



Research Article

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Perceptions of Current Training Monitoring Techniques for Fatigue Used by Strength Coaches on NCAA Division II Women's Soccer Players

Brandon Snyder^{1,2} *, Brian Oddi¹, Marc Federico¹, Rebecca Hess¹, Shala Davis² and Gavin Moir²

¹Exercise and Sports Science Department, Pennsylvania Western University California, United States of America

²Exercise Science Department, East Stroudsburg University of Pennsylvania, United States of America

*Corresponding author: Brandon Snyder, East Stroudsburg University, 200 Prospect Street, East Stroudsburg, PA 18031, United States of America.

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Abstract

NCAA Division II women soccer athletes may experience high levels of fatigue which negatively affects their performance on the field. Although coaches agree that monitoring fatigue is an important element in program design, there is no one widely accepted measure used to monitor training. Thus, the primary purpose of this study was to provide an investigation on the preferred mode of action by strength and conditioning coaches to reduce fatigue and increase performance of NCAA Division II women's soccer players. Eight (n=8) head strength and conditioning coaches, two (n=2) women's soccer coaches, and eighteen (n=18) women's soccer players from the NCAA Division II PSAC participated in this retrospective qualitative study from the fall 2019 semester. Strength and conditioning coaches and head women's soccer coaches participated in a semi-structured interview while women's soccer players completed an open-ended survey to share their insights to examine the current fatigue monitoring techniques utilized at the NCAA Division II level with all information subsequently analyzed thematically to code the data. All strength and conditioning coaches interviewed believed monitoring fatigue is important (100%), yet only a select number of coaches are currently implementing such fatigue monitoring techniques (38%). Of the programs being implemented, the women's soccer players believed the programs do help reduce fatigue (72%) and increase performance (78%). Thematic analysis of the barriers that strength and conditioning coaches face to implement a fatigue monitoring program were also identified, which include limited staff, budget, and facilities at the NCAA Division II level. With the wide range of fatigue monitoring techniques available, selection and implementation of the most appropriate test based on the various factors at each specific university can provide an effective and productive system to garner the most out of each athlete during training and competition.

Keywords: Fatigue monitoring, NCAA Division II, women's soccer, Strength and conditioning coaches

Introduction

Athletes are continually striving to improve their performance during competition, and training sessions, as well as in the weight room. To continually increase their performance, many athletes, coaches, and support staff are taking an increasingly scientific approach to both designing and implementing training programs [1]. To increase performance, athletes are participating in more training

programs, practices, and competitions over the course of the year, thus increasing their overall training load. The resultant fatigue from the added training load can take up to three days to return to baseline post-competition, with sports that have frequent competition (less than three days between) inducing accumulative fatigue over time [2,3]. Excessive and repeated fatigue (chronic) could lead



athletes to a state of non-functional overreaching associated with negative physiological, psychological, and sociological measures as well as a higher risk of injury occurrence [3,4]. In NCAA college athletics, between the years of 2009-2014, soccer athletes had the highest competition injury rate of any NCAA sport across all Divisions; 17.2 per 1,000 injured athletes [5]. Previous research has identified low injury rates as one of the most important factors in team success [6]. Thus, a well-designed and appropriate training program is essential to both individual and team success.

Even when a training program is appropriate and adequate recovery time is administered between each session, optimal gains in muscular strength and performance for each individual athlete are not assured. Research has shown that athletes who perform the same resistance training program can elicit different adaptations while completing identical programs [7]. This is due to individual factors such as athlete's genetics as well as external factors such as effort, sleep, and lifestyle choices, which all play a role in the overall benefits or hindrance of performance [8]. Due to the individual responses by athletes to the same training load, one must have a means of monitoring the responses of the athlete. Thus, a way for the coaching staff to monitor the fatigue of the athletes is a crucial element in program design.

Although coaches agree that monitoring fatigue is an important element in program design, there is no one widely accepted measure used to monitor training [9]. This can be seen through the number of tests currently being examined in research which includes wellness questionnaires, rating of perceived exertion (RPE) scales, biochemical markers, countermovement jump, squat jump, etc. [3]. As well as the many different techniques used to monitor training and the recent focus on research to monitor training, coaches are still relying on personal experiences and anecdotal information, with most strategies routinely incorporated remaining unpublished [9].

As well as the many different techniques used to monitor training, another factor the strength and conditioning coaches must take into consideration is the collegiate athletes' return to play. Athletes' schedules and training programs have been greatly affected due to the COVID-19 pandemic. All NCAA Division II women's soccer programs within the PSAC lost their Spring 2019 non-championship season and Fall 2020 championship season due to the COVID-19 pandemic. An advisory panel for the NCAA has recommended the importance of a 7 to 10-day transition period to reduce the stresses the athletes will experience as they return to their normal training regimen [10]. These added stresses, as well as an unusual training schedule for each athlete, make it imperative that strength and conditioning coaches utilize best practices to monitor fatigue and to reduce the chance of injury.

A previous survey study examined fatigue monitoring techniques in NCAA (all Divisions and NJCAA) male soccer players and found that nearly one-third of the coaches performed no athlete monitoring over the course of the season [11]. Interestingly, si-

milar to the information reported by Jones, et al., (2017), [3] the other two-thirds of the surveys collected had used monitoring tools of a wide variety that included sports performance, self-reported questionnaires, and physical performance tests [11]. The NCAA is made up of 3 Divisions, with NCAA Division 1 being the highest level of competition and funding. The NCAA Division 1 consists of just about 25% of all soccer programs within NCAA competition. This research finding may not provide the true story of fatigue monitoring techniques with strength and conditioning coaches at the NCAA Division 2 and 3 levels with potentially lower funding and less support staff.

As well as the potential for limited support staff and funding, a recent article saw that both position and general performance capacity has a great impact on the presence of fatigue during a soccer match in soccer players competing in the four highest divisions in the Netherlands [12]. Players that have a lower general performance capacity reported a higher presence of fatigue both before a match started as well as during various check points during the match [12]. Based on these findings, individuals that are not participating at the NCAA Division 1 level may be more susceptible to experiencing higher levels of fatigue. Furthermore, the position of the attackers at each of these respective schools may experience more fatigue compared to the defensive position players.

Thus, the primary purpose of this study was to provide an investigation on the best mode of action by strength and conditioning coaches to reduce fatigue and increase the performance of NCAA Division II women's soccer players. A secondary aim of this study was to determine which tools used to monitor fatigue are currently being utilized in the Pennsylvania State Athletic Conference NCAA Division II women's soccer programs and the athlete's perceptions on the ability of these tools to reduce the fatigue. Conclusions drawn from this NCAA Division II setting can provide insight into the implementation of programs with schools of smaller stature and limited funding.

