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# Effect of Two Training Methods on Improving Baseball Performance Variables

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## Abstract

**Potteiger, J.A., Williford Jr., H.N., Blessing, D.L. and J. Smidt. Effect of two training methods on improving baseball performance variables. *J. Appl. Sport Sci. Res.* 6(1):2-6. 1992.** — *The purpose of this study was to determine whether a weight/sprint or an aerobic dance conditioning program would significantly change selected body composition (BC), cardiovascular (CV) and performance (PF) variables in baseball players. Twenty-one collegiate baseball players participated in a 10-week conditioning program in addition to their normal baseball activities. Subjects were randomly assigned to either a weight/sprint (WS) or an aerobic dance (AE) training group. The WS group performed strength and sprint training, while the AE group was involved in an aerobic dance program. Pre- and post-training measurements were taken of the following variables: weight, percent fat, lean body mass, lower body flexibility, aerobic power, anaerobic power, throwing velocity and 30-yard sprint time. A repeated measures ANOVA was used to evaluate the data. Significance was established at $p \leq 0.05$. The WS group showed significant improvement in the PF variables. Anaerobic power increased 4.2 percent, while throwing velocity increased 3.0 percent after the WS training. No significant changes in the BC or CV variables were observed. The AE group produced significant differences in the BC variables. An 8.5 percent decrease was observed for percent fat, while lean body mass increased 2.1 percent after the aerobic dance program. There were no significant changes in CV or PF variables in the AE group. There were no significant interactions between the WS and AE groups for any of the variables. Results indicate that a weight/sprint training program will improve PF variables related to baseball, while maintaining acceptable BC and CV components. Based on this information, it is suggested that baseball coaches use weight/sprint conditioning when training their players.*

KEY WORDS: baseball, conditioning, sprint training, aerobic dance

## Introduction

Baseball is a sport that traditionally has been unresponsive to change. This is evident in the area of conditioning programs. Baseball coaches typically have used very conservative methods when conditioning their players. In the past, players often began training programs only six to eight weeks before the start of the season; however, it is now common to have players involved in year-round conditioning programs (16). These programs often involve new and innovative methods for conditioning in an effort to help prevent injuries and enhance performance levels.

Numerous specialists have proposed the importance of certain fitness parameters as they relate to successful performance in baseball (14, 25). This has resulted in a variety of conditioning programs being designed specifically for baseball players (13, 15, 18, 21, 22, 24). Many of these programs focus on the development of strength, flexibility, muscular endurance and cardiovascular fitness through the use of a wide variety of activities. Weight training, sprint training, distance running, aerobic dance, jumping rope and swimming have been used as conditioning modes for players.

While many different programs have been developed, relatively few studies have examined the effects of these training programs on the important components of fitness as they relate to baseball players. Some studies have examined in-season conditioning (1, 6), while others have used increased resistance programs to determine changes (7, 8, 9). The purpose of this study was to examine the effects of two training methods on selected physiological and performance components deemed important to successful performance in baseball. Collegiate baseball players participated in a 10-week conditioning program to determine whether weight/sprint or aerobic dance methods of training were significantly different in their effects on baseball-related parameters.

## Methods

Twenty-one male, NAIA varsity collegiate baseball players participated in the study. Testing of subjects took place over two days. On the first day each subject reported to the laboratory, where procedures for the study were explained and informed consent was obtained. Additionally, measurements were taken of height and weight, body composition, flexibility, anaerobic power and aerobic power. On the second day, throwing velocity and 30-yard dash time were recorded.

Height and weight were measured with standard calibrated physician's scales. Body density was determined via a seven-site sum of skinfolds (10), with percent fat calculated according to Siri (23). Flexibility of the lower back and posterior leg muscles was measured by a sit-and-reach test (11). Leg power was determined via the modified Sargent vertical jump test (11). Anaerobic power then was calculated using the following formula (25):

P = 2.21 x weight (kg) x the square root of the distance jumped.

