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# The Effect of an Upper Body Strength Program on Intercollegiate Baseball Throwing Velocity

**Tony Lachowetz, John Evon, and Jamie Pastiglione**

*Department of Movement Sciences, Springfield College, Springfield, Massachusetts 01109.*

**Reference Data**

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ABSTRACT

Twenty-two college baseball players participated in a study designed to examine the effect of upper body strength training on the velocity of a thrown baseball. The treatment group received 8 weeks of strength training while the control group received no training during the fall portion of the preseason. Throwing velocity was measured for 19 players using a radar gun. Differences in mean throwing velocity were calculated for both groups, and overall significance ($p < 0.05$) for the interaction of group means was found. Post hoc analysis showed a significantly higher mean throwing velocity for the training group following 8 weeks of strength training. The implication is that college baseball players can improve throwing velocity via a structured strength training program.

*Key Words*: performance, conditioning, sports testing

## Introduction

Throwing velocity is one of the more important determinants of success in baseball, especially among pitchers. It appears that previous research on strength and throwing velocity (2, 7, 11, 12) has focused on increasing the strength of the muscles responsible for arm acceleration, with minimal attention given to the decelerators of the arm. Since much of the research on strength and throwing velocity has failed to address the issue of proper muscle balance, the training program in the current study was designed to specifically target both the accelerators and decelerators of the throwing arm.

Players and coaches once considered weight training to be detrimental to throwing performance. However, research supports the adoption of weight training as a form of conditioning for baseball players. Pawlowski and Perrin (9) investigated the relationship between several isokinetic measures and throwing velocity for college baseball pitchers and found significant relationships between both shoulder internal and external rotation strength and throwing velocity. Also, exercise scientists have used multiple regression analysis to demonstrate the significant relationship between elbow extension strength, shoulder extension strength, shoulder flexion strength, and throwing speed (10).

Strength continues to play an important role in athletic performance. Heusner and Van Huss (5) and Heusner (4) referred to strength as an effective force provided by the musculoskeletal system. Baseball players, after proper strength training, combine that effective force with neural adaptations to improve skills such as throwing (3). Thus the purpose of this study was to examine whether an upper body strength training program would increase the throwing velocity of college baseball players.

## Methods

### *Subjects and Equipment*

Twenty-two college baseball pitchers and position players, 18 to 22 years of age, volunteered to participate in the study as part of a fall preseason conditioning program. Twelve players were randomly assigned to the treatment group and 10 to the control group. Procedures for the study were explained and informed consent was obtained from each subject.

Equipment and facilities needed for the study included five Wilson A1001 NCAA baseballs, a hand-held Sports Radar (model 8100) radar gun manufactured by Midex, Cybex and Nautilus weight training equipment, free weights, and the Springfield College indoor baseball facility as well as its weight training facility. The baseball facility was the site for pre- and posttest measures of throwing velocity.

### *Measurement Instrument*

Maximum throwing velocity was measured over a distance of 18.44 m, the distance between the pitching mound and home plate. After adequate stretching and warm-up, each player was allowed 5 pitches at maximum effort with a 20- to 30-sec rest between pitches. Velocity was measured with the Sports radar gun just outside the netting 2 m directly behind home plate. The radar gun was calibrated immediately prior to all test sessions according to the user manual. It was held at chest height and pointed directly at the base of the pitching mound. Proper positioning of the gun ensured that the speed of the pitch was measured, not the speed of the arm throwing the ball (11). The validity of the radar gun is measured with the manufacturer setting the transmitter frequency level over a specific temperature and specific period of time. Reliability is measured according to the user manual.

### *Treatment Protocol*

The treatment group participated in an 8-week supervised upper body strength training program consisting of 11 exercises, listed below. The control group did not train.

*Mon/Thurs*

- Flat bench press (f)
- Triceps extension (n)
- Upper lat pulldown (c)
- Biceps curl (f)
- Lateral row (c)
- Shoulder press (f)

*Tues/Fri*

- Internal shoulder rotation (cp)
- External shoulder rotation (cp)
- Horizontal shoulder abduction (cp)
- Horizontal shoulder adduction (cp)
- Shoulder extension (cp)

(f = free weights; c = Cybex; n = Nautilus;
cp = Cybex cable pulley system)

Each week consisted of 4 days of training: 6 exercises on Monday and Thursday, 5 exercises on Tuesday and Friday. Proper warm-up and stretching preceded any weight training. In addition, both groups were required to adhere to a throwing program 3 times a week consisting of 15 min of long toss at a distance of approximately 76 m, and 20–25 max effort throws at a distance of 27 m.

Both groups were measured for maximum throwing velocity prior to and retested following the 8-week strength training program. Strength was measured using the 10-RM (repetition maximum) protocol for all 11 exercises during Weeks 1 and 8 for both groups in an effort to associate strength gains with increased throwing velocity. According to Braith et al. (1), the 10-RM protocol can accurately predict 1-RM strength. In order to report overall strength gains for each subject, percentage increases or decreases were added together for all 11 exercises and the total was divided by 11. As part of the post hoc data, subject compliance rates were recorded for both the strength training program and the weekly throwing prescription designed to keep the throwing arm in shape throughout the study.

The subjects, working in pairs, undertook 3 sets of 10-RM for every exercise during the 1st week, with 2 min rest between sets. In Weeks 2 through 8 the 10th repetition of the 3rd set of each exercise was immediately followed by 5 assisted repetitions. The lifter, due to "momentary muscular failure" (8), was assisted by his partner through the concentric (positive) phase of the exercise, then performed the "isolated" eccentric (negative) phase of the exercise unassisted. The weight for any exercise was increased any time the lifter could complete an 11th rep of the 3rd set without assistance.

