# Description of Potential Gender-Specific Factors Influencing Injury and Performance in Professional Female Football Athletes

by

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**INTRODUCTION:** The Women's Football Alliance (WFA) is a professional Women's American football tackle league. This is an understudied population and no study, to date, has reported on female football players. The purpose of this study was to describe variables related to performance and injury risk in professional women's football teams and compare these variables. **METHODS:** Eighty-seven female football players (age: 32.56 ± 7.47 years) from the WFA league participated in the study. A survey was administered through Qualtrics with questions pertaining to sports participation and injury, menstruation, contraception, mental health, and nutrition. Independent sample t-tests and Fishers exact tests were used to assess associations between variables. Frequency distributions were also used to assess trends present in the population**.** **RESULTS:** Frequency distribution of respondents for Division I was 48.3%, Division II with 31.8% and Division III 37.9%. Participants were from the Northeast (40), Midwest (32), South (9), and West (6). Most participants (37.9%) had less than one year of experience playing professional football and 50.6% of participants sustained an injury between April 2019 and February 2022. Age was not significantly different (p=value: 0.624) between injured and uninjured participants. Almost half had a mental health disorder with anxiety being the most frequent. There was no statistically significant differences (p-value: 0.060) between proportion of respondents with a diagnosed mental health disorder among regions. There were no statistically significant differences between proportions of respondents with mental health counselor access among divisions (p=value: 0.391). A little over half used contraception at some point throughout their life with the pill being the most common form. Over 50% of the participants rarely or never ate oily or white fish, so some nutritional deficiencies, like omega-3 fatty acids, may be present in the diet. **CONCLUSION:** The results of this study provide insight to sex-specific characteristics related to health, injury, and performance in a female football athlete population. Future research should prospectively investigate the relationship of these variables with injury and performance in order to optimize training and resources for these athletes.

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## 1.0 Introduction

The Women's Football Alliance (WFA) is a professional Women's American football tackle league that began play in 2009. There are three different divisions with a total of 62 different teams at the start of the 2021 season. They span from California to New Mexico, to Maine and Florida. Unlike male American football players, these women football players hold daytime jobs in addition to their positions on the team. This means they are juggling jobs and family on top of football, and they also pay to play football unless they receive money from sponsors. Little is still known about the sport or athletes within each team even when the league has been around for several years. No study reported on female football players and the different variables that make females unique. These include the menstrual cycle, oral contraceptive use and disuse, mental health disorders, and nutrition for performance. These factors could be similar between female-based sports, but differences are present between males and females. While the sport of American football is similar between males and females with regards to structure of the game, many factors differ and therefore are not comparable. That leads to the purpose of this study as gender-specific risk factors for performance and injury in professional women's football athletes will be analyzed. Areas such as menstruation and oral contraceptives, mental health, and nutrition will be highlighted in this study.

## 1.1 Injuries in Women's Contact Sports

### 1.1.1 Epidemiology

In 1994, Rosser wrote "Women are the forgotten gender in much health research, where the selection and definition of problems for study, the choice of experimental subjects, and conclusions drawn . . . often fail to include women or women's changing needs throughout the life cycle" [1]. Participation in sports for women began to increase in the 1960s and 1970s in school and university programs and in the Olympic Games [1]. With sports, comes injuries, and it was around the 1990s that it was evident injury rates differed between genders[1]. Knee injuries, specifically tears to the anterior cruciate ligament (ACL), were higher amongst women than men with the highest rates occurring in women's gymnastics, women's basketball, and women's soccer [1]. While injury rates and frequency are not heavily studied in women's football, there are patterns that occur in similar sports including rugby and soccer. These injuries involve areas mainly to the knee and head.

