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VO2max and Playing Time in Female Collegiate Soccer Players

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$VO2_{max}$ and Playing Time in Female Collegiate Soccer Players

Introduction

There are almost two million youth female soccer players in America; however, less than thirty-six thousand of these athletes get the chance to play in college (NCSA). Female soccer players require a high level of aerobic fitness to be successful on the field. In fact, individuals with higher aerobic fitness are more likely to receive more playing time (Esco, 2014). In order to measure this aerobic fitness, sports coaches can use a $VO2_{max}$ test. A $VO2_{max}$ test, or a maximal oxygen uptake test, refers to the maximum amount of oxygen that the human body is able to deliver from the circulatory system into the muscles (Habibi, 2014). In other words, $VO2_{max}$ refers to the maximum volume of oxygen that can be consumed, or utilized during exercise.

Individuals with higher aerobic fitness have a higher $VO2_{max}$; this greater oxygen consumption provides greater adenosine triphosphate (ATP) production to enhance athletic performance. A $VO2_{max}$ test typically consists of an individual performing high intensity aerobic exercise, such as running on a treadmill, while measuring their heart rate and gas exchange. Numerous studies, including Dawes (2016), Strom (2018) and Vasileios (2018), have shown that $VO2_{max}$ tests can be beneficial in determining both placement on athletic teams and the likelihood that the individual will receive playing time. Additionally, Strom (2018) found that the $VO2_{max}$ test was the best way to determine aerobic conditioning and fitness.

Multiple studies have determined the benefits of $VO2_{max}$ testing, the changes of $VO2_{max}$ results throughout a period of intense training, and the placement of individuals on a team using $VO2_{max}$ values (Adnan, 2011; Davis, 1992; Dawes, 2016; Esco, 2014; Haugen, 2014; Shete,

2014; Vasileios, 2018). However, no known studies have been conducted in order to determine how playing time affects $VO2_{max}$. For example, studies such as Esco (2014) and Dawes (2016) have supported that training and athletic events help increase $VO2_{max}$ results, but there has not been any previous evaluation of individuals who receive very little playing time.

The question arises as to the connection of increased playing time for some players, and consequently decreased playing time for other players, and its association with subsequent increases and/or decreases in $VO2_{max}$. For example, each game lasts at least ninety minutes. Therefore, an individual who plays the entire game will complete ninety more minutes of combined aerobic and anaerobic exercise each game compared to a player that does not receive any playing time. Additionally, practices are often focused around the players with the most playing time, so individuals who do not participate in games often do not get to participate as much in practices either. Unless these players compensate for this lack of fitness outside of practices or games, they may fall severely behind.

The purpose of this study is to determine the effects of playing time on maximal oxygen consumption in collegiate female soccer players. It is hypothesized that the players with the highest $VO2_{max}$ values during pre-season will receive more playing time during the beginning of the year. As playing time increases, the $VO2_{max}$ values of these players will subsequently increase as well. However, individuals with lower $VO2_{max}$ values during pre-season will receive less playing time, and subsequently these individuals' $VO2_{max}$ values will decrease as the season progresses.

This study may give athletes and coaches a better understanding of the likelihood of whether or not athletes are going to receive playing time. If an athlete has a very low $VO2_{max}$

during preseason testing, there may be a greater likelihood that these individuals will not be put in the starting lineup, and will be less likely to receive playing time. The participants with more playing time on the team may receive more conditioning during the games and thus increase their $VO2_{max}$. While participants with more playing time are increasing their aerobic capacities, the players with less playing time are not receiving this opportunity. This study will help determine if the participants with more playing time will increase their $VO2_{max}$ while $VO2_{max}$ values of participants with less playing time may remain the same or decrease. If the values of participants with less playing time are decreasing while the values of participants with more playing time are increasing, there will be an even larger gap between the aerobic conditioning of these two types of players that the participants with less playing time must cross in order to receive playing time.

Literature Review

Soccer is an incredibly intense sport that requires repetitive sprinting, running, jumping, and turning. Thus, to be a successful soccer player, an athlete must not only be physically fit, but they must also be aerobically conditioned (Stolen, 2005). Shete (2014) reported the difference in $VO2_{max}$ values between females that participate in regular physical activity and females that do not participate in regular physical activity. Similar to the current study, Shete (2014) focuses specifically on females between the ages of seventeen and twenty-two. While the females who participated in regular physical activity had a $VO2_{max}$ of 39.62 ± 2.80 ml/kg/min, the females who did not participate in regular physical activity only had a $VO2_{max}$ of 23.54± 3.26 ml/kg/ min. The more aerobically conditioned a female athlete is, the higher their $VO2_{max}$ will be, which is especially important for soccer players. Vasileios (2018) reported that the average soccer player

runs approximately five to seven miles per game and heart rates tend to be between 150 to 190 beats per minute. Within the average population, a female between the ages of seventeen and twenty-two that has excellent maximal oxygen uptake should have a $VO2_{max}$ values higher than 56 milliliters per kilogram per minute. As previously mentioned, collegiate soccer players must be extremely aerobically fit. Thus, the individuals that receive the highest playing time were predicted to have $VO2_{max}$ values higher than 56 ml/kg/min.

