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## Sports Physiology

### DIFFERENCES IN RUNNING SPEED AMONG MAJOR LEAGUE BASEBALL PLAYERS IN GAME SITUATIONS

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#### ABSTRACT

**Coleman AU, Dupler TL.** Differences in Running Speed Among Major League Baseball Players in Game Situations. *JEPonline* 2005;8(2):10-15. The purpose of this study was four-fold. First, to determine how fast professional baseball players run to first base in game situations. Second to determine if there was a significant difference in speed between RHB and LHB. Third, to determine if there was a significant difference in speed among different positions. Fourth, to determine if speed was related to age, height, weight and playing experience. Three hundred and sixteen professional players participated in the study. A total of 1,580 times were recorded during 486 games as players ran from home plate to first base (30 yards) in game situations. The average MLB player ran to first base in  $4.32 \pm 0.17$  s. There was no significant difference in the mean time to run to first base between RHB and LHB. Mean time for RHB was  $4.35 \pm 0.15$  s. Mean time for LHB was  $4.31 \pm 0.18$  s. Significant differences in speed existed among positions. The faster players played in the middle of the field (CF, SS and 2B), the slower players occupied the corner positions and were catchers. Speed was independent of age, experience, height and weight.

**Key Words:** Sprinting, Power, Performance, Baseball

#### INTRODUCTION

Running speed is essential for success in professional baseball. It is one of the five physical tools that pro scouts assess when evaluating talent (1), and the only physical tool that is used on both offense and defense. Given the importance of running 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. Coleman and Dupler (3) quantified and qualified speed among Major

League Baseball (MLB) players and determined that the running that players do in game situations is sufficient to maintain speed throughout the season. No study, however, has attempted to qualify speed among MLB players in game situations. Likewise, no data exist with which to compare right and left-handed batters or to compare speed by position.

This study was designed to answer four questions concerning running speed in MLB players: 1) What is the average time that it takes MLB players to run from home plate to first base in game situations? 2) Is there a significant difference in time between right (RHB) and left (LHB) handed batters? 3) Are there significant differences in time among positions? 4) What are the effects of age and playing experience on time?

## METHODS

The subjects in this investigation were 316 Major League Baseball players representing 25 teams, 9 American League and 16 National League, during the 2000-2002 seasons. No pitchers were tested. One hundred and seventy-five (175) players were right handed batters (RHB), 92 were left handed batters (LHB) and 49 were switch hitters. All positions were represented; 43 catchers, 126 infielders, 111 outfielders and 36 utility players. The 316 players evaluated in this study represented approximately 70% of the 450 position players on active rosters of the 30 MLB teams during the three seasons examined.

Time to first base was assessed using a hand-held Casio (Model #H53) digital stopwatch calibrated using methods recommended by the metrics lab at the Johnson Space Center in Houston, Texas with an average error of less than 0.01% (4). Times were recorded for both home and visiting teams during 486 MLB games over a three-year period (2000-2002). All times were assessed and recorded by the same investigator who was seated at field level even with first base. Time was recorded to the nearest 0.01 s. The watch was started at bat contact and stopped when the player touched first base.

### Statistical Analyses

Differences in running performance were determined using an analysis of variance to determine if the differences in velocity recorded between RHB and LHB and among positions were significant. A significance level of 0.05 was chosen to determine differences. The values were expressed as Mean $\pm$ SD. Significance was accepted at  $p < 0.05$  and assessed with a Tukey HSD Post Hoc test.

## RESULTS

Descriptive data for all subjects, age, height, weight, and years of experience in professional baseball, appear in Table 1. These values are consistent with those reported for MLB players (1,3,6).

Table 2 compares descriptive data by position and batting preference.

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

<i>Variable</i>	<i>Mean<math>\pm</math>SD</i>
<i>Age (yr)</i>	29.24 $\pm$ 4.15
<i>Experience (yr)</i>	6.82 $\pm$ 4.12
<i>Height (cm)</i>	184.43 $\pm$ 5.14
<i>Weight (kg)</i>	91.41 $\pm$ 10.11

No significant differences were observed between RHB and LHB. Significant differences in age, weight and experience were observed among positions. Catchers, first and third basemen, right fielders and utility players were significantly older than other positions. Catchers, first basemen, right fielders and utility infielders had significantly more playing experience than other positions. Middle infielders (SS and 2B) and utility infielders were significantly shorter than other positions. First basemen and catchers were significantly heavier than all other positions. Middle infielders were significantly lighter than other positions.