Researchers performed a two-year prospective study in elite Australian rugby sevens. Teams were made up of seven players instead of fifteen, to assess injury rates and severity in men and women. In total, 42 players (20 men and 22 women) played during both seasons and sustained the majority of their injuries to the knee (13.2%), head (12.6%), and thigh (12.6%) [2]. However, there were a total of ninety players that were included in the assessment as some players did not participate for the full two years. When comparing men and women, 46 male athletes sustained 213 injuries, while 27 women sustained 152 injuries [2]. The injuries that evoked the most burden to an athlete, and required the most absences in women's rugby were foot sprains, ACL injuries,

and ankle sprains [2]. This data is in alignment with other findings involving injuries sustained in women's contact sports.

Researchers analyzed and collected NCAA data on ACL injury rates. Sports like women's gymnastics, and basketball had the highest rates of injuries to the ACL [1]. Also, men's football recorded the highest overall number of ACL injuries. Two sports that were relatively similar between genders was men's and women's basketball and soccer. When comparing injury rates for the ACL between the years 1988/1989 – 2003/2004, the rate in basketball for men per 1000 exposures was 0.07 while women recorded 0.23 [1]. For soccer, the trends were similar in that men recorded a rate of 0.09 and women recorded 0.28 [1].

Another area with increased risk of injury, specifically in American football, is the head and concussions. In a systematic review, Prien et al. analyzed 70 different studies pertaining to concussions [3]. The sports that were included were soccer, rugby, ice hockey, and American football [3]. While the studies predominately included male athletes (86%), women were also represented in some of the data with increased interest pertaining to female football players [3]. Female American football players were more likely to sustain a concussion in both match and training scenarios as opposed to just match concussions [3]. In addition, women's football recorded the highest incidence rate per 1,000 hours of training with a concussion incidence density of 0.13[3]. Risk factors for sports concussions were evaluated during another systematic review. Of the 86 articles that were analyzed, 23 reported on concussion risk between male and female athletes. Of those, ten studies indicated women had a greater risk of concussion and nine found no association [4]. Women had a 1.5-fold to 2.5-fold greater concussion risk compared to men in various levels of soccer and similar results were found for basketball [4].

To support the information in the previous section regarding injuries in women's contact sports, injuries sustained during the 2010 Women's Rugby World Cup were assessed. The most common injuries occurred to the knee (28%), ankle (13%), and head (23%) [5]. The activity during match play that also caused the most injuries was during a tackle, specifically the person being tackled [5]. While the incidence of injury for women was significantly lower than for men during the Rugby World Cup, women still record a higher risk of ACL injuries compared to men [5]. Further assessment of the patterns associated with ACL injuries and concussions are indicated below.

### 1.1.2 Risk Factors for ACL Injuries and Concussions Among Female Athletes

With the increased prevalence rate of ankle, head and knee injuries during contact sports, it is important to review the risk factors that may be involved. Neuromuscular factors, playing surface, practice versus competition, playing level, type of cleats, and joint stability are all contributing factors that could increase the risk of injury.

ACL injury rates in female athletes have been heavily studied and internal risk factors that have been identified include anatomical, hormonal, and neuromuscular factors [1]. It is suggested that women perform riskier neuromuscular patterns more often than men as a majority of ACL injuries occur due to a non-contact mechanism [1]. It is known that women have a 2-3 times greater risk for an ACL injury and many times, the tuck jump and drop vertical jump are used throughout the rehabilitation process. One study examined the differences between male and female football players and jump performance during a tuck jump and drop vertical jump [6]. When performing the tuck jump, subjects would jump continuously for ten seconds with a video recording their movement [6]. Then, the video was assessed for errors with a screening tool consisting of ten

criteria. A zero indicated no flaw and a then a one indicated a single error. [6]. A score greater than six, which was previously mentioned as the cutoff score for a higher risk of ACL injuries, indicated an abnormal tuck jump score [6]. Women recorded a higher tuck jump score, meaning more technique flaws [6]. Women also presented with more knee valgus motion and landed with less hip flexion and ankle dorsiflexion, which could indicate poor landing control and increased risk of injury [6]. This study reveals the differences in jumping performance between men and women, which could lead to an increased risk of injury.