A maximal treadmill test was administered to each subject. The protocol consisted of walking for three minutes on the treadmill at three mph with zero percent grade. After three minutes, the speed was increased to six mph at zero percent grade. After four minutes, the grade was increased 2.5 percent each minute until the player reacher his maximal level of exhaustion. The test was terminated when the subject reached volitional exhaustion. If the respiratory exchange ratio was greater than unity, it was assumed the subject reached his maximal level of exertion. Metabolic responses were continuously monitored and recorded during the treadmill test using a computer-based system (Rayfield, Chicago, Illinois). The system involves the interfacing of a dry gas meter and electronic gas analyzers (Applied Electrochemistry CD-3A and S-3A1 analyzers) with an Apple computer. The analyzers were calibrated before and immediately after each test. The $\dot{V}O_2$ max values were peak $\dot{V}O_2$ max values determined at the conclusion of the treadmill test.

Throwing velocity was determined via radar gun technique (RA-GUN G1, Decatur Electronics, Decatur, Georgia). Subjects were given an unlimited number of warm-up pitches before testing. Five consecutive throws at the subject's maximal effort were recorded. The high and low values were eliminated, and the remaining three scores were averaged for data analysis.

Running speed for the 30-yard dash was determined using an electronic Dekan automatic timing device. Subjects used a crossover step at the start of the run in an effort to simulate the skill of base running. Each subject was given three trials, with the average used for analysis.

The subjects were randomly assigned to a weight/sprint or aerobic dance training group four days per week, for a 10-week conditioning program. Both groups completed a one-hour conditioning workout in addition to their normal baseball practice sessions. The weight/sprint training group participated in an hour-long strength and sprint training workout. The strength training workout consisted of a five-minute pre-exercise stretching routine, followed by three sets of eight to 12 repetitions in each of eight exercises. The first set consisted of eight to 12 repetitions at approximately 50 percent of the subject's eight to 12 repetition maximum. The second and third sets consisted of eight to 12 repetitions at 100 percent of the subject's eight to 12 repetition maximum. Resistance was increased when 12 repetitions were completed at a particular weight during sets two and three. The following exercises were performed: bench press, military press, squat, lat pulldown, leg extension, leg curl, tricep extension and bicep curl.

The sprint training workout consisted of a five-minute pre-exercise stretching routine, followed by two 10-second sprints at 50 percent of the subject's maximum effort, three 10-second sprints at 100 percent of the subjects maximum effort, and one 20-second sprint at 100 percent of the subject's maximum effort. Subjects were given a 30-second rest period between each sprint to allow for adequate recovery.

The aerobic dance workout consisted of a five-minute pre-exercise stretching routine, followed by 40 minutes of aerobic dance training and calisthenic activities led by a trained instructor. The aerobic dance routine included various low- and high-intensity exercises. The program was designed to work the upper and lower torso in an effort to enhance the development of the cardiovascular-respiratory and musculoskeletal systems. The players

**Table 1. Body Composition Variables ($\bar{X} \pm SD$)**

| | Weight/Sprint | | Aerobic Dance | |
|---|---|---|---|---|
| | **Pre-training** | **Post-training** | **Pre-training** | **Post-training** |
| Weight (kg) | 81.4 ± 9.0 | 81.6 ± 8.5 | 77.4 ± 6.2 | 78.3 ± 6.4 |
| Percent fat | 15.6 ± 2.5 | 15.2 ± 2.4 | 15.2 ± 2.4 | 13.9 ± 2.9* |
| Fat-free weight (kg) | 69.4 ± 6.8 | 70.1 ± 7.1* | 65.9 ± 5.0 | 67.3 ± 8.9* |
| Sum of skinfolds (mm) | 116 ± 19 | 112 ± 18 | 111 ± 22 | 104 ± 20* |

*Differs significantly from pre-test values ($p \leq 0.05$)

exercised at an intensity of 60 to 90 percent of heart rate reserve. Players periodically checked their heart rates to ensure that they were working at the prescribed intensity levels.

Each group was pre- and post-training tested for all variables. A repeated measures ANOVA was used to analyze the data. Significance was established at the $p \leq 0.05$ level.