**Table 2. Physical characteristics and playing experience by position and batting preference.**

<i>Position</i>	<i>N</i>	<i>Age (yr)</i>	<i>Experience (yr)</i>	<i>Height (cm)</i>	<i>Weight (kg)</i>
<i>RHB</i>	175	29.22±4.12	6.87±4.02	184.68±5.11	91.89±10.80
<i>LHB</i>	92	29.54±4.42	6.98±4.36	185.01±5.38	91.90±9.05
<i>Switch</i>	49	28.71±3.77	6.31±3.62	182.42±5.74	88.73±9.19
<i>Catcher</i>	43	29.84±3.18	7.00±3.51	185.29±4.78	96.40±7.28
<i>1B</i>	33	30.55±4.57	8.35±4.51	189.43±5.16	100.07±10.52*
<i>2B</i>	31	28.40±4.48	6.34±4.21	181.58±4.42	86.35±5.66
<i>3B</i>	29	29.00±4.45	6.68±4.12	185.42±4.27	94.33±8.29
<i>SS</i>	33	28.51±4.11	6.63±3.68	182.22±4.32	81.30±13.82
<i>LF</i>	36	28.73±4.19	6.48±4.28	184.79±6.45	92.66±8.47
<i>CF</i>	45	27.32±3.39	5.34±3.56	184.56±4.32	90.72±7.26
<i>RF</i>	30	30.50±4.83	8.43±4.73	184.79±5.33	93.02±8.45
<i>U IF</i>	16	31.96±3.17	7.96±3.38	182.04±4.95	88.67±6.49
<i>U OF</i>	20	29.08±3.26	4.83±3.66	183.31±5.61	89.24±10.12

\*Significant at  $p < 0.05$  level

**Table 3. Average running time for RHB and LHB**

<i>Batters</i>	<i>N</i>	<i>Time (s)</i>
<i>RHB</i>	224*	4.35±0.15
<i>LHB</i>	141*	4.31±0.17
<i>All</i>	365*	4.33±0.15

\*Includes switch hitters

Mean times for RHB and LHB are presented in Table 3. For analysis purposes, the times used were those recorded on balls hit to infielders in which the batter had to run at max speed. At least 5 times were recorded for each player. The criterion score for each

subject was the average of his three fastest times. Time to first base was converted to velocity (fps) by dividing distance (ft) by time (s). Ninety percent of the runs were made on natural grass, 10% on artificial turf. No attempt was made to differentiate between velocity and surface type.

The average MLB player ran to first base in  $4.33 \pm 0.17$  s. There was no significant difference in time base between RHB and LHB. Mean time for RHB was  $4.35 \pm 0.15$  s. Mean time for LHB was  $4.31 \pm 0.18$  s. While these times were not significantly different, they might be meaningful. Converting time to velocity indicates that the average LHB reached first base approximately 10 inches ahead of the average RHB. Given the fact that the difference between being safe and out is often a step or less, reaching first base with as little as 10 inches lead over other runners might be very meaningful in game situations.

**Table 4. Ranking of time by position, fastest to slowest.**

<i>Position</i>	<i>N</i>	<i>Time (s)</i>	<i>Velocity (fps)</i>
<i>CF</i>	44	4.16±0.14	21.63
<i>SS</i>	25	4.26±0.13	21.13
<i>2B</i>	35	4.27±0.14	21.08
<i>RF</i>	28	4.29±0.16	20.96
<i>LF</i>	39	4.30±0.14	20.94
<i>U OF</i>	12	4.30±0.15	20.91
<i>U IF</i>	24	4.32±0.12	20.83
<i>3B</i>	35	4.39±0.13	20.45
<i>Catcher</i>	43	4.48±0.11	20.11
<i>1B</i>	31	4.50±0.12	20.02
<i>All</i>	316	4.32±0.17	20.81

**Table 5. Distance (ft) from 1B among positions.**

Position	Catcher	1B	2B	SS	3B	LF	CF	RF	U IF	U OF
<b>Catcher</b>	0.00	0.39	4.44*	4.66*	1.62	3.81*	6.82*	3.80*	3.23*	3.59*
<b>1B</b>	0.39	0.00	4.86*	5.09*	1.93	4.23*	7.24*	4.20*	3.63*	3.99*
<b>2B</b>	-4.34*	-4.75*	0.00	0.23	-2.68	-0.59	2.36*	-0.52	-1.06	-0.72
<b>SS</b>	-4.56*	-4.97*	-0.19	0.00	-2.88*	-0.80	2.15*	-0.73	-1.27	-0.92
<b>3B</b>	-1.55	-1.95	2.75*	2.97*	0.00	2.14	5.18*	2.21	1.65	2.00
<b>LF</b>	-3.74*	-4.14*	0.64	0.86	-2.11	0.00	2.96*	0.06	-0.49	-0.14
<b>CF</b>	-6.82*	-7.24*	-2.31*	-2.10*	-4.91*	-2.87*	0.00	-2.81*	-3.33*	-3.00*
<b>RF</b>	-3.80*	-4.20*	0.43	0.65	-2.18	-0.08	2.90*	0.00	-0.55	-0.20
<b>U IF</b>	-3.23*	-3.63*	1.06	1.28	-1.64	0.48	3.46*	0.55	0.00	0.35
<b>U OF</b>	-3.59*	-3.99*	0.64	0.86	-1.98	.04	3.10*	0.20	-0.35	0.00

