

The Effects of an Off-Season Strength and Conditioning Program on Division III Collegiate
Female Soccer Players and Athletic Performance

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Abstract

The purpose of this study was to determine the impact of an off-season strength and conditioning program on the athletic performance of Division III female collegiate soccer players. This study utilized a quasi-experimental design using pre/post-testing of five different fitness tests. The null hypothesis that there would be no increase in athletic performance with the use of an off-season strength and conditioning program in female collegiate soccer players was rejected in 5 of the 6 dependent variables. There were no significant findings in the sixth variable. Research and participation in off-season strength and conditioning programs should be further assessed using a larger sample.

CHAPTER I

INTRODUCTION

Soccer is becoming one of the largest growing sports across the world. From the youth level to the professional level, the participation rate in soccer continues to grow year after year (Ladda, 2000). As the participation level increases, so does the physical fitness of the individuals involved. Soccer is a sport that involves many domains of physical fitness including, strength, power, agility, endurance and overall athleticism, so staying in shape is vital to the success of soccer players all over the world. According to Ladda the sport has transformed and developed each decade and the game is constantly changing, however, one thing that stays consistent is the fact that it is a sport that requires endurance and physical contact. A college soccer match consists of 90 minutes and usually requires minimum substitutions. Because of the lack of substitution, the coach must have the team prepared to play an entire game, thus the players must train to do so. College soccer players must train year round to maintain a fitness level appropriate to complete the soccer season, which consists of a pre-season, season and then off-season.

Statement of the Problem

The purpose of this study was to determine if the impact of an off-season strength and conditioning program on the athletic performance of Division III female collegiate soccer players.

Hypothesis

The use of an off-season strength and conditioning program will not impact the athletic performance of Division III female collegiate soccer players.

Operational Definition

The independent variable for this study is an off-season strength and conditioning program. The strength and conditioning program will be completed over an eight week span with pre-test prior to the eight weeks and post-test immediately following the eight week regimen. The dependent variable is athletic performance defined as improved results in the 40 yard dash test, the t-agility test, sit-up test, push-up test, leg-press maximum and bench-press maximum.

CHAPTER II

REVIEW OF LITERATURE

The first section of this literature review will provide the definition of athletic performance and what it means to be in-shape. The second section will discuss possible challenges and issues affecting the off-season. The third section will review off-season training programs and the elements of exercise included. In section four, the physiological effects of exercise on the muscles and the body will be discussed. Lastly, the fifth section will cover the psychological effects of the athlete who is participating in the program.

Athletic Performance

During any athletic event, the way the athlete performs will dictate the improvement as well as the success of that athlete. It is vital that the athlete perform at his/her highest potential in order to reach peak performance. Athletic performance can be described as the way the athlete performs during any given fitness test. According to Hoff and Helgerud (2004), an increase in the results of a 40-yard dash sprint test, a t-agility test, sit-up test and push-up test would result in an increase in athletic performance. In order for the athlete to reach an increase in athletic performance, he/she must maintain a level of fitness and therefore be in shape during the tests.

“Everyone who participates in long, vigorous exercise realizes that through continuous training, the body adapts to the physical demands and the body can increasingly handle more physical stress of exercise,” (Nessel, 2009, p. 7). As the body adapts to the stresses, the athlete notices a difference in many different components of his/her specific sport. An athlete who builds up endurance or strength through training will notice the change that the training causes on their bodies (Hoff & Helgerud, 2004). This is what every serious athlete strives for throughout his/her training. Being in shape is the ultimate goal of everyone who is labeled as an

athlete. The principle of being in shape means that the body will adapt to whatever challenges are presented. The body continuously improves its ability to handle increasingly more intense and vigorous exercise. “The three elements of training that must be addressed in order to allow the body to reach this peak of being in shape are endurance, strength and power,” (Nessel, 2009, p 7). The athlete should build endurance, then go for increased strength and finally work to produce power.

