THE EFFECT OF FALL AND SPRING COMPETITIVE SEASONS ON BODY COMPOSITION AND PERFORMANCE VARIABLES IN NCAA DIVISION I BASEBALL PLAYERS

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INTRODUCTION: Prior to the 1980's the use of resistance training to improve baseball performance was considered taboo as coaches feared players that became "muscle bound" would lose agility and speed. To the contrary, significant relationships between increasing body mass indexes and offensive performance have been recorded in professional baseball players since 1980 (Crotin, Forsythe, Karakolis, & Bhan, 2014). Methods that increase lower body strength and improve body composition are associated with improved sprinting and jumping abilities in collegiate athletes (Macdonald et al., 2013; Seitz, Reyes, Tran, Saez de Villarreal, & Haff, 2014). Specific to baseball, lean body mass, power, and strength are all positively associated with greater bat velocity in NCAA baseball players (Reyes, Dickin, Dolny, & Crusat, 2010; Szymanski, DeRenne, & Spaniol, 2009).

Despite the widespread use of periodized resistance training to increase performance (Szymanski et al., 2009), little is known about seasonal variations in collegiate baseball players. Factors that may influence changes in body composition or performance-related variables include differences in training variables (frequency, intensity, volume) as part of the annual training plan between the fall and spring seasons, travel required for competition during the spring season, and access to nutritious foods during frequent road trips. The purpose of this study is to investigate seasonal variations in body composition and offseason variations in performance-related variables.

METHODS: Thirty eight male Division I NCAA baseball players (position players: n = 19; pitchers: n = 19) ranging from 18-21 years old were recruited from Coastal Carolina University at the start of off-season training camp. All subjects read and signed informed consent documents approved by the University Institutional Review Board.

Body Composition was determined by air displacement plethysmography (BodPod, Cosmed, USA) according to manufacturer specifications at four time points correlating to start of the fall season (T1), end of the fall season (T2), start of spring training (T3), and end of the spring season (T4). Body mass (BM), fat mass (FM), fat-free mass (FFM), and percentage of fat mass (%FM) were recorded. Performance variables were measured at four time points separated by approximately 1 month during the fall season: September (T1), October (T1A), November (T1B), and December (T2). Performance testing was carried out on two separate days separated by 48 hours. All subjects performed a standardized warmup protocol prior to each testing sessions and at least 10 min of rest was provided between testing conditions.

Day 1: *Agility* was measured first with the 5-10-5 m shuttle. Subjects were provided at least 5-min rest between attempts, and the best of two was recorded. *Sprint* times were measured second with photo-cells placed at the start and finish of either the 60 m sprint (position players) or the 10 m sprint (pitchers). All sprint attempts began with the subject in a two point stance, were separated by at least 5-min of rest, and the best of two attempts was recorded.

Day 2: *Vertical jump* was determined first by performance of a countermovement jump (CMJ) as assessed by Just Jump! Mat (Probotics Inc.: Huntsville, AL). The best of the three trials separated by at least 2-min was recorded as vertical jump height. *Horizontal jump* was measured second by performance of a countermovement 2-foot forward leap on a carpeted long jump mat. Measurements were taken where the heels contacted the mat, were separated by at least 5-min rest, and the best of two attempts were recorded. *Back squat 1 RM* was measured third according to NSCA guidelines. Subjects were required to reach parallel for the attempt to be considered successful, all attempts were separated by at least 3-min rest, and 1 RM determination was made within 5 attempts.

Nine 2 x 4 (position x time) RMANOVAs were used to analyze changes in body composition and performance-variables. The normality of the data was checked and subsequently confirmed with the Shapiro-Wilk test. For all measured variables, the estimated sphericity was verified according to Mauchly's W test, and the Greenhouse–Geisser correction was used when necessary. When a significant interaction was found Fisher's LSD post hoc was used for specific pairwise comparisons. Changes in performance and body-composition variables between time points 1 and 2 were calculated and relationships between these variables were analyzed with Pearson correlations. Statistical significance was set at $p \leq 0.05$ and the data were analyzed using the Statistical Package for Social Sciences 22.0.

RESULTS: A total of 60 games were played by during the season. Of those 60 games, 33 were played at home and 27 were played on the road. Significant differences were found for position players and pitchers for body composition and performance-variables (Table 1 and 2). Significant correlations in changes in body composition variables were found for position players between body mass, body fat % (r = .706), and fat mass (r = .744); body fat, fat mass (r = .996), and lean body mass (r = -.546); and fat mass and lean body mass (r = -.502). Significant correlations for changes in body composition variables were found for pitchers between body mass, fat mass (r = .518), and lean body mass (r = .655); body fat %, fat mass (r = .974), and vertical jump (r = .585); and fat mass and vertical jump (r = .594).