The risk factors involved with the anatomical aspect of noncontact ACL injuries include increased femoral anteversion, increased Q angle, excessive tibial torsion, and excessive foot pronation in women compared to men [7]. Additionally, the relationship of the femoral notch to ACL injuries has been observed. On average, the width of the notch in females is less than males and the notch width in knees with bilateral and unilateral ACL injuries may be less than that in normal control subjects [7]. However, there is an increasing amount of variability with the anatomy of these structures to make a conclusion about this as an risk factor for ACL injuries [7].

Hormonal risk factors for ACL injuries have been more of a recent topic of discussion and suggest that estrogen and progesterone play a role in ACL structure as their receptor sites are found in human ACL cells [7]. Some studies have reported more ACL injuries during the ovulatory phase when estrogen levels are high, but other studies have found fewer ACL injuries during the estrogen surge [7]. This could be due to the differences in the populations studied where one study included women with regular menstrual cycles, while the other included women that were taking oral contraceptives [7]. Although there may be an interaction between hormone concentrations and ACL injury rates, more research needs to be done to confirm these findings.

Cochrane et al. reported the risk factors in Australian football during non-contact ACL injuries [8]. In decreasing order, the frequency in which ACL injuries occurred during particular movements include sidestepping (7 injuries), landing (6 injuries), landing and stepping (3 injuries), stopping/slowing (2 injuries), and crossover cutting (1 injury) [8]. Of the non-contact ACL injuries, 47.4% involved a valgus mechanism, 42.1% gave way in internal rotation, and 91.7% of the injuries occurred with an initial foot contact knee angle of thirty degrees or less [8]. This means that, compared to men, women could have more deficits in proximal control with more of a distal landing pattern [8]. In other words, women may lack hip strength to control the knees and feet during landing, but have more strength in the quadriceps compared to hip extensors [8].

The systematic review on sports concussions that was previously mentioned by Abrahams et al. also proposed the reasons for increased concussion risks. Female soccer players in particular "have been found to have increased head acceleration during impacts compared with males, indicative of decreased neck strength and effective head mass. Increased head to ball ratio may also play a role as well as their increased willingness to report injuries" [4]. Some other risk factors for concussions include age, playing level, and match versus practice. For age and playing level, there are varying results. Although more studies reported greater risk in the older population, only one of the eight studies assessing age as a factor was a high-quality level I study [4]. With regard to level of play, six articles were assessed. Two prospective cohort studies found that concussion rates were lower in Division I college American football and increased in Division III [4]. Additionally, one study found an increased risk as playing level increased in the professional rugby league, and three studies found no difference in risk [4]. Lastly, twenty-nine studies indicated a higher risk of concussions in matches compared to practices [4]. In summary, differences in jumping and landing mechanics as well as lower extremity angles, increase the risk of many non-

contact ACL injuries in women. Playing level also played a role in a collegiate American football study as more concussions were sustained at a lower division compared to a higher division.

## 1.2 Gender Specific Risk Factors for Injury and Performance in Female Athletes

In the previous sections, a review of the literature was presented for risk factors in female contact sports. Injuries to the knee, ankle and head are the most prevalent in sports like Australian football, soccer and rugby, but now, focus will be placed on risk factors that are more gender-specific [5 8]. Fewer research studies include women compared to men as there are gender-specific variables that should be accounted for. For example, women undergo a menstrual cycle and hormones fluctuate during the follicular and luteal phase along with ovulation. Oral contraception use can also alter hormone concentration. In addition, body image and mental health issues are an area of concern for both male and female athletes, but may be more prevalent in females because of society's pressure to be perfect [9]. However, women are also trying to maintain a body composition that is ideal for sport performance. Lastly, diet recommendations differ for males and females and even sport or position within the sport. A closer look at these four risk factors are described in more detail in the paragraphs below.