Challenges of the Off-Season

In order for soccer players to stay in shape during the off-season, they must follow the elements of being in shape that were previously stated: endurance, strength and power. According to Hrysomallis (2011), a soccer athlete utilizes all of these elements during a match because the athlete uses endurance for prolonged running and strength to help reduce fatigue. Power is used to produce better contact with the ball as well as the power to explode during a sprint. However, it is very difficult for a collegiate soccer player to maintain in-season shape year round. The demands placed on the body during season are very high causing the body many stresses which can later lead to overuse injuries (Rubini, Costa & Gomes, 2007). It is important that the coach design a program that will avoid these types of overuse injuries from occurring in the first place.

“When designing a training program it is important to understand that during intense training the body adapts but then will plateau during physical conditioning,” (Hoff & Helgerud, 2004, p. 171). Because this is a reality, it is important for coaches to understand that asking players to maintain game fitness is unlikely and should not be attained. Rather, the off-season work-out should be changed to accommodate other areas of the athlete’s physical fitness. These changes should result in less sprint fitness and focus more on the endurance core of the athlete.

The program should also incorporate more intense high resistance strength training to help develop the musculature of the athlete. The majority of college soccer coaches implement a type of workout regimen for their players so that they can maintain a good fitness base without being in in-season shape.

Problems with the off-season arise for many different reasons. The coach must find a balance between maintaining endurance and strength without causing the athletes to burn-out or over-train (Hoff & Helgerud, 2004). Because college athletes are also busy with school work, social lives and sometimes work schedules, finding time for the training program is difficult. It is important to delegate and organize times that work for the team. However, some people end up working out alone which could hinder their concentration or focus during training. While there are challenges in finding time for the team to get together, there are other challenges as well.

Many soccer athletes do not consistently implement a strength training workout regimen in their exercise bouts. Because of this, most of their muscular strength comes from playing the sport every day. Playing every day causes the body to adapt and create muscle memories. The activity of running and striking a ball with power multiple times per training session everyday causes the body to build muscle. Without the in-season training sessions with the coach, the players on the team begin to lose muscular strength, power and endurance. This means that it is vital that they implement this out of season workout including weight lifting. If the athletes are not maintaining the muscular strength built in their previous season then they are causing the body to start all over during the upcoming pre-season (Folland & Williams, 2007). An athlete who is able to maintain his/her strength through different activities such as weight lifting will allow for his/her body strength and endurance to improve rather than it decreasing then increasing again. Instead of the players taking too much time off, they continue to build on their

fitness base which allows for them to increasingly gain more muscular strength and endurance, cardiorespiratory endurance, power output and agility.

Off-Season Training

An off-season training regimen must consist of multiple elements in order for the athlete to maintain soccer shape. First and foremost it is important that the athletes maintain and continue to increase their endurance base which can be accomplished through cardiorespiratory training. According to Nessel (2007), cardiorespiratory endurance has been recognized by many researchers and authors to be one of the fundamental components of physical fitness. While the necessity for cardiorespiratory endurance in soccer is obvious, the type of training used to reach full capacity of endurance should be explored. According to Tanaka and Swensen (2002) endurance interval training using an intensity at 90-95% of maximal heart rate in 3-8 minute bouts have been effective in the development of endurance, and for performance improvements in soccer play. Because of the change in speeds and distances within a soccer match, it is important that the athlete be trained in distance running as well as in short sprints, which allows the athlete to train aerobically as well as anaerobically. This need is demonstrated through the research done by Hoff and Helgerud who state that a sprint bout in a soccer match occurs every 90 seconds and lasts 2-4 seconds (2004). They go on to state that sprinting constitutes 1-11% of the total match distance ran by the athlete. It is believed by many that while soccer players implement sprinting in a soccer match, the true endurance lies in the distance ran in an individual match. According to Ladda (2000) the average soccer player runs 6 miles in any given match. The distance that is covered during a soccer match is related to both the aerobic power of the player and the player's ability to withstand high levels of his/her aerobic power. This suggests that endurance is of high importance in an off-season training program.

