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CHANGES IN RUNNING SPEED IN GAME SITUATIONS DURING A SEASON OF  
MAJOR LEAGUE BASEBALL

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ABSTRACT

CHANGES IN RUNNING SPEED IN GAME SITUATIONS DURING A SEASON OF MAJOR LEAGUE BASEBALL. **Eugene Coleman, Terry L. Dupler.** JEPonline 2004;7(3):89-93. The purpose of this study was to determine how often and how hard professional baseball players run to first base during the season and whether or not they are able to maintain peak speed throughout the season. Ten professional players participated in the study. A total of 2,683 times were recorded during 162 games as players ran from home plate to first base (30 yards) in game situations. Players do not run all-out on every play. There was no significant change in speed from month to month during the 6-month season. The 90% threshold guideline recommended for maintaining speed in track does not fully apply to the sport of baseball. The main finding of this study was that running speed to first base in a subset of Major League Baseball players is maintained throughout the season.

Key Words: Sprinting, Power, Performance

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INTRODUCTION

Speed is essential for success in professional baseball. It is one of the five physical tools that professional Major League Baseball (MLB) scouting agents assess when evaluating talent (1), and the only physical tool that is used on both offense and defense. Given the importance of speed awarded by management, scouts and coaches, it is surprising that little research exists on this topic. Coleman and Lasky (2) presented pre-season normative speed data for professional baseball players by age, position and level of competition. However, no study has looked at speed during game situations to determine how often or how hard (percent of max speed) players run. Likewise, no one has attempted to assess changes in speed during the season. The purpose of this study was to answer four questions: (1) How often do MLB players run to first base during the season? (2) How hard (% of max speed) do they run? (3) How often (% of total runs) do they run at threshold intensity for speed improvement (at least 90% of max speed or faster) and/or maintenance? (4) Does peak velocity vary from month-to-month?

## METHODS

The subjects in this investigation were members of a MLB Team. Ten of the fourteen position players on the 1998 Major League roster were evaluated. No pitchers were tested. The 10 subjects accounted for 88% of the official at bats (ABs) recorded by non-pitchers during one season of MLB play. Eight of the subjects were right-handed hitters. One subject was a left-handed hitter and one was a switch hitter. All subjects participated in a non-structured running program approximately 15 min before each game. The running program consisted of a general warm-up, static stretching and a series of 20-30 meter sprints. Each player was allowed to determine how hard (intensity), how far (distance) and how many sprints he ran each day. All subjects also participated in a post-game strength-training program, 3-5 times/week.

Experience and age were computed to the nearest month using information in the MLB Green Book (3). Calibrated scales determined standing height and body weight. Skin-fold thickness was measured with a Lang skin-fold caliper using procedures described in a previous study (2). Time to first base was assessed using a hand-held Casio ((Model #H53) digital stopwatch calibrated in the metrics lab at the Johnson Space Center in Houston, Texas with an average error of less than 0.01%. All times were assessed and recorded by the same investigator. For all games, the timer was seated at field level, even with first base. Time was recorded to the nearest 0.01 second. The watch was started at bat contact and stopped when the player touched first base.

### Statistical Analyses

Changes in running performance were determined using a repeated measures analysis of variance to determine if the changes in velocity from month to month were significant. A significance level of  $p < 0.05$  was chosen to determine statistical differences. The values were expressed as Mean  $\pm$  SD.

## RESULTS

Descriptive data, age, height, weight, body composition and years of experience in professional baseball, appear in Table 1. These values are consistent with those reported for MLB players (1,4,5).

During the 162-game season, subjects put the ball in play and ran to first base 3,847 times. Time was recorded for approximately 70 percent of the runs (2,683 times). A notation was made with each measurement to indicate whether the runner ran straight to first base or rounded the base. Distance for runs straight to first base was 90 feet (27.43 m). Average distance, when the base was rounded, was 96 feet (29.26 m). Average distance, when rounding the base, was determined for each player using the equation:  $(D = (90 \times t_2)/t_1)$ ; where D = distance (feet) when the base was rounded;  $t_1$  = average peak time for 90 feet; and  $t_2$  = average peak time when the base was rounded. Average peak time was the mean of the five fastest times to first base under each condition. Time to first base was converted to velocity (fps) by dividing distance (feet) by time (seconds). Seventy-five percent of the runs were made on artificial turf, 25% on natural grass. No attempt was made to differentiate between velocity and surface type.

