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What is the effect of weight training on leg strength and speed in college athletes?

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ABSTRACT

Weight training may be contributed to strength and the speed at which you run. Age, sex and mobility are factors that can have an effect on the amount of weight you main train with as well as the speed at which you run. Sprint times were tested in 12 female college soccer players. A weight training regimen, focusing on leg strength was given to them over a 10 week period. This included many lower body lifts that were high weight and high intensity while also including short, explosive bursts of speed. Sprint times, weight, body mass index, and calf and quadriceps circumferences were all tested and measured both before and after the training regimen to determine whether or not there was a significant change in the sprint times.

It was concluded that weight training affects sprint speed but only in short, explosive sprints. Sprint times in the 40 yard sprint decreased while the times in the 100 and 200 yard sprints did not significantly change. There was a change in all of the girl's weights and BMI's, they all increased while the circumference of their quadriceps and calves increased due to the weights used in the training regimen.

Keywords: *Weight training, leg strength, athletic performance*

INTRODUCTION

Weight training is viewed as an important contributor to strength and the speed at which you run. There are many muscles in the leg which you can train in order to increase speed. The two main muscles to focus on when wanting to increase sprint are the quadriceps and gastrocnemius (Cronin and Hansen 2005). A study was performed on a rugby team to establish whether or not there was a relationship between strength, power and the measures of first step quickness. The study suggests that improving the power to weight ratio as well as plyometric training may be more effective for enhancing spring speed in elite players.

Age, sex and mobility are factors that can have an effect on the amount of weight you main train with as well as the speed at which you run. Muscle strength is a key component throughout life and especially into old age (Buchner et al., 1996), as well as having significant links with higher and lower intensity tasks such as walking (Fielding et al., 2005). A study was done with elderly men and women who did and did not exercise as they aged. The men and women who walked or continued some form of weight training were healthier and were able to walk better and faster than those who were not doing any physical activity (Buchner et al., 1996).

Strength training of the legs may increase the speed at which you run. The purpose of this experiment is to prove that strengthening the quadriceps and gastrocnemius muscles will lower your time during a short sprint. The purpose of this study is to determine whether or not leg strength and speed have any correlation to each other. This could help coaches in the off season prepare their athletes to reach their personal peaks.

MATERIALS AND METHODS

In order to find the answer to whether or not weight training has an effect on leg strength and speed in college athletes, I will use the women's soccer team from McPherson College and have them perform a series of physical fitness tests. Before beginning the training regimen, the team was timed in the 40 meter, 100 meter, and 200 meter sprint. These times were recorded and kept for later use. The circumference of the thigh and calf muscles' of each individual on the team was measured and recorded. The team then had their body mass index figured and their current weights recorded to ensure that weight loss is not the reason for a change in speed. After this, the ten week training regimen was started. The team was working out two days a week, two hours each day, to increase leg strength in order to increase speed.

Throughout the ten weeks they rotated through several different exercises. One of the first things that we did was start with will be the speed ladder. We did a series of quick foot work exercises. While the speed ladder is set, each person went through it with both feet going into each square of the ladder. The next set would be to go through putting both feet in the square and taking the right foot out to the side then put both feet in the next square and take the left foot out. This continued all the way through the ladder. Another run through was to jump on one leg all the way through and jump on the opposite leg the next time through. The next time through could be jumping (small, explosive jumps) with both feet. We also went through the ladder jumping, with both feet, forward two squares then backwards one and continue this until the end of the ladder. Other options are to do the grapevine through the ladder, which is done sideways, not forward through the ladder. Another exercise with the ladder going sideways would be to quickly put both feet in and out of each square. All of these exercises would need to be done quickly in order to workout the fast twitch muscles.

Plyometric boxes may be a big help in leg strengthening as well (Cronin and Hansen, 2005). The team did one foot box jumps, two foot box jumps, and side to side jumps over the box. The boxes were spread out evenly; each person went through and jumped up on the box, jumped back down and continues onto the next box.

The team then moved on to more running focused, leg strength sessions. The team did several sprint sessions in the gym. They also worked very hard in the weight room. Every Tuesday and Thursday the girls would go through a series of leg strengthening exercises. These focused on the fast twitch muscles in the legs. Their typical routine included a series of several types of lunges including regular lunges, walking lunges, side lunges, backward lunges, and jumping lunges. They also did standing calf raises on the edge of a step. This required them to stand on their toes on the edge of the step and rise up onto our toes.

After ten weeks of training, the women's soccer teams' calves and thighs were measured again to see if they had gotten any larger. They were then re-timed in the 40 meter, 100 meter, and 200 meter sprints and. That data were recorded and used to compare the before and after times in the sprints as well as before and after measurements to see if leg strength due to weight training has had an effect on everyone's speed. The team's body mass index and weight was taken again. Once all of the data had been collected, a paired sample t-tests were used to see if there is a correlation between changes in leg strength and speed.