Materials and Methods

The purpose of this ethnographic case study was to provide an investigation on the best mode of action by strength and conditioning coaches to reduce fatigue and increase the performance of NCAA Division II women's soccer players. The case study consisted of the lived experiences of the strength and conditioning coaches of an NCAA Division II conference within the same geographical location. This ethnographic case study employed the following means of data collection: interviews with strength and conditioning coaches of the women's soccer team, interviews with selected women soccer coaches, and an open-ended online survey completed by women's soccer players of the current monitoring tools within the same NCAA Division II conference. The integration of multiple data sources allows for an in-depth understanding with multiple viewpoints and the presence of triangulation to allow for a sound and thorough qualitative research design [13].

Participants

Certified strength and conditioning coaches that train the women's soccer team at each of the 18 PSAC institutions were asked to participate in this retrospective study during the spring 2021 semester (n=18). Purposeful sampling was used as well as homogeneous sampling to examine the different training monitoring procedures used at the 18 institutions with their NCAA Division II women's soccer teams during the fall 2019 season. The retrospective perceptions from the fall 2019 season were chosen due to the cancellation of the PSAC women's soccer season in the fall 2020-spring 2021 school year due to the COVID-19 pandemic. Exclusion criteria consisted of any strength and conditioning coach at any of the 18 PSAC universities that have not trained the women's soccer team during the fall 2019 academic semester, any women's soccer coach that was not the coach during the fall 2019 season, or any current soccer players at the institution that was not on the roster during the fall 2019 championship season. To achieve saturation, selected women's soccer players and coaches from the universities within the same conference was also utilized to help solidify and achieve triangulation in accordance with the strength and conditioning coaches' responses. If the school did not participate or acknowledge any fatigue monitoring technique, then that school's women's soccer players and coaches were excluded from the examination. IRB approval was gained from East Stroudsburg University of Pennsylvania and California University of Pennsylvania. Gate keeper notification to each athletic director of the 18 PSAC institutions was also contacted prior to contact with any strength and conditioning coach, women's soccer coaches, or women's soccer players. Consent from all participants was also collected prior to participation in the study.

Data Collection

The collection of three different data points first started with interviews by the strength and conditioning coaches at the respective universities, followed by interviews with the selected head sport coaches, and an open-ended online survey sent to women's soccer players at the same institutions. To ensure validity of the questions, all interviews, and the survey were reviewed by a current strength and conditioning coach before any interview or survey took place. After review of all surveys by the current strength and conditioning coach and before any survey or interview took place, each subject was asked to read the informed consent which detailed the interview protocol, a brief description of the study, an explanation of what will be required of the participants, and an assurance of confidentiality.

Interviews with Strength and Conditioning Coaches: After gatekeeper notification to the athletic director at each of the respective PSAC universities, each strength and conditioning coach was emailed during the spring of 2021 and was asked to participate in an interview on the fall 2019 championship season and any training techniques utilized during the COVID-19 pandemic. The semi-structured interview with each strength and conditioning coach

within the PSAC was administered by the primary researcher via Zoom from February through April of 2021. This time frame was selected due to the unusual alteration of the normal championship season due to the COVID-19 pandemic and the eventual cancellation of the women's soccer season during September of 2020. Utilizing an ethnographic case study approach, the interview sought to gain insight on the best mode of action by strength and conditioning coaches to reduce fatigue and increase performance through the fall 2019 semester and current trends administered during the athletes return to play after the loss of their 2020-2021 championship season. The interview discussed concepts such as the coaches' demographic data, which included education and background in the field, the mode of action used to reduce fatigue in women's soccer players, and how the coaches perceived current research for administering techniques for monitoring fatigue during the COVID-19 pandemic. Semi-structured interviews were developed based on the work by Pope, Penney, and Smith (2018) and Sams (2017) [11,14]. To strengthen the credibility of the interview, member checking took place. The interview was then transcribed verbatim and sent back to the interviewee to confirm what was said or make changes as deemed appropriate. Interviews lasted between 30 minutes and one hour in length.

Interviews with Women's Soccer Coaches: After the conclusion of the interviews with each strength and conditioning coach, four head women's soccer coaches within the same conference were invited to participate in a semi-structured interview. Exclusion criteria from the random selection consisted of any women's soccer coaches associated with any strength and conditioning coach that stated they currently do not use any fatigue monitoring technique. Semi-structured interviews were developed based off the work by Pope, et al., (2018) and Sams (2017) [11,14]. The interview discussed concepts such the coaches' demographic data, which included education and background in the field, the mode of action used to reduce fatigue in women's soccer players, and the coach's perceptions on the success of the mode used to reduce fatigue. The interview was scheduled and then recorded through Zoom. The semi-structured interview questions allowed for open-ended exploration of topics and feedback about the investigation to the best mode of action to reduce fatigue and increased performance of NCAA Division II women's soccer players and the ability of the mode of action to adequately reduce fatigue during the fall 2019 championship season and the COVID-19 pandemic. The second set of interviews allowed for a different viewpoint with the soccer coaches directly involved with the performance of each athlete on the field on an everyday basis. Within two weeks of data being collected from each semi-structured interview, the researcher transcribed verbatim each interview, and member checking took place. Emails were sent to each participant to allow the interviewee to review how their statements were noted and provide the option to add, remove, or alter the content in any way they felt best conveyed their perceptions. Interviews lasted between 30 minutes and one hour in length.

Survey to Women's Soccer Players: During the same time the interviews were taking place with the head women's soccer coaches at three PSAC universities, an open-ended survey created by the primary researcher (Snyder, 2021) titled "Athletic Monitoring in NCAA Women's Soccer," was sent to each current rostered women's soccer player at each of the same four PSAC institutions from the fall 2019 semester and was adapted from the work by Akenhead and Nassis (2015), Sams (2017), and Taylor, et al., (2012) [11,15,16]. The open-ended survey was sent through email by the primary investigator, and each player had three weeks to complete the survey through Survey Monkey. The survey included the informed consent, and the first question of the survey asked if the athlete agrees to participate in the study. If the athlete did not agree, the athlete was thanked, and the survey was concluded at that time. The survey was designed to provide an understanding of the athlete's perception of current fatigue monitoring techniques and the ability to reduce fatigue. All open-ended surveys were reviewed by the primary investigator, and each individual was contacted for a follow-up on the answers provided if needed.

Data Analysis

Interview data from the strength and conditioning coaches, head women's soccer coaches, and the surveys distributed to the women's soccer players were analyzed thematically to code the data. The open-ended interviews were recorded with the permission of the participants in Zoom and then transcribed using Otter-ai. Dedoose, an electronic data analysis software, was used to analyze the data. Using an inductive approach, meaningful units of text was attributed to themes and subsequently coded to nodes. The process was repeated many times to allow for accuracy and the nodes to evolve to ensure the data was accurately reflected. The nodes were then further divided into lower-order and higher-order themes. The researcher also elicited the opinions of content experts in the field for further external validity of the findings. Data analysis focused on exploring the following set of ideas; (1) what was the strength and conditioning coach's perceptions of the current tools used to monitor fatigue in women's soccer players at their respective institution, (2) what were the athlete's perceptions of their performance while utilizing the current monitoring tools used to monitor fatigue and (3) how did strength and conditioning coaches perceive the administering techniques for monitoring fatigue on their athlete's performance?