Likewise, Esco (2014) reported that higher $VO2_{max}$ values have been associated with athletes being able to run farther distances at a faster speed. Additionally, these individuals have better ball work and technical skills. Consequently, individuals who have better aerobic capacities are more likely to be successful on the field. Similarly, Aslan (2012) reported that each athlete reached over eighty percent of their heart rate max during games. Over eighty percent of the game is spent in aerobic fitness, and the rest is spent sprinting. It was also determined that $VO2_{max}$ increased with repeated games and practices. The more exercise the individual performed, the higher these values tended to be. Furthermore, Datson (2014) reported that female professional soccer players run at least six miles per game and that they sprint at least a mile of this distance. Finally, it was concluded that female soccer players perform approximately fifteen hundred movement changes throughout a game. These conditions can cause an athlete to fatigue quickly. In fact, it was found that there are decrements in playing ability between the first and second halves due to fatigue (Datson, 2014). Thus, the body's ability to quickly recover is extremely important. The individuals with higher $VO2_{max}$ values would be more likely to maintain the ability to perform at higher levels. Thus, it is expected that female athletes who are aerobically conditioned would be more likely to accomplish this successfully.

Additionally, Esco (2014) found that more elite teams tend to have higher $VO2_{max}$ on average than less advanced teams. Therefore, $VO2_{max}$ can be an accurate predictor of overall fitness levels among collegiate soccer players. Sports coaches can use $VO2_{max}$ data to determine which players deserve to be in the starting lineups, and to determine playing time. Similar to Esco (2014), Haugen (2014) also reported that $VO2_{max}$ values are also higher among more elite teams. Compared to Division I players, national team players were found to have five percent higher $VO2_{max}$ values. Additionally, Division I players had thirteen percent higher $VO2_{max}$ values than Division II teams. Zerf (2018) also reported that male athletes must have a $VO2_{max}$ of at least 60 ml/kg/min in order to perform at elite levels. This minimum value indicates that individuals with lower VO2 values will be unlikely to succeed at elite levels, suggesting that higher $VO2_{max}$ values are needed to compete at elite levels. Therefore, players with higher $VO2_{max}$ values can be expected to have more playing time than individuals with lower $VO2_{max}$ values.

Not only can $VO2_{max}$ data show fitness levels at the beginning of an athletic season, but data can also be used as a tool to track the progression of fitness levels throughout the season. Esco (2014) reported that $VO2_{max}$ values improve by the end of the athletic season. In less than eight weeks, the average $VO2_{max}$ value increased by 2.6 ml/kg/min. The highest change was 3.3 ml/kg/min. These findings are mirrored in a separate study completed by Dawes (2016) that determined preseason testing can have a significant impact on playing time. Dawes (2016) reported that coaches who use these types of preseason performance tests are more likely to be able to make educated decisions on which athletes should receive more playing time and start on the field or court during games.

Additionally, researchers tested the $VO2_{max}$ of a group of professional soccer players before and after a period of preparation time. After this period, there was an increase in $VO2_{max}$ of almost 20 percent (Vasileios, 2018). The initial average $VO2_{max}$ value was 53.6 ± 7.7 mL/kg/min, and the average value after the training period was 64.4 ± 5.7 mL/kg/min. This data can be used to determine the differences in $VO2_{max}$ values of individuals who play most of the game and individuals who receive very little playing time. Therefore, measuring an individual's $VO2_{max}$ throughout the season can help determine the correlation between playing time and the change in $VO2_{max}$. However, each individual's $VO2_{max}$ value cannot be evaluated on its own; it must be compared by position.

Each position in soccer has different fitness requirements, making it centripetal that one compares $VO2_{max}$ between players of each position, rather than comparing the entire team as a whole. For example, a forward or a midfielder is more likely to be more aerobically conditioned and have a higher $VO2_{max}$ value than a defender or a goalkeeper. Davis (1992) determined that goalkeepers had the lowest $VO2_{max}$ values on the team with 56.4 ± 3.9 ml/kg/min ($p < 0.01$). The next lowest position for $VO2_{max}$ values was found to be defenders with $VO2_{max}$ values of only $p < 0.05$ higher than the goalkeepers. The forwards were found to be the quickest among the positions; however, their $VO2_{max}$ values were not quite as high as the midfielders with (61.4 ± 3.4 ml/kg/min). Additionally, these results were also reflected in a study conducted by Adnan (2011), in which it was reported that there was noteworthy deviation between $VO2_{max}$ values of different soccer positions due to running requirements. It was found that midfielders on average run at least 2,600 meters or 1.62 miles more than defenders or forwards. This is because they are responsible for both defensive and offensive actions.