### 1.2.1 Fluctuations in Hormones Throughout the Menstrual Cycle

Throughout the menstrual cycle, estrogen and progesterone fluctuate, and may influence physiological systems that alter exercise performance [10]. The menstrual cycle is divided into a follicular and luteal phase with an ovulation period in between the two. During the early follicular

phase, estrogen and progesterone are low [11]. Estrogen then rises and is high during the ovulatory phase, while progesterone is still low [11]. During the mid-luteal phase, both estrogen and progesterone are high [11]. Testosterone also acts similarly by rising just before ovulation. [12]. It is possible that the increase in estrogen might affect muscular performance during the late follicular phase, ovulatory phase, and mid-luteal phase as it reduces inhibition and increases voluntary activation [11]. Hormone fluctuation across the menstrual cycle is an important factor to consider as it may affect performance and training may be structured to utilize each phase accordingly.

As hormones begin to fluctuate, symptoms can also fluctuate and effect training or how someone feels during their menstrual cycle. Physical symptoms that may be experienced before or during menses include cramps, headaches/back aches, bloating, fatigue, and heavy bleeding [13]. Other symptoms that involve the psychological aspect include worry and distraction [13]. The international rugby players included in this study worried about how heavy their bleeding was going to be and the lack of control they had over the menses and symptoms [13]. In addition, competition performances were perceived to be negatively impacted by over half of the athletes during menstruation [13]. This explains why some athletes, specifically 44% of elite athletes in a study containing 430 elite female athletes, manipulate the timing of their menses around training or competition [14].

Fluctuations in hormones throughout the menstrual cycle can raise some concern about athletic performance. Researchers have already looked at the effects the menstrual cycle has on anaerobic and aerobic performance. Some studies used multiple tests to assess strength at various stages throughout the menstrual cycle. For example, Giacomoni et al. assessed maximal sprints on a cycle ergometer in conjunction with a jump test to analyze power and jump height. However, there were no significant changes throughout the menstrual cycle [15]. A similar study examined

the neuromuscular, physical, and biochemical responses when doing a repeated sprint exercise throughout the different phases. Maximal voluntary contraction (MVC) of the knee extensors where also tested before and after the sprint exercise. There was a lower maximal voluntary contraction recorded during the premenstrual phase after the sprint exercise and a lower MVC during the luteal phase [16]. Another study incorporated the Smith machine to evaluate mean and peak force and velocity during the different phases. Mean force, peak force, and velocity during a 1RM half-squat were all relatively the same when compared throughout the menstrual cycle [17].

The menstrual cycle has been known to affect performance as hormone levels change across the cycle. However, little research has reported on the effects on performance during different phases. In one study, Julian et al. assessed several soccer related physical performance parameters during the early follicular phase (days 5-7) and mid luteal phase (days 21-22) to see if there were any differences in performance outcomes [18]. Lower limb power, sprinting capability and endurance capacity were the areas of concern for the study and closely relates to the movement of female football players. Specifically, jump height during a counter movement jump, 30 m sprint time and Yo-Yo Intermittent endurance test were used [18]. As expected, estrogen and progesterone levels were higher during the mid-luteal phase than the early follicular phase [18]. The only test that showed a significant difference was the Yo-Yo test during the luteal phase, which indicates that the menstrual cycle could reduce endurance performance [18]. Although some studies have found exercise performance, and in particular, endurance performance to vary between menstrual phases, there is also studies that have reported no differences [10]. For example, the studies previously reviewed, reported that there was no significant change in jump height, power on a cycle ergometer, or mean and peak force and velocity during a half squat throughout the menstrual cycle. However, other studies indicated that maximum voluntary contraction after a

sprinting exercise was lower during the luteal phase and there was a significant difference during the Yo-Yo test during the luteal phase. This suggests that further research needs to be done to assess the effects of the menstrual cycle on performance.

### 1.2.2 Varying Hormone Concentrations in Contraceptives and Side Effects that Affect Performance

Oral contraceptive use allows a female to have a consistent cycle by reducing endogenous hormone production and increasing exogenous estrogen and progestogen [19]. There are two types of oral contraceptive pills: one containing both estrogen and progestogen and the other containing just progestogen. With each pill, there are varying adverse effects and levels of the hormones provided [19]. There are also different ways that the hormones can be distributed with pills either being monophasic, biphasic, or triphasic. Monophasic pills will have a set estrogen and progestogen level over the course of 21 days and then 7 days of placebo [19]. Biphasic pills contain the same estrogen levels, but differ in progestogen potency [19]. There are two different strengths between days 7-10 and 11-14 with the last 7 days still being the placebo [19]. Lastly, triphasic pills increase in estrogen throughout the cycle at three different timepoints [19].