Results

The primary purpose of this ethnographic case study was to provide an investigation on the best mode of action by strength and conditioning coaches to reduce fatigue and increase performance of NCAA Division II women's soccer players. A secondary aim of this study was to determine which tools used to monitor fatigue are currently being utilized in the Pennsylvania State Athletic Conference NCAA Division II women's soccer programs and the athlete's perceptions on the ability of these tools to reduce the fatigue. Feedback was received through semi-structured interviews with head

strength and conditioning coaches (n=8), semi-structured interviews with head women soccer coaches (n=2), and an open-ended questionnaire with women's soccer athletes from the Fall 2019 semester (n=18). Primary themes emerged from each question, and an additional theme arose, which will be discussed in detail. The additional theme that emerged does not directly relate to any of the three research questions mentioned above but will help to further explore the perceptions and lived experiences of current strength and conditioning coaches and their practical experience while working with Division II athletes.

Demographic Characteristics

A total of eight (all male) head strength and conditioning coaches agreed to participate in the study. The interviews took place during the Spring 2021 semester, but the focus was on the perceptions from the Fall 2019 season because it was the last championship season for women's soccer due to the COVID-19 pandemic and cancellation of the fall 2020 sport season. Out of the 18 institutions that participate in women's soccer in the PSAC, five schools had either a new strength and conditioning coach or no current strength and conditioning coach in place and were excluded from the study, leaving the total number of schools contacted at 13 (8 of 13 [62%]). The head strength and conditioning coaches' demographics, such as average years at the university, sports at each institution, and university population, is below (Table 1).

Table 1: Strength and Conditioning Coaches Demographics.

Years at the University	5.50±4.04
Sports at the University	18.13±1.81
University Population (Fall 2019 Semester)	6,630.75±1902.53

Note*: N=8.

Some participants in the study involved a job assignment solely as the head strength and conditioning coach, while others held dual appointments by serving as the strength and conditioning and a supplemental role on campus. All participants' job responsibilities included no more than two roles (Table 2).

Table 2: Strength and Conditioning Coaches Assignment Load.

Assignment	Frequency	Percent (%)
Full-Time Strength Coach	4	50
Mixed- Load Strength Coach	4	50

Note*: Example of mixed loads seen were employees who acted as an athletic trainer and strength and conditioning coach, head men's soccer coach and strength and conditioning coach, or faculty member and strength and conditioning coach.

Along with the eight head strength and conditioning coaches, two women's soccer coaches, and 18 women's soccer athletes also agreed to participate in this study. The initial methodology was designed to interview four women's soccer coaches, but after the

first interview phase, only three of the eight participating schools discussed fatigue management techniques utilized during the Fall 2019 season. Out of the three women's soccer coaches asked to participate, two of the coaches agreed (2 of 3 [67%]). All women's soccer athletes that participated were from the same institutions as the two women's soccer coaches that agreed to participate. The women's soccer players that were asked to complete the survey participated in the Fall 2019 season at their respective institution and were still currently participating in the sport at the institution during the Spring 2021 semester. The subject demographics for these groups are below (Table 3).

Table 3: Head Women's Soccer Coaches and Women's Soccer Players Demographics.

Head Women's Soccer Coaches	Number of Participants	2
	Years at the University	15.5 ± 2.12
	Level of Education	Master's degree
Women's Soccer Players	Number of Participants	18

Note*: All coaches and players that participated in the study performed or participated in some type of fatigue monitoring program during the Fall 2019 championship season.

Qualitative Data Analysis for Each Research Question

Research questions 1 and 3 directly related to the semi-structured interview conducted with each of the strength and conditioning coaches. Table 4 provides the frequency results and exemplars from the question 1 analysis (Table 4).

Table 4: Codes and Frequency Count for Research Question 1.

Code	Frequency	Exemplars
Beneficial to Monitor Fatigue	8	"I do think it (monitoring fatigue) is very important because that helps me gauge what they are up to, on a day in day out basis"
Recovery	4	"I think recovery is important in women's soccer"
Overtraining	4	"Overtraining happens probably quicker than people think"
Injury Prevention	3	"I mean (it is beneficial to monitor fatigue) in all athletes in general but with females because their predisposition to certain injuries"
Vary Intensity and/or Volume	7	"Yes, we vary training volume and intensity using micro cycles"

Note*: N = 8 (Strength and Conditioning Coaches).

Table 5 and 6 provide the frequency results and exemplars for the question 3 analysis (Tables 5,6).

Table 5: Codes and Frequency Count for Research Question 3.

Code	Frequency	Exemplars
Where do you believe you learned about your current techniques		
Journal Articles (Limited Use)	7	"The journal articles come from the NSCA and strength and conditioning research"
Professional Networking	4	"Networking with other coaches is where I have gained the most knowledge"
Personal Experiences	3	"I have kind of taken what I have learned through experience"
Additional findings Literature	3	"I would say like 85% of what I do now is from outside education"
Professional Conferences	1	"I also took information away from research conferences prior to the COVID-19 pandemic"

Note*: N = 8 (Strength and Conditioning Coaches).

Table 6: Codes and Frequency Count for Research Question 3 Continued.

Code	Frequency	Exemplars
Ideal Fatigue Monitoring Methods		
Heart Rate Variability/Heart Rate Tracking	4	"I would use heart rate monitors"
GPS Tracking	3	"Each athlete would have GPS and heart rate units on, and the coaches would be tracking every single player in real-time"
Force-Velocity Measurements	2	"I like the gym aware equipment to get real time feedback"
Jump Mat	2	"I would also use a just jump mat or similar device to give me an indication of neuromuscular fatigue"
Sleep Patterns	1	"I would be monitoring their sleep patterns"

Note*: N = 8 (Strength and Conditioning Coaches).

Research question 2 directly related to the open-ended survey conducted with each of the women's soccer athletes from two different soccer programs within the PSAC. The two schools comple-

ted separate fatigue monitoring techniques. One school utilized the RPE scale before each practice or training session began while the other school classified players in three different groupings based on minutes played in the previous match. Based on their classification, strength and conditioning sessions were adjusted accordingly. Of the initial 38 women's soccer athletes contacted, 18 completed the questionnaire for a response rate of 47%.