Haugen (2014) also reported that there are differences among positions and $VO2_{max}$ values. In this instance, midfielders were found to have eight percent higher $VO2_{max}$ values than their goalkeepers had, thereby helping to explain or signify that playing time and $VO2_{max}$ values must be compared based on position. This conclusion was also evident in the aforementioned study conducted by Dawes (2016). In this particular study, Division II basketball players were the participants. However, researchers concluded that there was a slight relationship between an individual's $VO2_{max}$ and their allotted playing time (r = - 0.120). Despite these findings, it was also determined that specific positions that required longer running tended to have much higher $VO2_{max}$ (Dawes, 2016). Since most soccer positions require players to run up and down a majority of the 120 yard field, current researchers might draw conclusions that $VO2_{max}$ values would be a much more beneficial predictor of playing time in soccer players than in basketball players.

Although these studies have made it evident that $VO2_{max}$ testing is vital to understanding athletes' aerobic fitness throughout the season, maximal testing is not always beneficial or effective for athletes. Strom et al. (2018) determined that a submaximal $VO2_{max}$ test was more beneficial to athletes because it required less overall exertion. During a submaximal test, the individual will still participate in aerobic exercise, but they do not continue until maximal aerobic capacity is reached. Instead, they participate in a shorter test until they either reach a certain level, distance, or percentage of their maximum; this allows for nearly identical results without requiring full exertion from the athlete. This type of testing does not place as great of a strain on the athlete, so it is much more beneficial to athletes that are currently in season.

Noonan (2000) also determined that submaximal tests were more effective and valuable when attempting to find $VO2_{max}$ values. Although maximal tests are the most accurate, they are more difficult to measure. In order to achieve accurate results, the participants would have to reach maximum exhaustion, which is not only unlikely, but also may be extremely dangerous. Doing a maximal test during the season could cause injuries, and it would also not make valid results due to the players being tired from the season. Additionally, Akalan (2008) determined that submaximal testing was more cost effective, could be used on a variety of patients or participants, and was more effective when determining the $VO2_{max}$ values of more than one individual. More importantly, Akalan (2008) discovered that the researcher must take into account what population the participant is a part of to get the most accurate results. For example, a healthy, elite individual would need a completely different test compared to that of a sedentary, ill individual of the same age. A Cooper 1.5 mile run test will be conducted since the participants of this study are elite, athletic females.

The Cooper 1.5 mile run test entails an individual running a timed 1.5 miles as quickly as possible. After this is completed, the time is placed into an equation to estimate the $VO2_{max}$ value. Due to the nature of this aerobic fitness test, the speed of the run is placed in the participant's hands. In order to get accurate results, the individual must try their hardest. Luckily, Habibi (2014) reported that there is a positive correlation between the rating of perceived exertion and $VO2_{max}$ values. If the individual perceives the run as difficult, then they likely will provide accurate results, which makes motivating the participant is centripetal to limiting inaccurate or lower $VO2_{max}$ values. Additionally, Noonan (2000) discussed the Cooper 1.5 mile run test. It was determined that this test was the most beneficial examination of $VO2_{max}$ values

among athletes. These results were also supported by the results of a study conducted by Sartor (2013), in which it was reported that submaximal tests using running protocols were the most beneficial option for healthy individuals. Because the current study is evaluating the $VO2_{max}$ values of fit individuals, the running test should provide the most accurate results. Additionally, since soccer players run frequently, running on a track would be a better test than running on a treadmill.

Finally, $VO2_{max}$ values can be reproduced over short time periods. Santos-Silva (2007) conducted a study using eleven professional Brazilian soccer players. Two maximal VO2 tests were performed during the season with fifteen days in between them. It was found that there was little variation in $VO2_{max}$ values over such a short period of time. In fact, there was less than a single milliliter average difference between the two testing days. Therefore, it was determined that $VO2_{max}$ values can be reproduced. Although numerous studies have been conducted in order to monitor changes in $VO2_{max}$ values over time, Santos-Silva (2007) is vital in that it exhibits that these values can be reproduced. Therefore, $VO2_{max}$ values should be stable over time and reproducible unless more minutes are played. This will ensure increases in $VO2_{max}$ values are due to increases in playing time or fitness levels rather than randomized elevations.

Methodology

This study involved both quantitative and experimental research. It was conducted at Texas A&M University - Commerce using the women's soccer team. The potential participant pool was the twenty-five players on the team. Age ranged from 17 to 20 years old, ($M = 18.83$, $SD = 1.34$).