Building endurance takes the greatest amount of time and requires the most effort to develop physiological changes to the body. “While building endurance the athlete must concentrate on the muscular and cardiorespiratory systems because endurance becomes specific to the individual muscle groups,”(Tanaka & Swensen, 2002, p. 196). For a soccer player, the lungs and legs are the most important component of endurance due to the intense physical demands presented during a soccer match. A player’s legs must have muscular endurance to withstand the amount of running, cutting, jumping and change of speed during a 90 minute soccer match. Meanwhile, according to Nessel (2009) the lungs and heart, as part of the cardiorespiratory system, must withstand the amount of stress placed on the body through the aerobic and anaerobic exercise. Cardiorespiratory endurance means endurance of the body as a whole and its ability to tolerate extended and vigorous physical exercise. “Without endurance, fatigue can set in which causes the muscular strength to diminish along with neuromuscular coordination, concentration and alertness of the athlete,” (Hoff & Helgerud, 2004, p.173).

This shows that endurance and muscular strength go hand in hand. A stronger athlete can perform tasks with less effort because of muscular strength. “The stronger the athlete is, the more likely they are to withstand the prolonged exercise bouts with less fatigue, thus, the athlete whose focus is endurance should also devote time and effort to strength training,”(Hoff & Helgerud, 2004, p. 173). The two work directly with each other and an athlete with great muscular strength and endurance can participate at a higher level of competition for a longer period of time. This is possible because this athlete will not experience the fatigue as quickly as an athlete who has not gained the muscular strength and endurance and thus is not in shape.

A variety of training methods can be used in order to increase strength and power. These methods are mostly used in sports that involve acceleration and explosive force development

such as sprinting and jumping. All of these things are required in a soccer match and therefore should be a concentration of the soccer athlete in off-season training. “Strength is defined as the integrated result of several force-producing muscles performing maximally either isometrically or dynamically during a single voluntary effort of a defined task,” (Hoff & Helgerud, 2004, p. 166). Power, however, is the ability to produce as much force as possible in the shortest amount of time. According to Cronin and Sleivert (2005) the muscles’ ability to develop great force depends on many factors including positioning of the movement, speed of lengthening of the muscle, speed of shortening of the muscle, the eccentric movement phase in the muscle, the types of muscle fibers and the number of motor units active at the same time. For an athlete to produce force great enough to increase power output they must train in the sport specific activity. It is important when designing the strength and conditioning program that the coaches keep in mind the contraction type, force, and movement to ensure that you are focused on the correct muscle groups. In order to gain this force production necessary to increase power, the muscular strength must be developed.

“Power is developed through moving heavy resistance quickly, but under control,” (Cronin & Sleivert, 2005, p. 226). A powerful athlete is able to move through his/her sport-specific actions with speed and should concentrate on training for power. Cronin and Sleivart also report that fast-twitch muscle fibers are a large component of producing power. Both slow and fast twitch muscle fibers rely on different energy systems and support the body in different ways. Fast twitch muscle fibers contract more quickly and produce power and strength. These fibers are activated during short bursts of speed and strength and are designed to grow large in response to training. Someone who is born with more fast-twitch fibers is able to more consistently and successfully produce more power. “Targeting the specific motor neurons within

the muscle fibers allows for the nervous system to adapt to the stresses put on by the strength training program,” (Folland & Williams, 2007, p. 226).