Table 7 provides the frequency results and exemplars from the analysis. Nine women's soccer players from each school responded. The players from the university that used the RPE scale responded yes, the program did help reduce fatigue ($n = 4$), and no, the program did not help reduce fatigue ($n = 5$). The players that were classified in three groups based on minutes played all found the program to be effective at helping to reduce fatigue ($n = 9$) (Table 7).

Table 7: Codes and Frequency Count for Research Question 2.

Code	Frequency	Exemplars
Training Monitoring Program Helped Reduce Fatigue	13	"Yes- our trainers listened to us and the scale helped keep us less fatigued"
Training Monitoring Program was Not Effective at Reducing Fatigue	5	"No because athletes are not truthful with their answers"
Increased Performance	14	"Yes, it kept my body in peak performance over the season without overdoing it"
Injury Reduction	3	"Yes, if we were sore and our coaches knew that, we did not go hard that day which helped us prevent injuries"
Tools to Aid in Recovery	14	"Yes, if many of us were tired or sore they altered the lift or the practice on the fly to be more of a recovery day"

Note*: N = 18 (Women's soccer athletes).

Research Question 1: What is the strength and conditioning coach's perceptions of the current tools used to monitor fatigue in women's soccer players at their respective institution?

Two themes emerged under research question number one, which details how strength and conditioning coaches perceive the current tools to monitor fatigue in women's soccer players in a Division II conference. The way the strength and conditioning coaches perceive the benefits of monitoring fatigue will directly relate to the need to implement such techniques. Two major themes were identified within research question one, as seen in (Table 8).

Table 8: Themes for Research Question 1.

Themes	Frequency	Percent
1. Strength and conditioning coaches believe it is beneficial to monitor fatigue.	8	100
2. Strength and conditioning coaches believe there are varied benefits to monitoring fatigue.	6	75*

Note*: N = 8. *Some coaches believe there is more than one benefit to monitoring fatigue as discussed in Table 8 and will be further covered below.

A. Theme 1. Strength and Conditioning Coaches Believe It is Beneficial to Monitor Fatigue:

Every strength and conditioning coach interviewed from the PSAC (8 of 8 [100%]) believes that it is beneficial to monitor fatigue. Participant 1 stated, "I think it is important to monitor fatigue and know when we can ramp things up and when we need to pull things down." While Participant 3 stated, "Yes, it is beneficial (to monitor fatigue) to help with the recovery cycle. It is also important to help maintain the idea that our objective, the athlete's objective, and the coaches' objective are running parallel." According to *DeWese, et al.*, (2015), fatigue can be present due to external factors such as effort, sleep, and lifestyle choices, which will all play a role in the overall benefits or hindrance of performance [8]. Thus, Participant 8 stated, "I do think it is very important because that helps me gauge what they are up to, on a day in and day out basis." Participant 5 also believes it is important due to the limited scholarship availability. Participant 5 commented,

I do think it is important. Especially at the university we are at. We do not have a lot of scholarship money. So, we do not rely on all 30 players or all 35 players that are on the roster. Our women's soccer coach usually has a rotation where he is 14, maybe 15 players that make an impact in the game. So, we have to be careful with what we are doing in terms of training.

Although all coaches believe monitoring fatigue is important, one coach stated they do not have the adequate resources to properly monitor fatigue. Participant 4 stated,

But monitoring fatigue should definitely be something that is investigated more frequently. We do not have access to the necessary equipment to do so here. But it could be it could be game changing, depending on how it is used. At my university specifically, I think it is a combination of both budget and staffing to purchase as well as use the heart rate monitors and analyze them correctly.

B. Theme 2: Strength and Conditioning Coaches Believe There are Varied Benefits to Monitoring Fatigue:

Participants provided feedback on what they believed are the most important benefits of monitoring fatigue with common statements that consisted of recovery, injury prevention, and overtraining. Most participants (6 of 8 [75%]) stated that at least one of these items is why it is beneficial to monitor fatigue with some of the participants provided a belief that there are multiple reasons

as to why monitoring fatigue is important. Participant 1 stated, "So yeah, I think from a performance training, stimulus, and injury prevention monitoring fatigue is key." While Participant 8 also agreed that there are multiple benefits. Participant 8 added,

So, if I know what their fatigue level is, I know if an athlete is overtraining, or if they are not training up to what my expectations for them are, and more importantly, because I am also the athletic trainer, that helps me prevent injuries. The majority of the injuries that I see on the practice field are injuries that occur late because we practice for two and a half hours. Most of those are fatigue related.

According to *Ascensao, et al., (2011)* and *Jones, et al., (2017)*, resultant fatigue from added training load can take up to three days to return to baseline from post-competition [2,3]. Many participants believe monitoring fatigue is important for recovery. Participant 2 added, "It (monitoring fatigue) is very valuable, because it helps with monitoring recovery after heavy games and heavy workloads." Participant 5 agreed, "I think recovery is important in women's soccer players." Participant 1 also added,

It is important from the standpoint of injury prevention, but also from the standpoint of training stimulus. What I mean is that overtraining happens probably quicker than people think. So, if you are kind of fatigued, and your kind of beat down, whether its localized or system kind of neuromuscular fatigue, either one, we are not going to the get the same training stimulus that we need. So sometimes it is beneficial to evaluate fatigue, and do mobility, do relaxation exercises, things like that.

Research Question 2: What are the athlete's perceptions of their performance while utilizing the current monitoring tools used to monitor fatigue?

Three themes emerged under research question number two which details the athletes' beliefs in the effectiveness of the current monitoring tools being implemented to increase performance and reduce fatigue over the course of the season. Achieving athlete buy-in to the program will directly relate to the effectiveness of the program and increase the likelihood of athletic performance over the course of the season. The three major themes identified within research question 2, as seen in (Table 9).

Table 9: Themes for Research Question 2.

Themes	Frequency	Percent
1. Athletes believe the training monitoring program helped increase performance.	14	78
2. Athletes believe the training monitoring program helped reduce fatigue.	13	72
3. Balance in training stimulus to aid in recovery based on fatigue and/or soreness.	14	78

Note*: N = 18 (Women's soccer athletes).

A. Theme 1. Athletes Believe the Training Monitoring Program Helped Increase Performance. Most athletes that participated in the open-ended survey believed that the training monitoring program helped increase their performance over the course of the Fall 2019 season (14 of 18 [78%]). Participant 3 stated, "Yes- we were honest with our bodies, and we were able to work off of it." While Participant 15 also believed it helped by adding, "I do believe it increased my performance because I was able to recover better and perform at my highest with the appropriate changes." Participant 18 also believed it helped by stating, "Yes because even if you were in the red, you still did some type of movement that day to keep you going strong."