### *Statistical Analysis*

A 2 × 2 mixed factorial ANOVA with repeated measures on test time (before and after the 8-week training program) and with independent treatment groups (experimental vs. control) was used to determine any mean differences in throwing velocity. Both groups underwent repeated testing for throwing velocity 2 times over the 8-week period. Because an overall significant *F*-ratio for the interaction of group means was found, a simple effects test was required. Statistical significance for all tests was set at $p \le 0.05$.

## Results

Three subjects were eliminated from the study due to injuries incurred outside the parameters of the strength training program. An overall significant interaction of group means was observed, $p < 0.05$. Therefore, a simple effects test was required. The results indicated that the training group had a significantly higher mean throwing velocity score than the control group at posttest. Additionally, the simple effects test showed that the training group had a significantly higher mean throwing velocity score over the pretest score (Table 1).

**Table 1**
**Statistics for Throwing Velocity (mph) for all 19 Subjects**

| Variable | Mean | ±*SD* | Min | Max |
|---|---|---|---|---|
| Training (*n*=11) | | | | |
| Pretest | 69.08 | 3.07 | 65.20 | 74.20 |
| Posttest | 70.77 | 2.36 | 68.00 | 74.00 |
| Control (*n*=8) | | | | |
| Pretest | 70.36 | 4.17 | 62.50 | 75.40 |
| Posttest | 69.31 | 3.52 | 63.00 | 74.00 |

Descriptive statistics for throwing velocity scores for each level of the independent variables are listed in Table 1. Although not statistically analyzed, strength increased 37.1% for the training group and 8.05% for the control group when averaged for percent changes in all 11 exercises. Post hoc analysis of compliance data for the training group showed average adherence rates of 64.5% to the weekly throwing schedule and 95.0% to the strength training program. Adherence rates were computed by dividing actual number of attendance days by the prescribed number of days.

## Discussion

Throwing velocity scores for both groups were similar prior to the 8-week strength training program. Following training, treatment group scores improved while control group scores declined, suggesting a causal effect between improved strength and throwing velocity. However, individual changes in throwing velocity within the training group varied considerably. Hence a post hoc analysis was conducted on subject compliance rates for the prescribed weekly throwing schedule and strength training program.

There is still disagreement today as to which form of strength training will elicit the best results for what Young and Bilby (15) refer to as speed-strength. Adaptation of the anaerobic capacity to increased high-intensity work performance has significant implications for sports that require the athlete to repeatedly generate explosive power. Yessis (13) suggests the only way to develop speed-strength is via fast explosive movements using light weights. In contrast to Yessis, Young (14) claims that training with heavy loads is effective and may even be better than light loads for developing speed-strength, as long as the contractions are done with the intent of an explosive movement. Young says that contractions emphasizing fast force production may stimulate fast-twitch muscle fibers and improve the rate of force development in trained muscles.

In the current study, the subjects in the training group were instructed to perform each muscular contraction in an explosive movement. Based on the results of the data collected, the current strength training program appeared to be effective in increasing the rate of force development. Although no specific measurements for force development were taken, the increase in ball velocity was assumed to be a direct result of greater muscular force development.

A post hoc analysis of the data on compliance suggests that those in the training group who adhered to the prescribed weekly throwing program showed greater increases in throwing velocity than those who were unwilling or unable to adhere to the throwing program. Results for the 11 members of the training group are listed in Table 2.

**Table 2**
**Individual Differences (rank) in Training Group (*N*=11)**

| Subject | % Increase in strength | Throwing velocity | Compliance rate |
|---|---|---|---|
| 1 | 48.0 (2) | +4.30 mph (2) | 85% (3) |
| 2 | 12.0 (11) | –0.20 mph (9) | 62% (7) |
| 3 | 26.5 (8) | +5.25 mph (1) | 92% (1) |
| 4 | 31.0 (6) | +3.15 mph (3) | 87% (2) |
| 5 | 27.0 (7) | –1.10 mph (10) | 42% (10) |
| 6 | 59.0 (1) | 0.00 mph (8) | 43% (9) |
| 7 | 32.0 (5) | +1.20 mph (7) | 55% (8) |
| 8 | 21.0 (9.5) | +2.20 mph (6) | 72% (5) |
| 9 | 33.0 (4) | –1.20 mph (11) | 25% (11) |
| 10 | 21.0 (9.5) | +2.60 mph (4) | 77% (4) |
| 11 | 35.0 (3) | +2.40 mph (5) | 70% (6) |

In addressing the issue of small overall increases in throwing velocity for the treatment group, one might check the findings of Newton et al. (6), who investigated the kinematics, kinetics, and neural activation of the traditional bench press performed explosively and the explosive bench throw in which the barbell was projected from the hands. The results suggested that the velocity and force curves for the throw were more similar than the press with respect to the force and velocity exhibited during throwing and jumping. The underlying reason was that no deceleration of the bar was needed during the throw as opposed to the press (6). It appears that the throw is more specific to movements typically used in sports and should be investigated further with respect to increases in throwing velocity for college baseball players.

## Practical Applications

The implication of this study is that college baseball players' throwing velocity can be effectively enhanced with proper conditioning. Unlike most other programs designed for baseball players, the current study used a progressive strength training program incorporating eccentric training. The result of the strength training—coupled with players complying with a proper throwing program—is that players can significantly improve throwing velocity. Increased strength alone may not be the key to maximizing increases in throwing velocity.

Finally, research needs to be conducted on the effect that the current training program might have on reducing pain at the medial epicondyle of the elbow and the rotator cuff portion of the shoulder. Strengthening these areas of the throwing arm with progressive strength training techniques should help reduce the pain experienced, particularly by a pitcher, following a max-effort throwing performance.

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