Relationships between Strength, Power, and Sprint Performance in High School Softball Players

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ABSTRACT

High school strength and conditioning (S&C) programs tend to focus on improving strength, power, and speed in athletes. Program prescription to increase muscular strength and power is given with the goal of translating these improvements into sport-specific speed. Previous research has shown conflicting relationships between measures of strength and speed in different athletic populations There has been limited analyses of the relationships between strength, power, and sprint performance in high school softball players. Better understanding relationships between strength, power, and running speed in these players could help improve athletic performance by providing guidance on what to include in their S&C programs. **PURPOSE:** To determine the relationships between linear speed, lower-body strength, and lower-body power in high school softball players. **METHODS:** Analysis was conducted on data collected from 34 high school softball players prior to participation in a S&C training program. The data recorded for each player included: age, height, and body mass; 9.14-m (10-yard) and 18.29-m (20-yard) sprint times; standing broad jump (SBJ) distance (lower-body power); and absolute and relative 3-repetition maximum (3RM) front squat and trap bar deadlift (lower-body strength). Pearson's correlations ($p< 0.05$) were conducted to derive the relationships between data recorded, with a specific focus on linear speed. **RESULTS:** Significant, strong correlations were found for the 9.14-m sprint and SBJ (r=-0.778, p<0.001), and the 18.29-m sprint and SBJ (r=-0.772, p<.001). There was a moderate correlation between the 18.29-m sprint and relative 3RM trap bar deadlift (r=-0.349, p=0.043). There were no significant correlations between absolute strength measures and sprint times. **CONCLUSIONS:** The nature of softball includes utilizing bouts of explosive power. The significant negative correlations between sprint times and SBJ show the positive effects of higher lower-body power in relation to faster (i.e. lower) speed times. The correlation between relative strength of 3RM trap bar deadlift and speed suggests higher amounts of relative lower-body strength could contribute to better acceleration and top-end speed. The lack of significant relationships between absolute strength measures and sprint times may suggest some limitations in this quality for high school softball players. Strength training may not be implemented for most female athletes in softball especially if there is a higher importance placed on speed and power. It is possible the coaches of the softball players from this sample could focus on maximal strength development in future programs. This may subsequently be expressed in the powerful and explosive demands of the sport. **PRACTICAL APPLICATIONS:** The significant correlations between sprint times and SBJ and sprint times and relative 3RM deadlift could better guide coaches to emphasize lower-body power and lower-body strength development in their S&C programs. This could potentially contribute to improvements in sprint performance for high school softball players. It is important to note that correlation strength between the variables in this study may change based on other factors such as age, level of athlete, and overall training experience. Further research analyzing longitudinal data may determine whether there are causative relationships between enhancing lower-body power and relative strength with linear speed.

INTRODUCTION

- High school strength and conditioning programs tend to focus on improving strength, power, and speed in athletes (2, 3). Having a certified strength and conditioning coach professional on staff in high schools is often viewed as a bonus or perk (2), which can often lead to high school athletes obtaining strength and conditioning programming from private training facilities not offered on campus.
- Program prescription to increase muscular strength and power is given with the goal of translating these improvements into sport-specific speed (2, 3). Previous research has shown conflicting relationships between measures of strength and speed in different athletic populations (1, 3, 4, 5).
- There has been limited analyses of the relationships between strength, power, and sprint performance in high school softball players. Better understanding relationships between strength, power, and running speed in these players could help improve athletic performance by providing guidance on what to include in their strength and conditioning programs.
- The purpose of this study was to determine the relationships between linear speed, lower-body strength, and lower-body power in high school softball players.