Everything took place here on campus, in the gyms, on the track and on the field as well as in the weight room.

RESULTS

Twenty women started this initial study but due to complications we ended with only twelve. Figures 1-7 were all tested statistically with a paired t-test followed by a test of normality. They were all tested with a 99% confidence interval ($\alpha = 0.01$).

The data in Figure 1 showed a p-value of p= <.001. This showed a statistically significant change that is greater than is expected by chance. The normality test showed that it passed with a p-value of p =.235.

Figure 2 had a p-value of p= .079. The change that occurred with the treatment is not great enough to exclude the possibility that the difference is due to chance. The normality test passed with a p-value of p= .012.

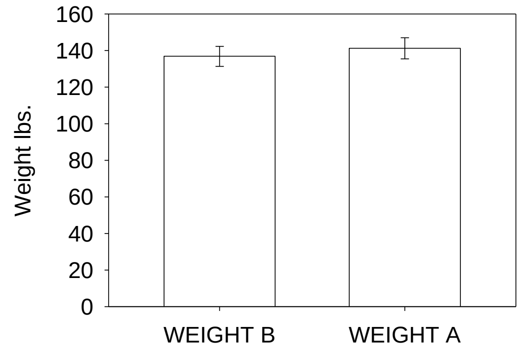

Figure 1. The weight in pounds of 12 female athletes measured both before (B) and after (A) the ten-week training regimen described in the text. The error bars indicate 1 standard error of the mean.

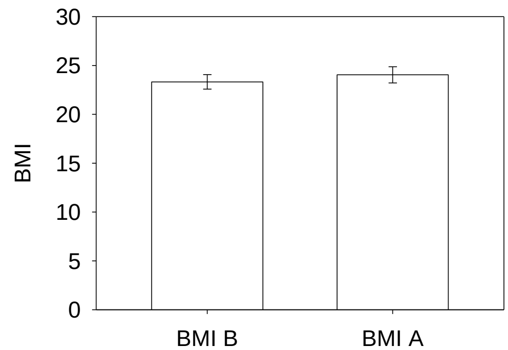

Figure 2. The body mass index (BMI) of 12 female athletes measured both before (B) and after (A) the ten-week training regimen described in the text. The error bars indicate 1 standard error of the mean.

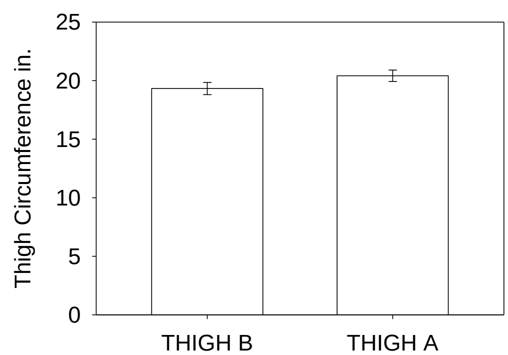

Figure 3. The circumference the thigh in inches of 12 female athletes measured both before (B) and after (A) the ten-week training regimen described in the text. The error bars indicate 1 standard error of the mean.

Figure 3 has a p-value of p= .609. The change that occurred with the treatment is not great enough to exclude the possibility that the difference is due to chance. The normality test passed with a p-value of p= .503.

Figure 4 has a p-value of p= .183. The change that occurred with the treatment is not great enough to exclude the possibility that the difference is due to chance. The normality test passed with a p-value of p= .159.

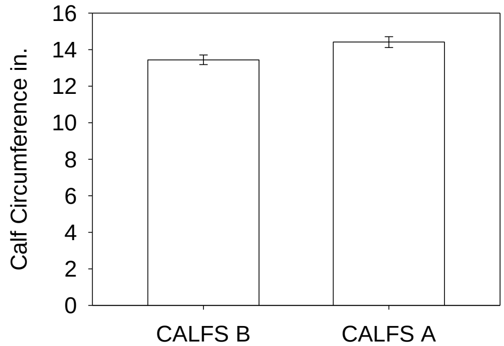

Figure 4. The circumference of the calves in inches of 12 female athletes measured both before (B) and after (A) the ten-week training regimen described in the text. The error bars indicate 1 standard error of the mean.

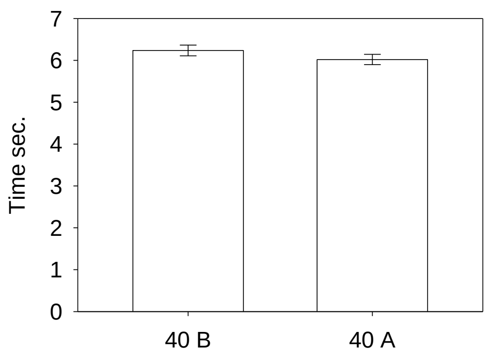

Figure 5. The time in seconds for the 40 yd. sprint of 12 female athletes measured both before (B) and after (A) the ten-week training regimen described in the text. The error bars indicate 1 standard error of the mean.