## Results

The mean age and height for the subjects were as follows: weight/sprint training group (n = 10), 19.6 ± 1.3 years and 181 ± 7.6 centimeters; aerobic dance group (n = 11), 19.9 ± 1.3 years and 176.8 ± 7.1 centimeters. Table 1 shows the pre- to post-training test values for the body composition variables. The aerobic dance group produced a significant ($p \leq 0.05$) decrease in percent body fat (-1.3 percent) and an increase in fat-free weight (+ 1.4 kilograms). The weight/sprint training group showed a significant increase in fat-free weight (+ 0.7 kilogram). There were no other significant changes or interactions between groups.

Table 2 shows the results of the cardiovascular-respiratory variables. There were no significant changes from pre- to post-training tests for any of the variables measured. Table 3 shows the results of the measured performance variables. The anaerobic group produced a significant 3.0-centimeter increase in flexibility, with no significant change for the aerobic dance group. The weight/sprint training group made a significant increase in both anaerobic power (5.8 kg•min$^{-1}$),vertical jump (2.6 centimeters), and velocity throw (2.3 mph), with no significant change for the aerobic dance group. There were no significant changes in 30-yard dash times for either group.

## Discussion

The purpose of this investigation was to compare two conditioning programs during the preseason to evaluate performance and physiological variables. In evaluating the results of the program, it should be noted that both groups were engaged in regular preseason practice for several hours every afternoon. The conditioning program occurred at 7 a.m. Because both groups were performing the same activities during practice, this may be one reason why there was no interaction between groups on any of the measured variables. Within groups, there were some interesting changes that took place. Table 1 shows the body composition values. The players in the aerobic dance group showed a significant decrease from pre- to post-training tests (15.2 to 13.9 percent) in percent body fat. The mean respective pre-training test values of 15.6 percent and 15.2 percent for the weight/sprint and aerobic dance training groups were similar to values reported for other groups of baseball players (4, 5). Wilmore and Costill, in summarizing body composition of baseball players, reported mean values ranging from 9.9 to 16.2 percent for college and professional players (25). The aerobic dance group produced a slight but significant decrease in percent body fat. The decrease in percent body fat is consistent with exercise programs that use aerobic exercise. The weight/sprint training group did not decrease in percent fat. Both groups made slight but significant increases in fat-free weight.

There were no significant changes in any of the cardiorespiratory variables. In terms of cardiovascular fitness, both groups possessed relatively high peak $\dot{V}O_2$ values. The mean respective pretest values of 51.3 and 55.8 ml•kg$^{-1}$•min$^{-1}$ for the weight/sprint and aerobic dance groups were similar to the $\dot{V}O_2$ max value of 52.3 ml•kg$^{-1}$•min$^{-1}$ for college baseball players reported by Novak et al. (17). Traditional conditioning programs have emphasized an aerobic-type program for training baseball players (20). Many of the present players had been on an aerobic training program in high school and junior college. One of the possible reasons for the high peak $\dot{V}O_2$ values may be related to the emphasis that was placed on aerobic conditioning during their previous training. The lack of a

**Table 2. Cardiovascular-Respiratory Variables ($\bar{X} \pm SD$)**

| | Weight/Sprint | | Aerobic Dance | |
|---|---|---|---|---|
| | **Pre-training** | **Post-training** | **Pre-training** | **Post-training** |
| Max heart rate ($b \bullet min^{-1}$) | 195.7 ± 10.4 | 194.4 ± 11.3 | 192.4 ± 7.2 | 194.2 ± 7.0 |
| Peak $\dot{V}O_2$ ($ml \bullet kg^{-1} \bullet min^{-1}$) | 51.3 ± 5.6 | 52.6 ± 5.9 | 55.8 ± 4.8 | 56.1 ± 3.0 |
| $\dot{V}E$ max ($l \bullet min^{-1}$) | 114.0 ± 13.9 | 115.7 ± 10.9 | 122.9 ± 12.5 | 126.1 ± 18.4 |
| Respiratory exchange ratio | 1.17 ± 0.1 | 1.16 ± 0.1 | 1.2 ± 0.1 | 1.2 ± 0.1 |
| Treadmill test time (min) | 9.2 ± 1.2 | 9.9 ± 1.0 | 9.5 ± 0.8 | 10.0 ± 0.8 |

*No significant differences

change in $\dot{V}O_2$ max values is probably related to the high pre-training test values. Because of such high initial values, large changes would not be expected with this group of athletes.