According to Timmons (2011), athletes who perform the same resistance training program can elicit different adaptations while completing identical programs. This is of particular importance, not only for each individual athlete but also athletes who are coming back from surgical procedures [7]. Particularly with Participant 11, who had recently undergone ACL reconstruction, believes the program was critical towards her coming back to play. Participant 11 stated, "Yes, I was able to push myself on days when I wasn't sore. Then on days when I was sore, I could have a lighter lift, where I was able to still move and get a workout in but not push my body too far." While participant 13 also described the training program as a balancing act throughout the season with also taking an individualized approach. Participant 13 said, "Yes it increased performance in that it balanced pushing the limit while also letting the body relax at times. As mentioned before, it prevented injuries for the players who were exhausted at some sessions."

While other players did not believe the training monitoring program helped with their performance. Participant 1 stated, "No, I feel like (the RPE Scales) were not taken into account most of the time." Participant 8 also agreed with this sentiment and said, "No, because our coaches did not take advantage of the scales and it was not discussed much."

B. Theme 2. Athletes Believe the Training Monitoring Program Helped Reduce Fatigue: Most athletes that participated in the open-ended survey believed that the training monitoring program at their respective institution helped reduce fatigue over the course of the 2019 season (13 of 18 [72%]). Participant 11 stated, "Absolutely, the system allowed each player to specialize and adapt their lifting routine to their personal and physical capabilities based on how each person was feeling and their soreness level." While Participant 18 agreed, "Yes, it allowed me to correctly allow my body to recover and stay fit at the same time." Participants 17 and 18 also felt it was important to help with recovery and added, "Yes, it helps us recover," and "Yes, it allowed me to correctly allow my body to recover and stay fit at the same time." While recovery was a common thread echoed in the responses given from the athletes, a few athletes mentioned that the coaches were there to listen

to the athletes and adjust workouts accordingly. Participant 15 added, "I do believe the training monitoring program helped reduce fatigue because we were able to communicate with our coaches and strength and conditioning coach on how our bodies felt and they would adjust our workouts." Participant 4 also felt that the monitoring program was beneficial because of the coach involvement and stated, "Yes- our trainers listened to us, and the scale helped keep us less fatigued."

While some athletes did not believe the training monitoring program helped reduce fatigue. Participant 1 stated, "No, I feel like (the RPE Scales) they were not taken into account most of the time." Participant 2 echoed this, "No, does not make a difference." While Participant 8 believed that some athletes were not truthful with the answers they provided, reducing the effectiveness of the training monitoring system. Participant 8 stated, "No because athletes were not truthful with their answers."

C. Theme 3. Balance in Training Stimulus to Aid in Recovery Based on Fatigue and/or Soreness: Based on the athletes' feedback on the open-ended survey, it was apparent that the strength and conditioning coach and the athletic coaching staff listened to their athletes and made adjustments to the training stimulus for a given workout session to help aid in recovery and/or muscle soreness. Most athletes (14 of 18 [78%]) provided input that the coaches implemented many different tools to aid in recovery and soreness. A large number of athletes stated that this generally happened after games days. Participant 3 stated, "Yes- after game days we would have the strength coaches bring out foam rollers and do stretches. (They were) very understanding of our bodies and how we are feeling." Participant 5 also echoed this sentiment, "Yes, after really tough games we would have a cool down stretching practice to make sure we stretched out every muscle." Participant 4 also provided a similar response, "We had stretch days after hard game days." While another participant (Participant 16) from the second institution also provided similar information, "Yes, there were days after games where we lifted very lightly and focused on stretching."

Similar to the recovery after hard game days, a few participants also mentioned that they found it very beneficial that the strength and conditioning coach was routinely checking in with each one of them to see how they felt and made adjustments individually to their strength and conditioning program. Participant 13 stated,

Yes, our strength coach at the university is awesome. He really understands the athletes and lets us push it when we can and take a step back when we need. Even on yellow-red days, he lets us do some exercise to move the muscles the perfect amount.

While Participant 15 also mentioned the strength and conditioning involvement, "Every time my team would have lift, the coach and his team would check up on all of us and adjust how that training day went." While many of the responses focused

on adjusted weight training programs, stretching, and foam rolling, one athlete mentioned other forms of recovery. Participant 17 stated, "Yes they gave us days off, put us through pool workouts, and did put us through stretching."

Research Question 3: How do strength and conditioning coaches perceive the administering techniques for monitoring fatigue on their athlete's performance?

Two themes emerged under research question number two which details the strength and conditioning coaches' perceptions of the current fatigue monitoring techniques. Understanding where the coaches are garnering the information that they are currently putting into practice as well as what type of fatigue monitoring techniques they would implement in a perfect setting, provides great insight. The two major themes identified within research question 3, as seen in (Table 10).

Table 10: Themes for Research Question 3.

Themes	Frequency	Percent
1. Strength and conditioning coaches garner information from a variety of places for their current practices	7	88
2. Variety of ideal fatigue monitoring techniques that are not currently being implemented	7	88

Note*: N = 8.

A. Theme 1. Strength and Conditioning Coaches Garner Information from a Variety of Places for Their Current Practices: The majority of coaches (7 of 8 [88%]) stated that they garner their information from what is being implemented in their current practices. The most frequent response provided was in terms of information from journal articles (7 of 8 [88%]). Although this was a common response, some of the respondents (4 of 7 [57%]) stated that the information obtained from the articles is limited or too narrow in scope in most instances. Participant 3 stated, "I rely on information from journal articles the least. I do read the journal articles, but I derive a little bit less information from them, and I think they are narrow in scope." While participant 2 echoed the same sentiment, "I have been able to gain a little knowledge through some research journals..." While participant 7 felt stronger for the use of scientific journals and his current practices, "I have all of the NSCA strength and conditioning journals. I keep them and I do not throw them away when I'm done reading them, because I always end up highlighting and referring back to information and different things that I read in them."

Other areas in which the strength and conditioning coaches gather information used in current practices consist of professional networking (4 of 8 [50%]), personal experiences (3 of 8 [38%]), outside literature (3 of 8 [38%]), and through professional conferences (1 of 8 [13%]). In terms of experience and professional networking, Participant 2 stated, "Experiences and networking with other coaches is where I have gained the

most knowledge.” While Participant 5 felt that his experiences at his previous institution helped him the most in his current situation. Participant 5 said,

I think the best thing that happened to me was four years ago, I took over a Division I women’s soccer team, and it was a case of do whatever you want. I was leading every training session and ran every warmup for away games and home games. That for me cemented that we are doing some of the right things here. I was there for spring, fall and spring so you have three semesters worth of training and a lot of data points from there and was able to implement some of those things at my current university as well.

Another common thread that was highlighted by a few individuals is the use of outside literature that is not found in scientific journals. Participant 4 added, “I would say like 85% of what I do now is from outside education, or education outside of your standard college or master’s program or anything like that.”