The Cooper 1.5 Mile Run Test allows a researcher to estimate total $VO2_{max}$ by using a prediction equation. Participants completed a 1.5 mile run at best effort pace. After the run was completed, the following equation was used to determine the $VO2_{max}$ values: $VO2_{max}$ = 89.39 - (time x 3.61) (Grant, 1999). Participants completed the informed consent prior to the collection of data (Appendix A). Additionally, height and weight for the participants were recorded on a separate data collection sheet (Appendix B). At that time, their positions were also recorded. Participants reported to the track at the Memorial Stadium at Texas A&M University - Commerce for the Cooper 1.5 mile run. The only instruments needed besides the track were stopwatches, a scale (Tanita TBF-300A BIA analyzer, Arlington Heights, IL), and a stadiometer (SECA Stadiometer, Chino, CA). Participants completed a self-paced warm-up before running 6 laps around the track. The 1.5 mile run time was recorded for each participant. After the run, participants completed a self-paced cool down.

There were three different testing intervals throughout the playing season. The first testing period was the pre-testing of $VO2_{max}$ values; this occurred on July 30th, 2022. This test was conducted prior to the season starting during preseason. At this point, playing time was equal to zero. The next two tests were conducted at the mid-point of the season (October 4, 2022), and at the end of the season (November 16, 2022). These tests occurred approximately six weeks after the previous test. The playing time at this point was summed from the conference website using the post-game statistics, which can be found at the following link: https://lionathletics.com/sports/womens-soccer/stats?path=wsoc. Statistics include which players start and how much playing time they receive during each game. Playing time was added up between the first and second test, the second and third test, and the overall playing time during

the season. Data was then compared to the new $VO2_{max}$ values. The changes in VO2max were calculated between the first and second test, the second and third test, and then the overall change throughout the season.

Statistical analysis

Descriptive statistics were reported for participant demographics including age, height, and weight. A repeated measure ANOVA was used to determine if there was a difference in 1) $VO2_{max}$ from pre-season to mid-season to post-season and 2) $VO2_{max}$ and position. Additionally, paired samples t-tests were used to determine the relationship between $VO2_{max}$ and playing time throughout the season.

Results

The participants were 18 female Division I soccer players. The average age was 18.83 ± 1.34 years (mean ± SD). The average pre-season weight was 65.56 ± 9.83 kg, and their average height was 167.24 ± 7.39 cm. The results of the Pearson *r* correlation indicated there was only a weak correlation between $VO2_{max}$ and playing time. Mid-season $VO2_{max}$ and playing time data show a weak negative correlation of $r = -0.190$. Post-season $VO2_{max}$ and playing time data show a weak positive correlation of $r = 0.098$. However, the repeated measure ANOVA results indicate that there was a significant difference between the pre-season, mid-season, and post-season $VO2_{max}$ values [$F(1.17, 10.56) = 12.63$, $p = 0.004$]. Mauchly's test indicated the sphericity assumption was violated, $\chi^2(2) = 9.76$, $p = 0.008$), and the Greenhouse-Geisser estimate of sphericity was used ($\varepsilon = 0.587$). Significant main effects show VO2 was greater at pre-season (47.39 ± 4.47 ml/kg/min) vs mid-season (43.44 ± 4.08 ml/kg/min, $p < 0.001$) and post-season (42.77 ± 4.82, p = 0.004). There was no significant difference between mid-season and

post-season VO2 values ($p = 0.586$). Finally, there was no significant difference in VO2 values between the positions, except between the goalies and midfielders, ($p = 0.042$). The average VO2 of mid-fielders was 47.84 mL/kg/min; the average for goalies was 39.77 mL/kg/min. The forwards had an average VO2 value of 43.77 mL/kg/min, and the defenders had an average value of 44.92 mL/kg/min.

Table One

Descriptive Statistics

	n	Mean	Std. Deviation
Height (cm)	18	167.24	7.39
Age (years)	18	18.83	1.34
Pre-Season Weight (kg)	16	67.58	9.83
Pre-Season VO2 (mL/kg/min)	16	45.45	5.11
Mid-Season VO2 (mL/kg/min)	16	42.63	4.86
Post-Season VO2 (mL/kg/min)	14	42.76	4.24
Mid-Season Playing Time (min)	18	553.44	326.64
Post-Season Playing Time (min)	18	1002.33	624.02