Strength training is used in order to gain muscle hypertrophy which causes the muscles to grow larger and therefore they are able to produce more power. “Long-term training studies have shown a temporally faster mobility of the nerve activity after intensive high-resistance training” (Folland & Williams, 2007 p.227). This allows a trained athlete to recruit more motor units within the muscle more quickly which allows them to produce more force during strength training workout regimens. This means that as the exercises recruit more motor units, an increase in motor units of the muscle fiber is made which causes the hypertrophy or growth of the muscle. If the muscle is growing that means that the individual is gaining muscular strength. Increasing force of muscle contractions through strength training allows for the soccer player to also increase acceleration and speed skills. According to Sporiš, Milanović, Jukić, Omrčen, and Molinuevo, (2010) skills then increase the athletes’ ability to turn and sprint allowing them to change direction and speed more easily. As stated earlier, the effect of combined muscular strength and muscular endurance training can result in better athletic performance from the athlete due to the decrease in fatigue. A college athlete who can sustain “high intensity long-interval endurance training and maximal strength training will see more neural adaptations which allow the body to adjust and gain strength and power in the motor units of the muscle fibers,” (Markovic & Mikuic, 2010, p. 863).

Another important element of physical training programs is agility. “Agility is defined as the ability of an athlete to change direction, make quick stops and perform fast, smooth, efficient and repetitive movement,”(Sporiš et al., 2010, p. 67). This type of training should be used in off-season and in-season training and should create the demands of the given sport. Because soccer

involves changes of speed and direction it is important that soccer players train in agility in order to reach their potential. According to Sporiš et al., agility is dependent on coordination and movement control, thus the bodies way of movement through the means of changing direction and speed. Many factors affect the level of agility including the mobility of joints, balance, power and flexibility, strength, speed and the biomechanics of body movement. Sporiš et al. examined the specificity of the training response to agility training over a 6-week period and found that a training method specific to one speed quality produced limited transfer to the other. If the athlete is successful in gaining agility movements then he/she creates better overall movement technique. When an athlete's movement technique improves then he/she is more likely to create better effects during the off-season program and therefore is more effective during competition. This suggests that a soccer player who has cardiorespiratory endurance, muscle strength and endurance, muscular power and agility will be very successful. An off-season program which targets all of the above will give the athlete the biggest increase in test results and therefore should cause an increase in athletic performance.

Physiological Effects

In order to understand why strength training is important to the athlete's body and the success in his/her sport it is important to understand how the strength training affects the body physiologically. As athletes participate in strength training programs, their bodies adapt to the demands which the activities place on them. "Understanding the adaptive processes in the circulatory system and endurance performance, as well as nerve and muscle adaptations to training and performance have given rise to more effective training interventions" (Hoff & Helgerud, 2004 pg. 175).

According to Folland and Williams (2007), chronic exposure to a strength training program will increase muscular strength which contributes to a range of neurological and morphological adaptations to the body, the muscles specifically. Folland and Williams also discuss that the primary morphological adaptations involve an increase in the cross-sectional area of the whole muscle and individual muscle fibers, which is due to an increase in myofibril size and number. When the body is undergoing such training, the muscles recruit more motor units which allow for an increase in myofibril number and size. The more myofibrils that are recruited and the bigger they are allows for a stronger muscle hypertrophy; in other words, the muscle grows. Within the muscle there are cells called satellite cells which are activated in early stages of training. Proliferation of satellite cells and later fusion with existing fibers appear to be intimately involved in the hypertrophy response.

According to Hoff and Helgerud (2004) through the neurological adaptations, the athlete becomes more coordinated and in the early weeks of strength training, voluntary muscle strength increases and gains continue for at least 12 months. Once the athlete reaches the 12 month period, the training effects cause the skeletal muscles growth to plateau. In order to properly train the muscles, one must understand the physiology and anatomy of the body. In order to target the right muscle groups it is necessary to understand the body and the types of muscles that are to be targeted to allow increases in performance of a specific sport.