\*Significant at the  $p < 0.05$  level; Positive values mean ahead.

Table 4 presents a ranking of time by position from fastest to slowest. The fastest positions were center field (CF), shortstop (SS) and second base (2B). The slowest were catcher (C) and first base (1B). These rankings are consistent with the theories of pro scouts who contend that the fastest players should occupy the positions in the middle of the field and the slower players should be located behind home plate and on the corners (1).

**Table 6. Correlation matrix for time, age, experience, height and weight.**

	Age	Exp	Height	Weight	Time1
Age	1.000				
Exp	0.842	1.000			
Height	-0.082	-0.017	1.000		
Weight	0.037	0.056	0.574	1.000	
Time1	0.181	0.160	0.334	0.381	1.000

Differences in time among positions were significant for several positions (Table 5). Center fielders were significantly faster than all other positions. Shortstops were significantly faster than all other positions, except CF and 2B. Second base was significant faster than all other positions, except CF and left field (LF). Third base (3B) was significantly slower than the three fastest positions (CF, SS and 2B). There were no significant differences between 3B and all other positions. Left field, right field (RF) and utility players (infielders and outfielders) were significantly slower than CF and significantly faster than catcher and 3B. There were no significant differences between these four positions and all other positions.

Table 5 contains distance data that indicate how far ahead or behind (feet) players at one position are that reach first base compared to players at another position. While many of these differences are not significant, they might be meaningful in game situations. The differences between SS and RF, for example, while not significant might be meaningful because the higher mean velocity of SS cause them to reach base ahead (0.65 feet or 7.8 inches) than RF.

The information in Table 6 indicates that age, height, weight and playing experience were not significantly related to the time required to run to first base. While height and weight might have a small, negative relationships with time, i.e., taller, heavier players were slower, age and experience had virtually no relationship to time. These findings were inconsistent with those observed by Coleman and Laskey (2). The current study, however, examined a relatively homogenous group consisting only of players at the Major League level. The previous study compared MLB players to minor league players who tended to be younger, lighter, less experienced and a shorter history of game-related injury.

## DISCUSSION

The results indicate that the average MLB player runs to first base in  $4.32 \pm 0.15$  seconds and that, although LHB reach base sooner than RHB, these differences are not significant. While these differences are not significant, they might be meaningful. Baseball is a game of speed with the difference between making a defensive play and/or reaching base safely is often a matter of inches. The fact that LHB reaches base approximately 10 inches ahead of RHB places added stress on the defensive player and provides a slight edge to the runner on close plays.

The data also indicate that significant differences exist among positions. In general, the fastest players are those who play the positions located in the center of the field (CF, SS and 2B). These individuals need to be fast because they have more ground to cover on defense. They also tend to bat earlier in the line-up so that their speed can be used get on base so that the slower, more powerful players can drive them in. Slower players play behind the plate (catcher) and the corner positions (1B, 3B, LF and RF). These positions have less ground to cover on defense, tend to be heavier and are selected more for their muscular power, ability to hit for average and drive in runs than for their speed and defense (1).

Finally, the data indicate that that age, height, weight and playing experience were not significantly correlated to speed. While height and weight might have a small negative relationship with speed (i.e., taller, heavier players were slower), age and experience had virtually no relationship to time.

## CONCLUSIONS

The information obtained in this study has several practical applications. First, it can be used in the selection and positioning of players. Coaches and scouts can use the data to help quantify speed when evaluating amateur and pro players. They can also use it to help determine the optimal position(s) for players. Players with exceptional speed can be encouraged to play in the middle of the field. Those with less speed can be asked to catch or try one of the corner positions.

Coaches can also use the data to determine if players are maintaining speed from month- -to-month and year-to-year. If speed decreases, players can be asked to participate in a speed-training program and/or move to a position that requires less speed. By comparing baseline times to post-rehab times, the data can also be used to determine how close an injured player is to returning to full-speed.

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.

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