Because oral contraceptive pills have varying concentrations of hormones at different periods, performance can be affected. It has been found in several studies that both monophasic and triphasic pill use has increased body mass and fat mass in the 4 and 6 months after administration [19]. Increases in body mass were about 3% and fat mass were about 9%, which may hinder some athletes in particular sports or positions [19]. When using oral contraceptives, it has also been reported that there is an increase in core body temperature [19]. This would not only hinder performance but increase the risk for heat illness. Aerobic capacity and oral contraceptive

use has been studied to analyze the affects after long-term use. Notelovitz et al. reported that after 6 months of monophasic oral contraceptive use, active women saw a decrease in VO2 peak of 7-8% and the control group had increased their VO2 peak [20]. Lebrun et al. reported similar findings as 14 trained athletes were assessed over two pill cycles while using a triphasic pill and there was a 4.7% decreased in VO2 peak [21]. However, there were no changes in endurance performance, hemoglobin levels, maximum heart rate, RER, or ventilation [21]. In regards to anaerobic capacity and strength, De Bruyn-Prevost et al. reported no change in lactate levels or strength across one pill cycle in monophasic users [22]. There are differing results for triphasic pill use and its ability to affect performance [19].

A recent study that was published in 2021 assessed oral contraceptive use via a survey in females participating in the Australian Football League, Rugby Australia, and National Rugby League [23]. It was previously reported that about 50% of elite level athletes use contraceptives for a variety of reasons, but only 58/177 (32.7%) participants in the current study were users [23]. Fifty-seven respondents previously used contraceptives, but no longer do, due to negative side effects including mood swings, weight gain, depression/anxiety, and headaches/migraines [23]. While the focus of this study was to analyze the reasons for contraceptive use and disuse in elite Australian athletes, there was only about a 20% response rate in which further research needs to be done [23].

Another study by Gallagher et al. examined sex and female-specific differences in outcomes following a concussion in collegiate varsity athletes with the use of hormonal contraception [24]. Results found that, on average, there was a longer length of recovery for females after a concussion when compared to males [24]. In addition, females using hormonal contraceptives tended to report lower symptom severity after a concussion when compared to

females not using hormonal contraceptives [24]. It was proposed that women who are injured with unregulated progesterone levels during the luteal phase, experience a sudden drop in progesterone, which adversely affect outcomes [24]. Women that then use hormonal contraceptives do not have adverse consequences due to the regulation of progesterone [24]. However, there was no difference in length of recovery when comparing hormonal contraceptive users and non-users [24].

In summary, when using oral contraceptives, a decrease in VO2 peak has been shown in two studies with no change in strength across the menstrual cycle in another study. There are various types of pills with varying symptoms and an individualized approach should be taken to pick the most appropriate one. Due to contraceptives having an effect on hormones, consideration should be placed on the use as it relates to performance and concussion symptom severity. Research on how contraceptive use affects female football athlete performance is warranted because potential risk factors for injury may be present with varying levels of hormone concentrations. The effects of hormonal concentration and rate of injuries or performance are still unknown, and more information regarding this topic could decrease the likelihood of those injuries.

### 1.2.3 Mental Health in Sports

Mental health awareness has increased over the years. Some countries, such as France, have mandated, by law, that psychiatric evaluations and diagnostic interviews be done in elite athletes [25]. The rate of mental health diagnosis, such as depression, may have a similar rate between athletes and the general population, but data is still somewhat limited with regards to this topic [26]. In a study reporting on elite athletes, the prevalence of depressive symptoms in elite athletes ranged from 4% to 68%, but when considering the whole population, the general

population appeared similar [27]. A recent meta-analysis supporting the topic of the increased rate of mental health symptoms in elite athletes compared to the general population stated that the frequency of mental health disorders is 34% amongst elite athletes, while the general population is about 20% [9].