Training for power can be accomplished by moving resistance at high speeds. The fast moving exercise activates the fast-twitch muscle fibers which will allow for quicker movements in the muscles and therefore more power. "Fast-twitch muscle fibers use anaerobic metabolism to create fuel for their movements and create short bursts of strength or speed. Meanwhile slow-twitch fibers use oxygen to fuel movements and can last for an extended period of time,"(Folland

& Williams, 2007, p. 149). An athlete who wants to accomplish quick bursts of energy such as sprints will recruit more fast-twitch muscle fibers, while someone who wants to accomplish distance will recruit more slow-twitch fibers. All people possess both types of fibers but the type of fiber recruited allows for the athlete to accomplish the task at hand. In soccer, athletes must be able to use both slow and fast-twitch fibers because soccer consists of distance bouts as well as sprint bouts. This supports the notion that power and endurance training go hand in hand. The Power training targets fast twitch fibers while endurance training targets slow- twitch fibers allowing for both aerobic and anaerobic training.

The slow-twitch fibers are also targeted during hypertrophy or growing of the muscles. As an athlete participates in a strength training program, he/she creates muscular endurance through the activation of slow-twitch fibers (Bottaro, Veloso, De Salles, Simão, Celes & Brown, 2009). By targeting these fibers through slow complete repetitions in weight lifting, the athlete is able to increase muscle mass and size and therefore recruit more motor units.

Psychological Effects

When dealing with female athletes, it is important to take into consideration the psychological side of things. Many female athletes do not take part in strength training because they are worried about what the physical effects will do to their physique. According to Shackell and Standing (2007), women have been increasingly participating in sports since the Title IX came into effect, but many women do not agree with the physical training that is required because of the effects that the training has on their bodies. When considering the ideal body type in today's society, it is not surprising to realize that female athletes struggle with the way strength training can make them look. This shows that there is a psychological effect in

exercising for women. The way a woman's body is built can affect her self-esteem, her self-confidence and can affect performance. The motivation of women is different, however.

According to Duff, Hong and Royce (1999), women who are motivated to lift weights find the motivation because they enjoy having a strong body, while men find motivation because lifting weights makes them feel masculine. A type of physical conditioning and training produces a strong body which many coaches, players and medical personnel believe gives the player an advantage during competition. During the same study the researchers discuss the differences between men and women and how they are programmed. Duff et al., state that men are programmed for aggression, competition and getting the job done to the point of subordinating their socio-emotional needs. Meanwhile, women socialize more for affection, compassion, looking good and making others feel good to the point of compromising performance. A senior soccer player expressed in that same article how much emphasis strength has on the game of soccer. She explains that "physical contact is inevitable and that the upper and lower body must be strong in order to hold the opponent off the ball as well as creating quick and explosive steps during running in soccer," (Duff et al., 1999, p. 79). Coaches and players all over the country need to understand the need for strength training programs so that the team can succeed at the highest possible level.

Summary

Soccer has become increasingly popular and the numbers continue to grow. It is a game that requires endurance and physical contact. In order for an athlete to sustain the physical demands of the game he/she must maintain a high fitness standard. Maintaining that fitness through the off-season is the most challenging and therefore requires a lot of attention. Through the use of a strength and conditioning program in the off-season, athletes will see an increase in

performance. The off-season strength training program will include cardio respiratory, endurance, agility, power, resistance and strength training. Through the program as a whole the athlete will see strength gains and will increase the overall threshold that the body can withstand through physical activity. The better the players fitness base, the more successful the player will be on the field.

CHAPTER III

METHODS

The purpose of this research was to determine the impact of strength and conditioning program used in the off-season would cause an increase in athletic performance for Division III female soccer players. The researcher hypothesized that the athletes would have an increase in athletic performance after performing strength and conditioning regiment in their off-season training. The athletes would see an increase in repetitions for strength training and decrease in time necessary to complete the timed tests for conditioning.

Design

This study utilized a quasi-experimental design of a pre-test followed by treatment and ending with the post-test. Performance was measured by an increase in the fitness tests from the pre to post-test.

Participants

The participants in this study are members of the women's soccer team at a small Division III liberal arts college in Baltimore Maryland. The study included 17 female soccer players from 10 different states in the age range of 18-22. Members of the team include five seniors, five juniors, two sophomores and six freshmen.