Table 2 illustrates how often subjects ran to first base. Table 3 shows the mean time, peak time and velocity to first base. Table 4 illustrates how often players ran at threshold intensity. Table 5 shows peak velocity and peak time from month to month.

**Table 2. Frequency with which subjects ran or failed to run to first base**

<i>Plate Appearances (PAs)</i>	<i>At Bats (ABs)</i>	<i>Total Runs to 1B</i>	<i>Timed Runs to 1B</i>	<i>Walks (BB)</i>	<i>Hit by Pitch (HBP)</i>	<i>Strikeouts (Ks)</i>
5373	4664	3847	2683	670	39	811

**Table 1. Physical Characteristics and playing experience**

<i>Variable</i>	<i>Mean</i>	<i>SD</i>
<i>Age (yr)</i>	27.67	4.45
<i>Experience (yr)</i>	9.21	5.93
<i>Height (cm)</i>	187.35	5.59
<i>Weight (kg)</i>	90.33	9.44
<i>Body fat (%)</i>	12.48	5.54

### How often do players run to first base?

The ten participants in this study made 5,373 total plate appearances (PAs) during the season (Table 2). They put the ball in play and ran to first base 3,847 times. Time was recorded for 2,683 of these runs. Subjects struck out, fouled out, walked or were hit by a pitch 1,526 times. Times were not recorded for these events. On average, participants ran to first base in 71.9% of PAs and walked back to the dugout or to first base 28.1% of the time. The average player ran to first base 2.4 times/game and 65 times/month.

**Table 3. Mean and peak time and velocity to first base.**

<i>Variable</i>	<i>Mean ± SD</i>
<i>Mean Time (sec)</i>	5.03 ± 0.98
<i>Peak Time (sec)</i>	4.30 ± 0.12
<i>Mean Velocity (m/s)</i>	5.45 ± 1.08
<i>Peak Velocity (m/s)</i>	6.38 ± 0.02

**Table 4. Frequency with which subjects ran at and below threshold value.**

	<i>Threshold Runs (&gt;90%)</i>		<i>Near-Threshold Runs (80-90%)</i>		<i>Sub-Threshold Runs (&lt;80%)</i>	
	<i>Number</i>	<i>% Total</i>	<i>Number</i>	<i>% Total</i>	<i>Number</i>	<i>% Total</i>
<i>Total Runs</i>						
<b>2683</b>	1296	49.40	873	31.80	564	19.70

**Table 5. Changes in mean peak speed and peak velocity from month to month.**

<i>Variable</i>	<i>April</i>	<i>May</i>	<i>June</i>	<i>July</i>	<i>August</i>	<i>Sept.</i>
<i>Speed (sec)</i>	4.33 ± 0.16	4.30 ± 0.14	4.31 ± 0.12	4.31 ± 0.13	4.32 ± 0.14	4.33 ± 0.15
<i>Velocity (m/s)</i>	6.34 ± 0.20	6.38 ± 0.19	6.37 ± 0.19	6.37 ± 0.19	6.35 ± 0.19	6.34 ± 0.20

### How hard do players run?

Peak velocity was determined by computing the mean of the best five times for each player. The typical player ran to first base at 84.1% of peak velocity. Average velocity was determined by computing the mean of 2,683 timed runs to first base. Average velocity was 5.45 m/sec; average peak velocity was 6.38 m/sec. Average time to first base was 5.03 sec. Average peak time to first was 4.30 sec. Average and peak times (Table 3) were comparable to the those recorded for other MLB players (2).