B. Theme 2. Variety of Ideal Fatigue Monitoring Techniques That are Not Currently Being Implemented: Although coaches agree that monitoring fatigue is an important element in program design (8 of 8 [100%]), there is no one widely accepted measure that was seen in the strength and conditioning coaches’ interviews. The most frequent responses provided by the coaches (listed in descending order) consisted of heart rate variability/heart rate tracking (4 of 8 [50%]), GPS tracking (3 of 8 [38%]), force-velocity measurements (2 of 8 [25%]), jump mat (2 of 8 [25%]), and monitoring sleep patterns (1 of 8 [13%]). Interestingly, there are three current teams that are enacting some type of fatigue monitoring (one team is utilizing the RPE scale while two other teams are classifying players in three different groups and altering training load/strength training sessions based off minutes played) with their women’s soccer teams and all three teams are not implementing the same fatigue measure technique based on the response given to the question, “In an ideal world, what fatigue monitoring techniques and schedule would be implemented with the women’s soccer team?”

Some coaches provided 2 different fatigue monitoring techniques that would be implemented together to not only track the individuals in the weight room, but also to monitor the workload during training sessions on the field. Participant 2 responded, “Each athlete would have GPS and heart rate units on, and the coaches would be tracking every single player in real-time.” Participant 6 also believed this would be the most accurate way to monitor women’s soccer players by stating, “Daily monitoring of training load with GPS and heart rate/ heart rate variability.” Participant 4 also said he would use two different fatigue measurements in congruency. Participant 4 followed with,

I would use heart rate monitors. If I could get somebody to analyse the data, and then I would also use a jump mat or simi-

lar device to give me an indication of neuromuscular fatigue...I think by using both tests and then comparing the data gives us a nice insight into two different ends of the spectrum.

While Participant 1 and Participant 7 felt strongly that tracking the force-velocity curve for real-time feedback would be the best way to monitor fatigue with their women’s soccer athletes. Participant 1 stated, “So, I think from a continuously monitoring standpoint, something like a gym aware, would be important. But yeah, that would be the immediate feedback where you could make adjustments and learn how it is not only adjustments but it’s also motivation...” Participant 7 added,

We would use strictly velocity-based stuff. We would get tendon units and/or push bands, and have them attached to a barbell, and then use that to monitor fatigue, live in the weight room. That would allow us to cut out sets early because you are not achieving the right velocity that we are looking for with the barbell, but then also putting that in conjunction with like, a GPS tracker. So that we can monitor what is going on both in the weight room and on the field.

Additional Findings: Additional findings were considered that may not strictly align with one of the three research questions but are integral to the process of fatigue monitoring and the results of this study. The additional findings came from the semi-structured interviews with the strength and conditioning coaches and may provide insight as to why the ideal fatigue monitoring techniques are not being implemented currently at the Division II level within the PSAC system. The following additional theme emerged as seen in (Table 11).

Table 11: Theme for Additional Findings.

Theme	Frequency	Percent
1. Strength and conditioning coaches face different challenges specific to their university to implement ideal fatigue monitoring techniques	8	100

Note*: N = 8.

All strength and conditioning coaches provided detailed feedback as to the barriers limiting them from completing their job to the best of their ability. According to the strength and conditioning coaches, the following factors are the largest barriers to completing their job; limited staffing (4 of 8 [50%]), limited budget or no budget at all (4 of 8 [50%]), limited facilities (3 of 8 [38%]), lack of time (2 of 8 [25%]), and multiple roles on campus (2 of 8 [25%]). It is important to understand that each of these barriers faced are very university-specific and must be resolved on an individualized basis for each strength and conditioning coach. Participant 4 stated, “Am I going to have available space in the gym to do (speed and agility) outside the weight room? I do not know. So, there are a lot of things that I wish I could do that are just not feasible. Space, equipment, and staff would be the other barriers.” While Participant 7 followed up with,

It is time and staff, I think. My long-term goal at my university for this staff is create the sort of part-time assistant position that I have right now to turn that into a full-time position and then also to be able to obtain a graduate assistant position. I can expect more of a full-time load and be able to divide all the teams between the three of us and we can do more with that.”

The average number of sports at the strength and conditioning coaches’ universities was 18.13 ± 1.81 . This is a very large number of sports to handle when looking at some staff’s that consist of one or two permanent positions and maybe one or two graduate assistants or student interns. Participant 8 was adamant that staffing is one of the biggest problems at the Division II level. Participant 8 stated,

Staffing levels. I think no matter where you are, even if you are in Alabama, you are going to say you need more help. And obviously, at Alabama, that is just them talking. But I think when we look at our institutions here in the conference, you have one person that is overseeing and running programming for 400 or 500 student athletes. That is absurd. And it is a wonder that we have not had more “Maryland moments” at this level, then we have had, because of just limited staffing, That, to me, is the single greatest barrier. Well, I need to have this equipment but if you are a good strength and conditioning coach you can make even the smallest amount of equipment work. If you are a good strength coach, you could go ahead and make a really good program with just one single 45-pound plate without even a barbell. You just have to be really creative and challenge yourself to do that. So, to me, it is not about equipment it is people. And that is, that is how you can make athletes better.

While two of the participants felt they were much less concerned with current barriers limiting them from doing their work to the best of their ability. Participant 5 said,

We also do not have a budget, but it is not the end of the world. At my Division I school (that I was previously at) we had a decent budget with GPS tracking devices and getting breakfast for the girls after workouts, but I think this Division II soccer team would match up very well to the Division I team who had all the extra stuff.

Just like Participant 5, Participant 1 also felt good about the situation that he was currently in. Participant 1 stated,

The first thought that came to my mind is time. I am in an incredibly a good position and I feel so grateful to have great help. You know, we create a nice environment of learning and working together. I get to work with great people, and I am talking my immediate staff, and this also extends to our sport coaches as well. We have created a very good relationship over my tenure. But just time you know, I get inundated with teams due to myself having almost 230 or 240 athletes. When they are all on, it gets a little bit tougher. Since I have been here, we have been able to triple our space. We have had many athletes enter the professional ranks in their respective sports that have given back to our facilities. We have also had generous donations and fundraising to help increase our space to where we went from a capacity of 25 students to almost 60 athletes through a workout in an hour which is amazing.

Discussion

The primary purpose of this study was to provide an investigation on the best mode of action by strength and conditioning coaches to reduce fatigue and increase the performance of NCAA Division II women’s soccer players. A secondary aim of this study was to determine which tools used to monitor fatigue are currently being utilized in the Pennsylvania State Athletic Conference NCAA Division II women’s soccer programs and the athlete’s perceptions on the ability of these tools to reduce the fatigue. One must first understand the participating university’s structure to further investigate the techniques currently being implemented within this Division II conference.