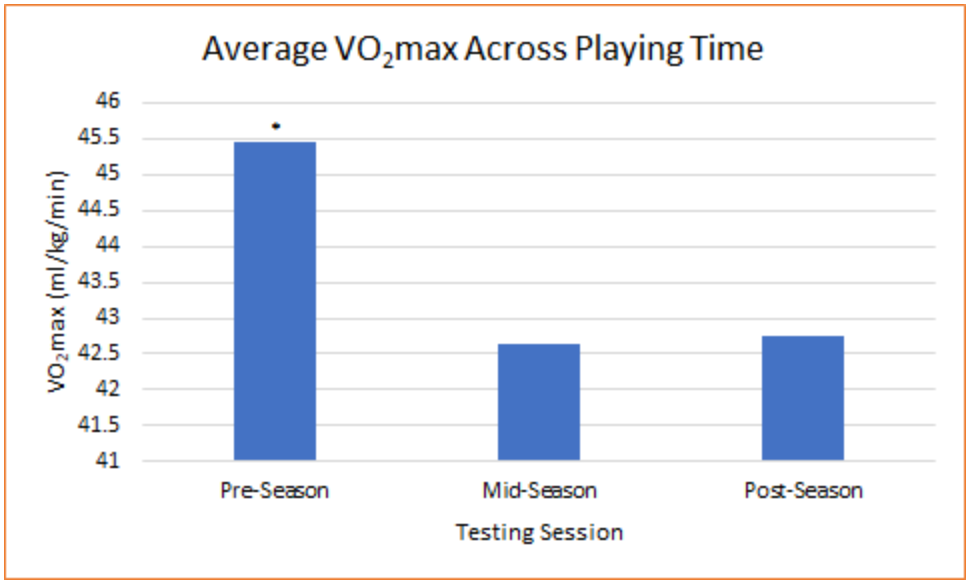

Figure 1. VO2max during the season. VO2 was greater at pre-season vs mid-season ($p < 0.001$) and post-season (p = 0.004)

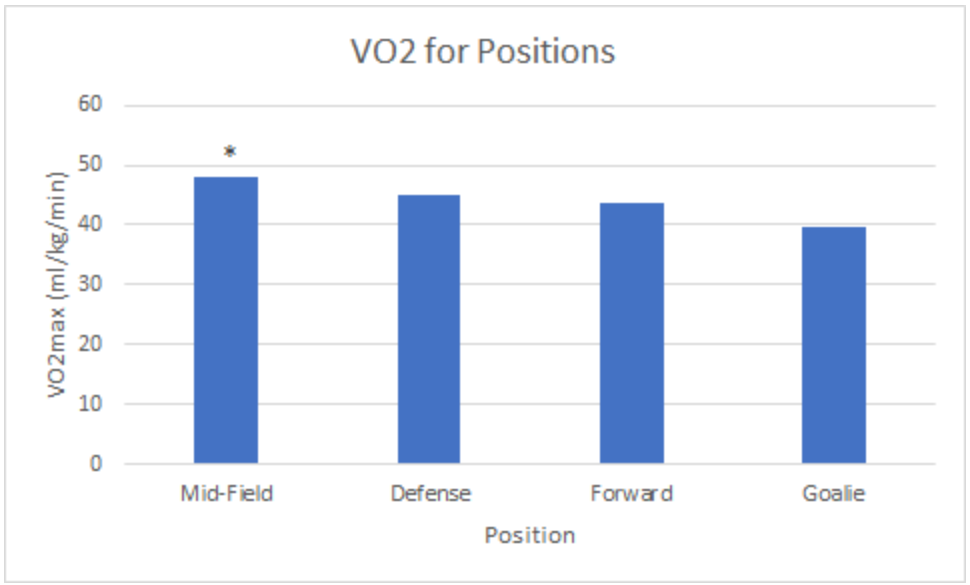

Figure 2. Average VO2 value based on position. Mid-fielders had higher VO2max compared to goalies (p = 0.042).

Discussion

The purpose of this study was to determine the effects of playing time on maximal oxygen consumption in collegiate female soccer players. It was hypothesized that the players with the highest $VO2_{max}$ values during pre-season would receive more playing time during the beginning of the year. However, there was only a weak, negative correlation of $r = -0.105$. Dawes (2016) reported that preseason testing can heavily impact playing time; this can only occur though if the coaches are aware of the results. Thus, this hypothesis relied on the coaches having access to the results of the preseason testing session. Due to the study being entirely voluntary, all the athletes chose to not disclose their VO2 values to the coaching staff. Therefore, the coaches did not have access to these results in order to make more educated decisions on which athletes should receive more playing time and start on the field during games.

In 1992, Davis found that there was significant variation in VO2 values between the different positions. However, these results were not consistent with the current study. This study found that the only significant difference occurred between the goalies and the mid-fielders, $p = 0.042$. This could be due to the playing style of the team being monitored. For example, the outside defenders play similarly to wing players, running from one 18 yard box to another. The forwards, on the other hand, are not required to run quite as much, so the rest of the analysis will not be based on position.

It was also hypothesized that as playing time increased, the $VO2_{max}$ values of these players would subsequently increase as well. On the other hand, it was hypothesized that individuals with lower $VO2_{max}$ values during pre-season would receive less playing time, with their values decreasing as the season progresses. However, the results of this study indicated that there was only a weak correlation between $VO2_{max}$ values and playing time. In fact, rather than

$VO2_{max}$ values increasing as playing time increased, there was a weak negative correlation between preseason and midseason VO2 and playing time with $r = -0.190$. However, there was a slight positive correlation between midseason and post-season VO2 and playing time of $r = 0.098$. Nevertheless, both the midseason ($p < 0.001$) and postseason ($p = 0.004$) VO2 was found to be significantly lower than those during the preseason testing .

