies Have Shown ER Correlates to Velocity**

Increases Shoulder and Elbow Forces:  
Werner, AJSM '01; Werner, AJSM '08;  
Aguinaldo, AJSM '09; Keller, Ortho '15

**The Injuries We are Seeing  
are Alarming**

**2 Injured Players Gained 10  
Degrees ER**

**Are We Pushing Past our  
Physiological Limits?**

**Are We Not Really Taking a  
Break from Throwing?**

**5X**

More Likely to Get Injured for Those  
Pitching > 8 Months Per Year  
Olsen: AJSM '06

**Overuse Not Just Quantity**

**Overuse is Equation of  
Quantity and Intensity**



**We Still Don't Know The  
Appropriate Dose**



**Future Studies**

Postseason Follow Up  
Acute Changes  
Different Components

***Thank You!***

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