The PSAC is comprised of 19 institutions and is the largest conference in the NCAA Division II. Within this conference, 14 of the schools are a part of the Pennsylvania State System of Higher Education (PASSHE). They are public state institutions, with most of the funding coming from the state and the affordable tuition paid for by the attending students. The PSAC is also comprised of four private institutions located in the state of PA and one public institution located in the state of West Virginia. For the present study, 8 of the 8 (100%) participating schools are public institutions (7 of the 8 currently in the PASSHE system) which enables the primary researcher to make comparisons of schools that include similar enrollments ($6,630.75 \pm 1902.53$) and are recipients of similar funding.

The results show that strength and conditioning coaches believed it is important to monitor fatigue with NCAA Division II women’s soccer players. Although the strength and conditioning coaches believe there is compelling evidence for many benefits of such monitoring, the results also found that there are limited schools currently utilizing such a program. The athletes also indicated that monitoring fatigue helped increase performance and reduce fatigue.

Benefits to Monitor Fatigue

Enhancing athletic performance while reducing the chance of injury is an integral part of program design [17]. To increase performance, athletes are participating in more training programs, practices, and competitions over the year, thus increasing their overall training load and increasing the likelihood of fatigue and potential injury. Therefore, a program to monitor training load and fatigue is an essential element that one must consider. The current findings within the PSAC at the NCAA Division II level show that all strength and conditioning coaches believe monitoring fatigue is important (8 of 8 [100%]), yet only currently three (3 of 8 [38%]) included a fatigue monitoring program in their current practices. The three programs currently being implemented include one team utilizing the ratings of perceived exertion (RPE) scale while two other teams were classifying players in three different groups and altering training load/strength training sessions based on minutes played. Previous research by Read (2016) examined the use of a fatigue monitoring program with strength and conditioning coaches at the NCAA Division I level [18]. Of the 240 coaches that responded,

75% of the strength and conditioning coaches utilized some type of current monitoring program with the most prominent responses including lifestyle tracking (82%), RPE scales (54%), vertical jump (41%), and a perceived recovery questionnaire (39%) [18].

Sams (2017) also examined the use of a fatigue monitoring program on schools across all levels (NCAA Division I, II, III, NAIA, and NJCAA) [11]. This exploratory study was significant because it provided a greater understanding of what is taking place across all levels of collegiate competition. Of the 119 coaches that responded, 109 of the coaches were from schools outside of the NCAA Division I level (109 of 119 [92%]) where funding and budgetary support are expected to be lower. Over half of the respondents (57.3%) stated that their current coaching staff does monitor their athletes' fatigue and recovery with the three leading responses including tracking performance in the sport (46.7%), self-reported questionnaires (38.7%), and physical performance tests (30.7%) [11]. In contrast, the present study reported only 38% of the current strength and conditioning coaches utilized a fatigue monitoring program which is relatively lower than the previously discussed studies [11,18]. Thus, we must further explore what is limiting such programs at the NCAA Division II level within the PSAC.

In the current study, all strength and conditioning coaches provided detailed feedback on the barriers limiting them from completing their job to the best of their ability. According to the strength and conditioning coaches, the following lived experiences are the largest barriers to completing their job; limited staffing (4 of 8 [50%]), a limited budget, or no budget at all (4 of 8 [50%]), limited facilities (3 of 8 [38%]), lack of time (2 of 8 [25%]), and multiple roles on campus (2 of 8 [25%]). It is important to understand that each of these barriers faced is very university-specific and must be resolved individually. Previous research by Judge, et al., (2014) examined the state of NCAA Division I athletics by looking at equipment, budget, and staffing at the top level of amateur sports. Their findings included a reported 73.8% of Division I schools have an equipment replacement budget of \$1,000-10,000 [19].

In contrast, a common statement made during the current interview process was the lack of budget for strength and conditioning, or they would have to request new equipment at the end of the year and see what is left over from the general athletic department budgets. Another statement that was provided on a limited basis during the research process was the strength and conditioning staff would have to seek assistance from alumni or professional athletes from the school to elicit funding for replacement equipment or any upgrades of the facilities. Although this could be seen more commonly at the Division I level, this is rarely seen at universities within the NCAA Division II or even Division III level.

Although it was difficult for each strength and conditioning coach to provide an exact number of staff due to fluctuating interns and graduate assistants yearly, only two schools stated they average more than six members on staff each year. It is important to

note that the six members on staff consist of one head strength and conditioning coach, one volunteer or full-time assistant, and four graduate assistants with a potential intern or two. Although this is a relatively strong financial commitment from the institution, this provides what seems to be adequate staffing with schools that average over 18 NCAA competing athletic teams yearly. One downfall to this structure is that it also leads to large turnover yearly with a large responsibility of the head strength and conditioning coach to adequately train and monitor the student assistants typically accepting short-term (1- or 2-year) positions. The more frequent number of staff reported during the current study was one or two paid positions with maybe one graduate assistant or a few undergraduate interns. This is far from the findings by Judge, et al., (2014), in which at Division I, the average strength and conditioning staff consisted of 7.7 employees (range 3 to 24) [19]. One respondent in the current study was adamant that staffing was an issue and said,

Staffing levels. I think no matter where you are, even if you are in Alabama, you are going to say you need more help. And obviously, at Alabama, that is just them talking. But I think when we look at our institutions here in the conference, you have one person that is overseeing and running programming for 400 or 500 student-athletes. That is absurd. And it is a wonder that we have not had more "Maryland moments" at this level, then we have had, because of just limited staffing. That, to me, is the single greatest barrier.

This is an issue that needs to be addressed at each university for the safety and welfare of the student-athletes. By increasing the number of staff and financial support at each university, you are not only decreasing the likelihood of turnover in the staff positions, but also eliciting a return in performance by each of the competing sport teams at the respective institutions.

Implications of the COVID-19 Pandemic

Although the strength and conditioning coaches at the NCAA Division II level believed there were some barriers to effectively instituting a fatigue monitoring program during the Fall 2019 semester, the COVID-19 pandemic will further elicit complications that each of the universities face. The economic fallout from COVID-19 on NCAA athletic departments is a top administrative concern at all levels but will arguably affect the smaller schools at the NCAA Division II, and III levels more since very few (if any) schools are making a profit within their collegiate athletic department [20]. Many universities a year after the pandemic began, within the PSAC and across the world, are still operating partially or fully remote. This has caused a large reduction in university budgets due to reduced tuition, little to no housing and food bills, and little to no fees being charged. This has led to sports being eliminated and athletics staff being reassessed, which could be a reason at the time of this research study that currently 5 of the 18 PSAC schools have either a new strength and conditioning coach or no strength and conditioning coach in place, ultimately leaving the expected subject pool at 13 for this study.