These results are inconsistent with several other studies. For example, Esco (2014) found that VO2 values improved over an eight week athletic season by approximately 2.6 ml/kg/min, with a maximum change of 3.3 ml/kg/min. Similarly, Vasileios (2018) documented a 20 percent increase in VO2 after a period of preparation time. However, these results were not observed in the current study. Rather than playing time causing VO2 values to increase, the results display the opposite relationship. As playing time increased, VO2 seemed to decrease. This could be due to several factors. For example, the midseason testing session was done the day after a major game due to it being the athletes' only available day. Fatigue and exhaustion could contribute to these decreased VO2 results. Thus, it is important to further this study in order to determine the exact correlation between playing time and maximal oxygen consumption.

However, these results are consistent with the results of Dawes (2016) with Division II basketball players. The results of the study indicated that although some positions that require more running tend to have higher VO2 values, there was only a minor relationship between $VO2_{max}$ values and playing time (Dawes, 2016). It was assumed that this finding would be rendered inconsequential due to the drastic difference in how much soccer players run compared to basketball players. Nevertheless, this finding may illustrate that there is not as much reliance on VO2 values once athletes reach an elite level of play.

Although the results of this study did not support the hypotheses, the study did provide valuable insight. The results indicated that VO2 values actually declined throughout the season. However, after receiving a brief, two week break, there was a slight increase in VO2 values. This suggests that more rest may contribute to higher performance. If the athletes become fatigued and exhausted by the end of the season, performance will decline. This study suggests that it is important to do further research into practice schedules and recovery periods in order to have the most efficient performance levels.

Delimitations

There were several delimitations put in place during this study. First, the participants were limited to a single, Division I soccer team. This was done due to the busy schedules of the student-athletes. It would have been extremely difficult to schedule more than one team's testing sessions during a single competitive season. Having one team as the population sample enabled there to be much more freedom and flexibility in scheduling. This also allowed each athlete to participate in the exact same practices, so there would not be discrepancies in VO2 values due to differences in conditioning at practices.

Additionally, there was a period of two weeks of complete rest given to the athletes prior to the post-season testing session. The athletes traveled 3.5 hours during the last week of the season to compete in the conference championship. During this time, they competed in three games within five days. Several athletes experienced minor overuse injuries, so this break allowed these athletes to rest and recover prior to the last testing session. This break could have contributed to the minor positive correlation between playing time and VO2 values between the mid-season and post-season testing sessions.

Limitations

There were some limitations present pertaining to this study. First, because participation was entirely voluntary, participants did not have any incentive to complete each testing session. Thus, there were instances when athletes simply chose not to show up to a testing session. This made it more difficult to draw accurate conclusions and correlations. Similarly, since there was a small sample size, injuries throughout the season were debilitating. In order to ensure that the current study did not cause detrimental effects to the athletes' health or the team's performance, any injured players, no matter how minute the injury, were not allowed to participate in the respective testing session. These two factors caused there to be only ten out of the twenty participants that completed all three testing sessions. This could have led to discrepancies in the results of the data.

Another limitation was that there was no way to tell whether the decreases in performance were caused by exhaustion or soreness rather than a decrease in the ability to transport oxygen to the muscles. The chosen population, being student-athletes, are extremely busy. Having to take out time to complete a testing session for this study makes their already difficult schedule even busier. Without a questionnaire to determine how the athlete felt, both mentally and physically, there was not any way to determine whether the VO2 values were accurate. The lower VO2 values could have been due to bodily fatigue or a lack of motivation rather than an inability to sufficiently deliver oxygen to the working muscles.

Finally, there could have been discrepancies in the data due to biased decisions on who gets playing time. For example, some players with the lowest VO2 values actually had some of the highest amounts of playing time. These players have special skills, such as heading or

throwing ability, that make their being on the field centripetal to success. These athletes are not required to run as much during games because their unique abilities are needed regardless of fitness abilities.

Further Study and Conclusion

For future studies, it is important to have a larger participant pool. This would account for injuries and lack of participation to ensure there are enough participants to develop meaningful, significant data. For this specific study, it might have been beneficial to use every female soccer team within the conference. This data could then be compared to the teams' overall performance throughout the season. Additionally, it could be advantageous to incorporate the run for the testing sessions into the team's actual fitness requirements. This would mean that each athlete is required to participate in the run, but their data could only be used if they decided to participate in the study. This would allow the athletes to be more motivated in order to get more accurate results.

Additionally, there should be a questionnaire or survey provided to the athletes before and after each testing session. This survey should ask the athletes to rate their average hours of sleep, level of fatigue, potential injuries, and level of soreness. The post testing session survey should also ask how they felt during the run and their perceived level of exertion. This could help the researcher have a better understanding of how accurate the results are.