Although the results of the two training regimens fail to show significant improvement in the cardiorespiratory variables, trends toward favorable improvement were noted after completion of the exercise training program. Positive changes in the measured cardiovascular variables, as indicated by increased treadmill time, were reflected after training, which is consistent with other studies using weight training (2, 12) and aerobic dance exercise programs (3).

Present research shows that several of the performance variables related to baseball performance emphasize the anaerobic energy systems (20). Strength and power are important variables related to throwing, running, jumping and sprinting. The weight/sprint trained group produced a significant increase in flexibility, with no change for the aerobic dance group. In the past, baseball coaches often have not recommended weight training for fear that it could decrease flexibility and negatively affect the performance of their players. The present study shows that if the players perform the weight-training exercises correctly, muscular flexibility can be increased and performance may be improved.

The weight/sprint training group significantly increased vertical jump and anaerobic power, with no change for the aerobic dance group. Increases in anaerobic power are related to increased leg strength and a greater vertical jump. The weight/sprint training group also increased throwing velocity. Using varsity college pitchers, Potteiger et al. found a high correlation ($r = 0.82$) between pitching velocity and anaerobic power (19). It was concluded that anaerobic power was a significant contributor to pitching performance.

When throwing a baseball, the player is required to exert maximal power production in a very short time. The ability to generate power depends on technique, skill and strength. The enhancement of anaerobic power through appropriate training and conditioning programs should improve throwing velocity.

There were no significant differences in 30-yard sprint time between the two groups. A possible explanation for the lack of differences could be due to the similar practice activities encountered by both groups. Because the study

**Table 3. Performance Variables**

| | Weight/Sprint | | Aerobic Dance | |
|---|---|---|---|---|
| | **Pre-training** | **Post-training** | **Pre-training** | **Post-training** |
| Flexibility (cm) | 30.4 ± 8.0 | 33.4 ± 7.6* | 32.7 ± 8.8 | 34.3 ± 8.0 |
| Vertical jump (cm) | 54.2 ± 6.9 | 56.8 ± 5.3* | 60.1 ± 14.5 | 60.0 ± 7.7 |
| Anaerobic power ($kg \bullet min^{-1}$) | 132.6 ± 19.0 | 138.4 ± 15.7* | 132.1 ± 17.8 | 133.2 ± 17.6 |
| Velocity throw (mph) | 74.8 ± 5.0 | 77.1 ± 3.8* | 73.7 ± 4.3 | 73.0 ± 5.0 |
| 30-yard dash (sec) | 3.70 ± 0.1 | 3.70 ± 0.1 | 3.75 ± 0.1 | 3.69 ± 0.1 |

*Differs significantly from pre-test values ($p \leq 0.05$)

was conducted during preseason practice, all subjects had to participate in the normal baseball activities of running, throwing, hitting and fielding, and this may account for the lack of difference between the groups.

## Practical Applications

The present study shows that college baseball players can be trained effectively with a weight/sprint training program. While coaches have been skeptical regarding the use of weight training to improve baseball performance, the present investigation showed no negative effects. Positive results were obtained in the performance variables of vertical jump, anaerobic power and throwing velocity. Additionally, the weight-training group made significant increases in flexibility. It can be concluded that weight training can significantly improve selected variables related to playing performance.

The results of this study provide important information for baseball coaches attempting to install conditioning programs for their athletes. Conditioning programs that are designed to improve strength and power are most desirable for baseball players attempting to improve performance. Examples of conditioning programs that are designed to improve strength and power are available (13, 15, 18, 21, 22).

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