Figure 5 has a p-value of p= .010. The change that occurred with the treatment is greater than would be expected by chance. The normality test passed with a p-value of p= .590.

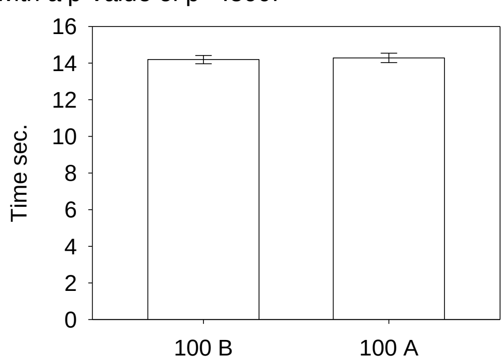

Figure 6. The time in seconds for the 100 yd. sprint of 12 female athletes measured both before (B) and after (A) the ten-week training regimen described in the text. The error bars indicate 1 standard error of the mean.

Figure 6 has a p-value of p= .001. The change that occurred with the treatment is greater than would be expected by chance. The normality test passed with a p-value of p= .779.

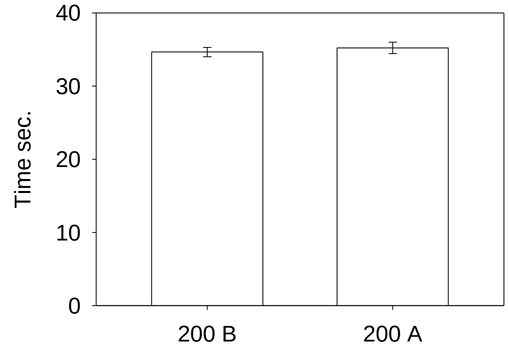

Figure 7. The time in seconds for the 200 yd sprint of 12 female athletes measured both before (B) and after (A) the ten-week training regimen described in the text. The error bars indicate 1 standard error of the mean.

Figure 7 has a p-value of p= .001. The change that occurred with the treatment is greater than would be expected by chance. The normality test passed with a p-value of p= <.010.

A study was done on a rugby team to identify the relationship between strength and power and measures of first-step quickness, acceleration and maximal speed. The team consisted of 20-to-26 year-olds who were examined based on a series of sprints and isokinetic strength measurements, such as squat jumps. The squat jump heights as well as squat jump power were the only variables that were significantly greater in the faster players. It was suggested that improving the power to weight ratio as well as plyometric training may be more effective for enhancing sport speed in elite. One distinctive aspect of this research is that it was done on a soccer team as opposed to just regular athletes. This helped us to see how it affects a sports team as a whole.

DISCUSSION

A limitation to these results revolves around the fact that 8 girls did not complete the training regimen for various reasons. This reduced the size of the group making it more challenging to discover exactly how significant the changes in weight, BMI, leg circumference and sprint times were. Another limitation I encountered was the length of the training regimen. I initially intended on having the training regimen last only 8 weeks but decided to prolong it another 2 weeks to finish out the month. At 8 weeks everyone had reached their maximum strength and due to outside influences, the intensity the girls were working at had significantly decreased.

The anticipated results would have shown a significant increase in speed in all three of the timed sprints. After seeing the actual results, there was a dramatic decrease in sprint speed in the 40 yard sprint but a slight increase or no change at all in the 100 and 200 yard sprints. After going back over the training regimen, it was seen that many of the exercises were geared toward quick explosive movements. Because of this, it was obvious that the shortest sprint would show the most dramatic change.

After examining the results and interpreting the data, I noticed that the only significant change in sprint time had occurred in the 40 yard sprint. This caused me to re-evaluate my previous hypothesis. It then became apparent to me that the training regimen involved a lot of high weight, high intensity and quick burst movements and because of that, the 40 yard sprint, the shortest and quickest, ended up being the only sprint to show a large significant change. The longer sprints showed little or no change because they were not working the muscles used in longer sprints.

There was a change in all of the girl's weights and BMI's, they all increased while the circumference of their quadriceps and calves increased due to the weights used in the training regimen.

In an experiment performed by Cronin and Hansen 2005 on a professional rugby team, the results were similar. By working on short, explosive bursts of speed with plyometric training, similar to that in this experiment, their results showed that the only significant change was found in those who participated in the plyometric group that worked specifically on quick burst movements. These results were very similar to my own results. Another experiment on leg strength and speed performed on older adults by Buchner et al 1996 showed a non-linear relationship between the two. They stated that "a point at which age-related strength loss begins to impair speed was not easily identified". Though their experiment was similar to mine, the results are varied.

For further research, I would recommend not having a team or group train for 10 weeks. I strongly suggest only an 8 week training regimen. This gives the team enough time to reach their maximum potential without over working themselves or losing interest. I would also suggest working with a larger group in order to get more varied and reliable results. These few changes, I believe, would make a difference in the outcomes of the experiment.

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