Appendix A

Information about Being in a Research Study
Texas A&M University-Commerce

Assessment of $VO2_{max}$ and Playing Time in Female Collegiate Soccer Players

Description of the Study and Your Part in It

(Advisor) and (Student Name) are inviting you to take part in a research study. (Advisor) is an assistant professor at Texas A&M University-Commerce. (Student) is an honors student at Texas A&M University-Commerce. The purpose of this study is to determine the relationship between estimated $VO2_{max}$ and playing time among collegiate female soccer players

Your part in the study will be weight and height assessment prior to the commencement of the study. You will then complete a 1.5 mile run at three different points during the semester. Each run will be about six weeks apart.

It will take you about an hour and a half total to be in this study.

Choosing to Be in the Study

You do not have to be in this study. Participation is voluntary. You may choose not to take part and you may choose to stop taking part at any time without penalty. You will not be punished in any way if you decide not to be in the study or to stop taking part in the study.

Risks and Discomforts

There will be minimal risks, no more than that expected in daily exercises. These may include sore muscles or minor injuries from participating in exercise. If injury is experienced, the participant will be referred to the TAMU Student Health Center for treatment.

Possible Benefits

Participants will receive their estimated VO2max at three different times during the soccer season. This can be helpful to the athletes to determine if they need to adjust their workouts due to changes in their VO2max during the season.

Incentives

No financial or other compensation will be offered.

Protection of Privacy and Confidentiality

We will do everything we can to protect your privacy and confidentiality. We will not tell anybody outside of the research team that you were in this study or what information we collected about you in particular. Any data that is accumulated throughout this research study will remain confidential. All data collected through this study will remain confidential. Names or participation status will not be released without written consent. If results of the study are published, no individual information will be disclosed. Only the researchers will be given access to any identifying information or participation status of the individuals within this research study. Finally, the coaches will not have access to participant data without written consent from the athlete.

We might be required to share the information we collect from you with the Texas A&M University-Commerce Office of Sponsored Programs and the federal Office for Human Research Protections. If this happens, the information would only be used to find out if we ran this study properly and protected your rights in the study. The data collected will be retained for a minimum of three years.

All written data accumulated from the participants will remain locked in the TAMUC Health and Human Performance laboratory. Any electronic data records accumulated will remain on a password protected laptop. Only researchers previously acknowledged will have access to any of these data records. Additionally, each participant will be given a random number in order to ensure that their privacy and results are kept confidential during the research and during its publication.

You may choose to stop taking part in this study after today. If you do, we will not collect any more information from you. However, we would keep and use the information we had already collected from you.

Contact Information

If you have any questions or concerns about this study or if any problems arise, please contact the researcher at

(Advisor)
Department of Health and Human Performance

Texas A&M University-Commerce
(Number)
(Email)

If you have any questions or concerns about your rights in this research study, please contact the IRB Chair at

Dr. Lucy Pickering
Chair, Institutional Review Board (IRB)
Department of Literature and Languages
Texas A&M University-Commerce
Commerce, TX 75429-3011
IRB@tamuc.edu

Consent

The signature below affirms that the undersigned is at least 18 years old, has received a copy of this consent form, has understood the above information, and agrees to voluntarily participate in this research.

Participant's signature: _____ Date: _____

A copy of this form will be given to you.

Appendix B

Data Collection Sheet

Participant Name:_____
Participant ID#:_____
Weight:_____
Height: _____
Position:_____

Preseason 1.5 Mile Run Time:_____
Date Taken:_____
Preseason estimated $VO2_{max}$:_____

Mid-season 1.5 Mile Run Time:_____
Date Taken:_____
Mid-season estimated $VO2_{max}$:_____

Postseason 1.5 Mile Run Time:_____
Date Taken:_____
Postseason estimated $VO2_{max}$:_____

Works Cited

Adnan, R., Sharifudin, S. A., Wahidah, T., Sulaiman, N. (2011). The VO2max Differences Based on the Position Roles Amongst Malaysia Leagues Soccer Athletes. *2011 IEEE Colloquium on Humanities, Science and Engineering*, https://doi.org/10.1109/chuser.2011.6163736.

Akalan, C., Robergs, R. (2008). Prediction of $VO2_{max}$ from an Individualized Submaximal Cycle Ergometer Protocol. *ResearchGate*, www.researchgate.net/publication/277048924_Prediction_of_$VO2_{max}$_from_an_individualized_submaximal_cycle_ergometer_protocol.

Aslan, A., Acikada, C., Guvenc, A., Goren, H., Hazir, T., Ozkara, A. (2012). Metabolic Demands of Match Performance in Young Soccer Players. *Journal of Sports Science & Medicine*, 11(1), 170-179.