METHODS

- Retrospective analysis was conducted on data collected from 34 high school softball players (age: 14.91 ± 1.00 years, height: 1.66 ± 0.69 m, body mass: 63.21 ± 9.59 kg) prior to participation in a strength and conditioning training program.
- All testing was conducted on-site at a private sport strength and conditioning training facility, off-campus, where athletes were attending training sessions regularly.
- The data recorded for each player included: age, height, and body mass; 9.14-m (10-yard) and 18.29-m (20-yard) sprint times; standing broad jump (SBJ) distance (lower-body power); and absolute and relative 3-repetition maximum (3RM) front squat and trap bar deadlift (lower-body strength).
- Pearson's correlations were conducted to derive the relationships between the data recorded, with a specific focus on linear speed: (e.g. the 9.14-m and 18.29-m sprint times with the measures of strength and power (p<0.05)).

RESULTS

- Descriptive data is shown in Table 1.
- Significant, strong correlations were found for the 9.14-m sprint and SBJ, and the 18.29-m sprint and SBJ, as shown in Table 2.
- There was a moderate correlation between the 18.29-m sprint and relative 3RM trap bar deadlift (Table 2).
- There were no significant correlations between absolute strength measures and 9.14-m and 18.29-m sprint times.

Table 1. Descriptive data for 34 high school softball players including age, height, body mass, standing broad jump, 3RM front squat, 3RM trap bar deadlift (DL), 9.14-m sprint, and 18.29-m sprint.

	Mean ± SD
Age	14.91 ± 1.00
Height (m)	1.66 ± 0.69
Body Mass (kg)	63.21 ± 9.59
SBJ (m)	1.94 ± 0.17
Absolute 3RM Front Squat (kg)	66.30 ± 11.67
Relative 3RM Front Squat (kg/body mass)	1.06 ± 0.19
Absolute 3RM Trap Bar DL (kg)	100.59 ± 20.27
Relative 3RM Trap Bar DL (kg/body mass)	1.60 ± 0.24
10-yard Sprint (s)	1.82 ± 0.08
20-yard Sprint (s)	3.12 ± 0.14

Table 2. Correlations between the 9.14-m and 18.29-m with standing broad jump, absolute and relative 3RM front squat and 3RM trap bar deadlift in high school softball players (N = 34).

	9.14-m Sprint		18.29-m Sprint	
	p	r	*p*	r
Standing Broad Jump	<0.001	-0.778*	<0.001	-0.772*
Absolute 3RM Front Squat	0.103	-0.284	0.071	-0.314
Relative 3RM Front Squat	0.245	-0.205	0.113	-0.276
Absolute 3RM Trap Bar DL	0.077	-0.308	0.110	-0.279
Relative 3RM Trap Bar DL	0.066	-0.318	0.043	-0.349*

* Significant (p < 0.05) relationships between the variables.

CONCLUSIONS

- The nature of softball includes utilizing bouts of explosive power for sport-specific tasks. The sport-specific requirements of softball can, in turn, dictate training programs prescribed to its athletes.
- The significant negative correlations between sprint times and SBJ show the positive effects of higher lower-body power in relation to faster (i.e., lower) sprint times.
- The correlation between relative strength measured by the 3RM trap bar deadlift and sprinting speed suggests higher relative lower-body strength could contribute to better acceleration and top-end speed in high school girls softball athletes.
- The lack of significant relationships between absolute strength measures and sprint times may suggest some limitations in this quality for high school softball players.
- Strength training may not be implemented for most female athletes in softball especially if there is a higher importance placed on speed and power. It is possible the coaches of the softball players from this sample could focus on maximal strength development in future programs. This may subsequently be expressed in the powerful and explosive demands of the sport.

PRACTICAL APPLICATIONS

- The significant correlations between sprint times and SBJ, and sprint times and relative 3RM trap bar deadlift, could better guide coaches to emphasize lower-body power and relative lower-body strength development in their strength and conditioning programs. This could potentially contribute to improvements in sprint performance for high school softball players.
- It is important to note that correlation strength between the variables in this study may change based on other factors such as age, level of athlete, and overall training experience (3).
- Further research analyzing longitudinal data may determine whether there are causative relationships between enhancing lower-body power and relative strength with linear speed.

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