The college soccer off-season runs from the middle of November until the middle of August. The team participates in an off-season training regimen without coaches during the winter months and then practices with the coaches for 5 weeks from the end of March until the end of April. The off-season training regimens all last from 1.5-2 hours for five days a week.

Instruments

Five fitness tests were used for pre and post measurements. The pre-test involves performing a T-agility test, a 40 yard dash sprint test, a 1 mile endurance test, push-up test and a sit-up test. The tests were performed prior to the start of the off-season strength and conditioning program which concluded the pre-test measures. After an eight-week off-season strength and conditioning program was performed by all subjects, the same five fitness tests are performed again.

Definition of Athletic Performance

Athletic performance can be defined as the way the athlete performs during any given fitness test. A decrease in time necessary to complete a test and an increase in repetitions in the push-up and sit-up test would result in increased athletic performance.

Procedure

This study was carried out over an eight-week period which took place from Monday January 30, 2012 through Monday March 26, 2012. All five fitness tests were performed prior to the start of the off-season strength and conditioning program. Fitness tests were performed in the same order and consisted of the T-agility test, 40-yard dash test, push-up test, sit-up test on January 30th. On January 31st the 1 mile endurance test was performed. Coaches were in attendance during the testing. The researchers told the subjects the purpose of the study and that the goal was to perform as best as possible.

Following the 1 mile endurance test on January 31, 2012 the team began their 8-week winter training packet which included cardio-respiratory workouts, agility workouts and strength training workouts. The coaches were not present during the workouts but team captains held

attendance mandatory for the purpose of the study. On March 26, 2012 the same fitness tests, in the same order, were used to evaluate the athletes' fitness levels.

CHAPTER IV

RESULTS

This study examines the impact of a strength training program in the off-season on athletic performance. Seventeen females participating in Division III Soccer were part of the study. Variables (data) gathered included: Sit-ups, push-ups, bench press maximum, leg press maximum, t-agility and a 40 yard dash spring test.

Data were analyzed using matched pairs (dependent) *t* analyses. Dependent *t*-analysis was selected over analysis of covariance since the number of subjects was small and the project was an action research study. Two tables are presented.

Table 1
Mean and Standard Deviation of Pre and Post Fitness Tests

		Mean	N	Std. Deviation
Pair 1	SitUpTest	49.18	17	14.540
	SitUpTest2	55.88	17	12.454
Pair 2	PushUpTest	23.29	17	11.362
	PushUpTest2	31.29	17	12.776
Pair 3	BPCConversion	577.35	17	131.816
	BPM2	676.47	17	98.612
Pair 4	LPMConversion	1829.41	17	375.441
	LPM2	2329.41	17	453.135
Pair 5	TAgilityTest	10.8271	17	.59422
	TAgilityTest2	10.8100	17	.63353
Pair 6	40yarddash	6.2006	17	.47373
	40yarddash2	6.0435	17	.44369

Table 1 shows the increase in athletic performance from the pre-test fitness to the post-test fitness through the mean and standard deviation. The repetitions performed during the sit-up,

push-up, leg press maximum and bench press maximum increased from pre to post fitness testing and therefore show an increase in athletic performance.

Table 2
Mean and Standard Deviation of Differences Between Pre and Post Fitness Tests

		Mean	Std. Deviation	t value	df.	Significance
Pair 1	SitUpTest - SitUpTest2	-6.706	6.332	-4.366	16	.000
Pair 2	PushUpTest - PushUpTest2	-8.000	7.348	-4.489	16	.000
Pair 3	BPCConversion - BPM2	-99.118	87.039	-4.695	16	.000
Pair 4	LPMConversion - LPM2	-500.000	303.109	-6.801	16	.000
Pair 5	TAgilityTest - TAgilityTest2	.01706	.16278	.432	16	.671
Pair 6	40yarddash - 40yarddash2	.15706	.11585	5.590	16	.000

Table 2 shows that the null hypothesis was rejected in five of the six fitness tests. Using the off-season strength and conditioning improved athletic performance in every test except the T-agility test where no significant data was found on a .05 scale.