Datson, N., Hulton, A., Andersson, H., Lewis, T., Weston, M., Drust, B., Gregson, W. (2014). Applied Physiology of Female Soccer: An Update. *Sports Medicine (Auckland)*, 44(9), 1225-40. https://doi.org/10.1007/s40279-014-0199-1.

Davis, J., Brewer, J., Atkin, D. (1992). Pre‐Season Physiological Characteristics of English First and Second Division Soccer Players. *Journal of Sports Sciences*, 10(6), 541-547. https://doi.org/10.1080/02640419208729950.

Dawes, J., Marshall, M., Spiteri, T. (2016). Relationship Between Pre-Season Testing Performance and Playing Time among NCAA DII Basketball Players. *Sports and Exercise Medicine - Open Journal*, 2(2), 47–54. doi:10.17140/semoj-2-138.

Esco, M., Snarr, R., Williford, H. (2014). Monitoring Changes in $VO2_{max}$ via the Polar FT40 in Female Collegiate Soccer Players. *Journal of Sports Sciences*, 32(11), 1084-1090. doi:10.1080/02640414.2013.879672.

Grant, J., Joseph, A., Campagna, P. (1999). The Prediction of $VO2_{max}$: A Comparison of 7 Indirect Tests of Aerobic Power. *The Journal of Strength and Conditioning Research*, 13(4), 346. https://doi.org/10.1519/1533-4287(1999)013<0346:tpooma>2.0.co;2.

Habibi, E., Dehghan, H., Moghiseh, M., Hasanzadeh, A. (2014). Study of the Relationship between the Aerobic Capacity ($VO2_{max}$) and the Rating of Perceived Exertion Based on the Measurement of Heart Beat in the Metal Industries Esfahan. *Journal of Education and Health Promotion*, Medknow Publications & Media Pvt Ltd, 3, 55. www.ncbi.nlm.nih.gov/pmc/articles/PMC4114002/#:~:text=VO2%20max%20(also%20maximal%20oxygen,use%20oxygen%20in%20motor%20muscles.

Haugen, T., Tonnessen, E., Hem, E., Leirstein, S., Seiler, S. (2014). VO2max Characteristics of Elite Female Soccer Players, 1989–2007. *International Journal of Sports Physiology and Performance*, 9(3), 515-521. https://doi.org/10.1123/ijspp.2012-0150.

Zerf, M., Zohar, B., Gourar, B., Ali, B. (2018). VO2max Levels as a Pointer of Physiological Training Status Among Soccer Players. *Acta Facultatis Educationis Fisicae Universitatis Comenianae*, 58(2), 112-21. https://doi.org/10.2478/afepuc-2018-0010.

NCSA. Everything You Need to Know about Women's College Soccer Scholarships. *NCSA Sports*, https://www.ncsasports.org/womens-soccer/scholarships.

Noonan, V., Dean, E. (2000). Submaximal Exercise Testing: Clinical Application and Interpretation. *Physical Therapy*, 80(8), 782-807.https://doi.org/10.1093/ptj/80.8.782.

Santos-Silva, P., Fonseca, A., de Castro, A., Greve, J., Hernandez, A. (2007). Reproducibility of Maximum Aerobic Power (VO2MAX) Among Soccer Players Using a Modified Heck Protocol. *Clinics (São Paulo, Brazil)*, 62(4), 391-96.https://doi.org/10.1590/S1807-59322007000400004.

Sartor, F., Vernillo, G., de Morree, H., Bonomi, A., La Torre, A. Kubis, H., Veicsteinas, A. (2013). Estimation of Maximal Oxygen Uptake via Submaximal Exercise Testing in Sports, Clinical, and Home Settings. *Sports Medicine (Auckland)*, 43(9), 865-73. https://doi.org/10.1007/s40279-013-0068-3.

Shete, A., Bute, S., Deshmukh, P. (2014). A Study of VO 2 Max and Body Fat Percentage in Female Athletes. *Journal of Clinical and Diagnostic Research,* 8(12), https://doi.org/10.7860/jcdr/2014/10896.5329.

Stolen, T., Chamari, K., Castagna, C., Wisloff, U. (2005). Physiology of Soccer. *Sports Medicine*, 35(6), 501-536. https://doi.org/10.2165/00007256-200535060-00004.

Strom, C., Pettitt, R., Krynski, L., Jamnick, N., Hein, C., Pettitt, C. (2018). Validity of a Customized Submaximal Treadmill Protocol for Determining Vo2max. *European Journal of Applied Physiology*, 118(9), 1781-1787. https://doi.org/10.1007/s00421-018-3908-x.

Vasileios, A., Athanasios, S., Antonios, S., Nikos, G., Giorgos, P. (2018). The Increase of $VO2_{max}$ Variation and the Specific Biochemical Parameters in Soccer Players after a Pre-Season Training Program. *Journal of Physical Education and Sport*, 18(2), 686-694. https://doi.org/10.7752/jpes.2018.02100