Table 1: Changes (mean ± SD) in body composition variables over the fall and spring seasons in college baseball position players (n=19) and pitchers (n=19)

		Time 1	**Time 2**	**Time 3**	**Time 4**	**ES**	**1-β**
BM (kg)	Position	82.7 ± 1.7	84.5 ± 1.6 [a]	84.4 ± 1.9 [a]	83.4 ± 2.0	.277	.947
	Pitcher	82.7 ± 2.0	83.2 ± 2.2	84.4 ± 2.2 [a]	81.5 ± 2.3 [c]	.339	.959
BF %	Position	12.5 ± .88	12.4 ± .81	12.6 ± 0.9	12.5 ± 0.8	.017	.086
	Pitcher	14.9 ± 1.4	14.7 ± 1.3	15.5 ± 1.2	13.6 ± 1.5	.197	.691
FM (kg)	Position	10.5 ± .88	10.6 ± 0.8	10.7 ± 0.8	10.5 ± 0.8	.024	.102
	Pitcher	12.4 ± 1.3	12.5 ± 1.3	13.4 ± 1.3	11.3 ± 1.4	.226	.775
FFM (kg)	Position	72.5 ± 1.4	74.0 ± 1.4 [a]	73.9 ± 1.7	72.9 ± 1.6 [b]	.276	.946
	Pitcher	69.4 ± 1.6	70.7 ± 1.6	71.0 ± 1.5 [a]	70.5 ± 1.9	.318	.940

[a] Significantly different from T1; [b] Significantly different from T2; [c] Significantly different from T3

ES: Effect size (d). 1-β: Power.

DISCUSSION: This study examined the effects of the fall and spring competitive seasons on body composition, and the effects of the fall season on performance variables in collegiate baseball players. Small changes in body composition were found, with body weight and fat free mass increasing after the fall season, with a slight decrease in fat free mass in position players following the spring season. Based upon correlational analysis between T1 and T2, it appears that pitchers increased their body mass by adding both lean mass and fat mass. The negative correlation between body fat percentage and lean body mass in position players, as well a significant increase in lean mass only in position players, suggests that position players added more lean mass in the fall season.

Large effect sizes were found for agility and strength, with increases occurring following the first month of fall training and then being maintained over the course of the fall season in both pitchers and position players. Changes in jumping ability occurred predominantly at the end of the fall season, and likely reflect a reduction in resistance training volume and ensuing super-compensation. Since base running, batting, and throwing are associated with optimal force production (Reyes et al., 2010; Szymanski et al., 2009), an emphasis on training means that lead to improved strength and power measures are likely to result in enhanced baseball performance.

Table 2: Changes (mean ± SD) in performance variables over the fall season in college baseball position players (n=19) and pitchers (n=19)

		Time 1	Time 1A	Time 1B	Time 2	ES	1-β
Agility (sec)	Position	4.52 ± .040	4.42 ± .032 [a]	4.42 ± .027 [a]	4.40 ± .028 [a,b]	.815	1.00
	Pitcher	4.58 ± .031	4.57 ± .040 [a]	4.54 ± .041 [a]	4.51 ± .035 [a]	.678	1.00
Sprint (sec)	Position	6.71 ± .056	6.80 ± .066	6.61 ± .127	6.70 ± .050	.140	.364
	Pitcher	1.71 ± .015	1.70 ± .020	1.69 ± .021	1.67 ± .017 [a,c]	.219	.644
Vertical (cm)	Position	73.2 ± 1.7	76.5 ± 1.5	78.2 ± 1.3	79.2 ± 1.4 [a]	.371	.877
	Pitcher	72.9 ± 1.6	75.7 ± 1.9 [a]	75.7 ± 1.9 [a]	77.5 ± 1.7 [a]	.352	.961
Horizontal (cm)	Position	257.3 ± 4.8	258.6 ± 4.3	265.9 ± 4.1	267.2 ± 3.8 [a,b]	.272	.785
	Pitcher	257.6 ± 4.8	264.9 ± 4.1	265.7 ± 4.3 [a]	268.5 ± 4.1 [a]	.297	.889
Squat (kg)	Position	130.3 ± 3.2	167.3 ± 5.3 [a]	166.9 ± 4.8 [a]	173.9 ± 4.5 [a,b]	.815	1.00
	Pitcher	115.9 ± 3.6	143.7 ± 5.1 [a]	142.6 ± 5.2 [a]	148.5 ± 6.7 [a]	.678	1.00

[a] Significantly different from T1; [b] Significantly different from T2; [c] Significantly different from T3

ES: Effect size (d). 1-β: Power.

Given the strong relationship between body composition and jumping ability (Macdonald et al., 2013) and strength and sprint performance (Seitz et al., 2014), we expected to see correlations between strength increases and jumping ability. However, no relationships were found between any of the performance variables. Surprisingly, we found a correlation for pitchers between fat mass and vertical jump. This may be because position players are required to jump more frequently in practice and competition, but this remains speculative.

This study provides data to strength coaches and sport scientists that increased strength, agility, jump performance, and lean body mass may be achieved during the competitive seasons in collegiate baseball players. Future research is needed to track performance changes during the spring competitive season.

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