CHAPTER V

DISCUSSION

The purpose of this study was to determine whether the use of an off-season strength and conditioning program would result in athletic performance increase. In an attempt to test this idea a pre-test using six different fitness tests was issued including: 40 yard dash sprint test, t-agility test, push-up test, sit-up test, leg press maximum test and a bench press maximum test. An eight-week training regimen was issued to 17 female collegiate soccer players including agility, strength, cardiorespiratory and core exercises. Immediately following the eight-week training regimen post-tests were performed rejected the null hypothesis in 5 of the 6 dependent variables and retained the null in 1 dependent variable. Significant findings were present in each of the tests except the t-agility test. Each of the tests which accounted for the weight being lifted or repetitions saw a greater increase in the post-test showing that the use of the strength and conditioning program did increase the athletic performance. There were no significant findings in the t-agility tests. While some of the players were able to decrease the time it took to perform the test, the findings were not significant. The use of an off-season strength and conditioning program was able to produce athletic performance increases in the majority of the athletes' fitness testing.

Comparison to Literature

In the study done by Hoff and Helgerud (2004), an increase in the results of a 40-yard dash sprint test, t-agility test, situ-up test and push-up test would result in an increase in athletic performance. However, the results in this specific quasi-experimental study show that there was no increase in the t-agility test. Further studies done on this specific test and an off-season strength and conditioning program should be performed. Sporiš et al. (2010) expresses that the

growth in muscle hypertrophy will go hand in hand with agility allowing a stronger athlete to perform at a high intensity with change in direction. However, the researcher in this study found that while strength increased through the pre-test and post-test comparison that the agility performed through the t-agility test showed no significant findings.

Threats to Validity

This study has both internal and external threats to the validity. Internal sources of threats to validity include the flaws in design and execution of the study. The pre-test was done at a 6:00 am practice and therefore the subject's motivation level and energy level may have been lower than usual. The execution of the study may also have been affected because all of the test involving running were performed on the same day which could mean not enough time for adequate rest in-between tests. An experimenter bias effect could have come into play because the subjects are coached by the experimenter. A sense of pressure or need to please may have been experienced by the subjects of this study. The results may have been skewed because there was no control to compare the results to and the sample was not randomized.

External sources of threats to validity include the possibility of different results when using multiple Division III Collegiate women's soccer teams. The different teams may show different results in testing due to their training environment and/or coaching style used by their coaches. The sample was limited only to the Women's Soccer Team at Goucher College.

The study supports that of findings throughout other studies and research done regarding all components of an off-season training regimen for athletes in general but specifically soccer players. The use of many different sources of training including strength training, endurance and cardiorespiratory training as well as speed and agility will increase the athletic performance of an individual. According to Nessel, (2009) the three elements of training that must be addressed in

order to allow the body to reach a peak of being in shape are endurance, strength and power;” all of which were used in this study. While the physical changes take place, the research shows that psychological and physiological changes occur as well. A player’s body will adapt and change according to the type of training executed and with much practice, repetition and strength and endurance building an athlete can improve athletic performance.

Implications for Future Studies

In reference to future studies, it was observed that female collegiate soccer players at a Division III level improved athletic performance through the use of an off-season strength and conditioning program. Although research over the matter has been going on for some time, future research is still warranted. Future suggestions include addressing types of motivation and encouragement, taking a look at the intensity of the training being used and the coaching styles for each of the institutions as well as using the program for a longer period of time. Observing the subjects throughout their training regimen will allow the experimenter to evaluate whether or not the subjects are performing the training at a significant and similar intensity to disallow or discourage different results for different subjects. Performing the tests at multiple times within the training regimen would more closely monitor the changes seen in athletic performance.

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