As well as budget, staff, and athletic team cuts, the COVID-19 pandemic has altered how strength and conditioning coaches can currently train student-athletes. The NCAA provided a full resocialization report that each university must follow [10]. There are a set number of days when the athletes return to campus that they must train at a lower intensity before moving to the next phase to limit injury and help the athletes build up both stamina and strength. More importantly, the NCAA also issued guidance to help protect the student-athletes in terms of social distancing by reducing capacities in weight rooms and other training facilities [10]. This was routinely mentioned during the interview process with women's soccer (as well as other athletic teams on campus) having to split into two or three groups to adhere to COVID-19 procedures while still trying to implement the best training program, thus increasing the amount of time each strength coach spends in the weight room as well as during their working day. Prior to the COVID-19 pandemic, the strength and conditioning coaches already mentioned limited time and staffing, yet these issues are even more pressing during the current climate. Although many problems need to be addressed at the NCAA Division II level, one strength and conditioning coach believes the COVID-19 pandemic could help his planning move forward. Accordingly, another statement provided more insight,

But I really look at COVID as just being an opportunity. Educate coaches, that you just cannot expect somebody to walk into the weight room next August and be ready to go. You cannot bring them in and expect that each person lifted all summer long, you cannot make that assumption. You have to come in and figure out where people are at and then adjust your training load based upon that lowest common denominator (while using parts of the transition back to the campus that was applied after the COVID-19 pandemic). I think that to me is what has been a big advantage and will bear some fruit for us next year. I know it will help us because my coaches already understand it now. So that is going to help us prepare for that (upcoming) season a little bit more effectively.

This statement provided a very interesting recommendation as athletes will typically leave campus early in May and not return until August, which could be considered an extended time away that will mimic the return to play guidelines from the COVID-19 pandemic. This type of return to play guideline will allow each strength and conditioning coach and athletic coach a blueprint to help keep athletes healthy by reducing the chance of injury during the first few weeks of team activity.

Current Fatigue Monitoring Tests Being Implemented

During the current study, two fatigue monitoring tests were being implemented during the Fall 2019 semester. One team utilized the RPE scale while two other teams classified their athletes into one of three groups and altered their training load/strength training sessions based on minutes played in the previous competition. Of the three teams currently performing the monitor, two teams chose to participate in the study (one team collecting RPE and

one team examining minutes played and placing athletes into three separate groups) with nine athletes from each school responding to the open-ended survey. Interestingly, the RPE collection can be classified as an internal (subjective) monitoring technique, while the classification based on minutes played can be classified as an external (objective) monitoring technique.

Recent literature has shown RPE as an accurate measure of fatigue [21,22], while implementing the RPE scale (internal monitoring technique) during the current study found the athletes had mixed feelings on the benefits of the program to help identify and reduce fatigue. Of the nine players who responded to the survey, five women's soccer athletes believed the program did not help reduce fatigue (5 of 9 [56%]). One athlete in particular, believed that the program was not effective because the soccer athletes were not truthful in their reported numbers. Previous literature has reported similar findings with underreported RPE values while performing a maximal number of repetitions at a given load, and this could be attributed to athletes wanting to continue to practice or athletes not wanting their coaches to know that they are tired or perceived as weak [23,24]. This also could be due to how coaches explain the RPE test or from a small sample size in which the current findings are the perception of 9 athletes within one Division II soccer team. Due to this, the information needs to be further studied on a larger scale. It is also imperative that the coaches create a culture of trust with an open line of communication between the strength and conditioning staff and each player to allow each athlete to compete to the best of their ability.

As well as picking the most appropriate test to monitor fatigue based on the resources available at each university, one must further examine how the test is conducted to see if it is providing the most accurate results. A study by Roos, et al., (2018) investigated the effects of survey methods and time points when RPE was assessed in relation to heart rate data and found that reporting RPE scales by a mobile device or online tool showed a higher correlation with HR than the paper-pencil method [25]. Interestingly the current process of collecting by paper and pencil after practice or by word of mouth with other athletes listening to the reported scale may influence the RPE that each athlete reported. Providing a safe environment in which each athlete can share their RPE scale without others over hearing or seeing their results may provide more accurate and useful feedback while implementing the fatigue monitoring program.

While the internal load is essential to understand both the relative physiology and psychological stress imposed by the training stimulus on each athlete, external load monitoring has been the foundation of most current monitoring systems [1]. The current study found that the athletes believed the program of classifying the women's soccer athletes into three different groups based on minutes played during their matches and subsequently altering load during strength and conditioning sessions after competition did help reduce fatigue and increase performance throughout the

season (9 of 9 [100%]). A study by Martin-Garcia, et al., (2018) looked to quantify external load during competition and training days' post-competition [26]. The findings align with the structure used by the current university in which there was a significant difference between players without game time completing a more strenuous workout the day after competition compared to players that performed in the competition ($p < 0.05$) [26]. This training session performed by players without game time was used to replicate competition loads while players with game time completed a recovery session [26]. It is important to note that the coach is trying to keep each player ready for when their time is called while still reducing the presence of fatigue in the players participating in heavy competition minutes.

Although this system seems to be used regularly, one must also understand that minutes played by athletes in different positions could greatly affect the chance of fatigue being present. Barte, et al., (2017) found that attacking position players may experience more fatigue than the players who play defense for their respective teams [12]. Further complicating the classification of players in three groups, DeWitt, et al., (2018) found that player load during a match was heavily dependent on the result of the match [27]. For instance, total distance and total player load were less when a team was leading or trailing during a game than when the score ended as a draw [27]. The above points make it imperative that there needs to be some subjectivity or instincts by the coaching staff when placing the players into their three different groups for the upcoming sessions. As a result, a combination of both an internal and external load may provide the most accurate information to the strength and conditioning coach and staff when examining fatigue throughout the season [1].

Conclusion and Future Direction for Research

Although this study was one of the first to examine current fatigue monitoring techniques at the NCAA Division II level within women's soccer players at one institution, the limited evidence cannot apply directly to all NCAA Division II soccer or other sport programs. It is important to note that if one is examining the current practices, it is recommended that the research also include the athletes' perceptions as to the successfulness of the program. Without reviewing the athlete's perception of the program, future research limits the feedback on the success or limitations of the current practices. Nonetheless, this qualitative view, while specific, does provide insight into other similar environments.

In 2016 and 2017, the NCAA mandated that all strength and conditioning coaches working at an NCAA-certified institution must hold the NSCA CSCS certification. Although this was a giant step forward in standardizing and legitimizing the current practices at each institution, those that can achieve the certification is still not as stringent as it will be in coming years. In the year 2030, new regulations by the NSCA state that one must obtain a bachelor's degree from an accredited university if they wish to sit for the CSCS certification. This policy will further help standardize this

certification and warrant future research on the current practices instituted by strength and conditioning coaches at each NCAA institution. This area of research should provide insight into the current practices utilized by the athlete and coaches as well as perception of these techniques. While the rigor of this research will be intense, it will potentially provide the greatest insight into the true effects of monitoring training as it relates to athletes on-field performance while also limiting the susceptibility of injury.

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None.

Conflict of Interest

None.

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