### How often do players run at threshold intensity?

According to authorities in speed training, the threshold for the development and maintenance of running speed is 90% of peak velocity (7,8). Authorities in track contend that athletes who train at less than 90% of max velocity are working on something other than speed (7,8). The data in Table 4 indicate that the players in this study ran at threshold intensity less than 50% of the time. Approximately 32% of the runs were at near-threshold level (80-89%) and 20% were at less than 80% effort. The average player ran at threshold intensity slightly less than 1.2 times/game and 30-35 times/month.

### Does peak velocity change from month-to-month?

The data in Table 5 indicate that, although there were differences in speed and velocity from month to month, these differences were not significant. Data indicate that peak speed and velocity were the slowest in the first and last month of the season and highest in mid-season.

## DISCUSSION

The results clearly show that most players don't run all-out on every play. Second, the running that players do before and during games is sufficient to maintain speed from game 1 to game 162. Third, the 90% threshold guideline recommended for maintaining speed in track does not fully apply to the sport of baseball. Speed in track usually refers to top speed and top speed is usually attained after running 50-60 meters. In baseball, most players seldom run 50-60 meters in game situations and top speed is rarely achieved. Baseball is a game of acceleration, not top speed.

The findings of this investigation were inconsistent with those observed by college football and basketball players (9, 10). The duration of the season, number of games played and opportunities for training by the

subjects in this study, however, were significantly greater than those experienced by the collegiate players. The football players (9) practiced for 10 weeks and participated in 10 games. The basketball players (10) practiced for 20 weeks and participated in 40 games. In contrast, the baseball season was 26 weeks in duration and the subjects played 162 games in 180 days.

It is also important to note that running in game situations is not limited to runs to first base. Players have several opportunities to run both while on offense and defense. Offensive opportunities include running out base hits and errors, taking primary and secondary leads, going base to base, stealing bases, hit and run attempts, passed balls/wild pitches and run downs. Defensive opportunities include making routine plays, fielding balls in the gaps, backing up bases, getting in position for cut-off and relay plays, covering bases and participating in run downs. The length of the season, number of games played and game-related movements allow players ample opportunities to work at a level sufficient to maintain running speed.

## **CONCLUSIONS**

The information obtained in this study has several practical applications. First, coaches can compare times recorded during spring training to evaluate the effectiveness of the pre-season running program. If speed does not improve from week to week, the program can be adjusted to ensure that players get enough quality running prior to the start of the season. Second, coaches can compare times recorded during the season to determine the effectiveness of the in-season running program. If speed is not maintained from week to week and month to month, adjustments can be made to ensure that players can run as fast at the end of the season as at the beginning.

Third, coaches can use the data to determine if players are maintaining speed during the season and to motivate them to run harder in game situations and/or make adjustments in the pre-game running program. Data can be plotted week-to-week and month-to-month to show players how often they run at max or near-max velocity. If a player goes 3-4 days without achieving near-max velocity, the coach can encourage him to run harder in pre-game drills and in game situations. Likewise, if velocity decreases from month-to-month, coaches can encourage players to increase the intensity of their pre-game workouts.

Fourth, the data can be used for player evaluation. Some teams routinely time players during spring drills at 30 and 60-yard intervals. These data are useful, but the times are artificial. Players, who run good times in a speed test, don't always run as fast in game situations. Game times are more valid than speed tests because they tell coaches how fast a player is when it counts, in game situations. Timing players during games also reduces the potential risk of injury associated with time trials. The data can also be used to determine how close to full-speed a player has returned following an injury and indicate if a player is slowing down from season to season.

Finally, the data can be used in player development. Coaches can compare the times recorded on minor league players to those obtained at the Major League level to show a player how he compares to other players who play the same position and to prescribe appropriate developmental drills.

Running times are easy to obtain and provide a valid index of running performance in game situations. Players and management are receptive to the data collected. The data provide the coach and player an accurate and reproducible index of effort and performance. It can be used to help motivate players to give better effort, more often because players tend to put forth more effort when they know that they are being timed. Game times can also be used to help determine when a player has fully returned from an injury.

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