Athletes may also choose not to seek support for mental health disorders due to a belief that it is a sign of weakness [28]. However, sports that are concerned with the leanness or body weight of an individual, may have a greater prevalence of mental health diagnosis [9]. French athletes that were more involved in aesthetic-based sports were at greater risk of experiencing depressive symptoms when compared to team-based sports [27]. The expectations of coaches, parents, spectators, the media and society as a whole, plays a major role in mental health issues as pressures are put on athletes from everyone around them to look or perform a certain way [9]. The body type that might be ideal for a given sport, may not be the body type that society views as ideal. This can lead to body dissatisfaction and other psychological issues [26]. There are also several risk factors associated with depressive symptoms in elite athletes which include, family history, relationships, lack of social support and other environmental factors, injury, failure, and retirement from sport [27]. This could lead to a decrease in performance.

In a study conducted by Gulliver et al., 224 elite athletes from Australia completed a survey regarding mental health [26]. A variety of items were assessed including general psychological distress, depression symptoms, anxiety symptoms, social anxiety symptoms, panic disorder symptoms, eating disorder symptoms, and prior help-seeking behavior [26]. Most of the respondents were between the ages of 18-25 years and played a variety of sports including cricket, soccer, hockey, netball, rowing, sailing, water polo, softball, and other [26]. It was found that just under half of the subjects (46.4%) met the criteria for at least one mental health issue [26]. Of these

cases, 53.4% included females and 38.7% of these cases were males [26]. It is also important to note that one-third of females (32.2%) met the cut-off score for an eating disorder [26]. For generalized anxiety disorder, 10.2% of females met the cut-off score and 30.5% of females met the cut-off score for depression [26]. It should be noted, however, that 24.1% of the subjects were currently injured and results could have been affected by this.

Although mental health is becoming an area of emphasis in healthcare, athletes may still not feel comfortable speaking about it due to not knowing who to talk to, not having access to a mental health counselor or it not being affordable, or not wanting their teammates or coaches to know they are struggling. Factors such as sport, gender, and level of play, may play a role in raising mental health concerns. Also, those who are reaching the end of their careers or experiencing decreased performance and injury may increase the risk of mental health diagnosis. A study was conducted by Purcell et al. to assess the rates of mental health symptoms in currently competing elite athletes registered with the Australian Institute of Sport [29]. This study included all athletes aged 17 years and over (mean age of 24.6 years) who were already at or preparing for Olympic level competition [29]. In addition, this study also included both female and male athletes with a majority of female athletes completing the survey at 54.1%. The goal of this study was to compare mental health rates of elite athletes to published community norms using the General Health Questionnaire 28, Kessler 10, Rosenberg Self-Esteem Scale, Problem Gambling Severity Index, Maladaptive Response to Physiological Distress, Eating Disorders Examination Questionnaire, Alcohol Use Disorders Test, and Satisfaction with Life Scale [29]. The results indicated that one in five athletes had previously been treated for a mental health or a psychological problem [29]. Elite athletes reported higher scores for psychological distress, anxiety/insomnia, and self-esteem categories and the total score for the general health questionnaire compared to community norms

[29]. However, athletes reported lower rates for risky alcohol consumption, problem gambling, and body dissatisfaction when compared to the community [29]. This study is comparable to the present study because demographics such as age, gender, and level of play are similar. Both studies include women who participate in a sport at the elite level during their mid to late twenties.

Another study regarding mental health was conducted in Swedish elite athletes to analyze the prevalence of specific disorders and sex differences [25]. A web-based questionnaire was used and sixty-three sports were represented [25]. The results indicated that the mean age of onset of mental health disorders was 19.2 years and 47.6% of athletes with a history of mental health diagnosis, reported three or more episodes [25]. The GAD-7 was used and 12.6% reached the cutoff for moderate symptoms (females: 16.8%, males 6.6%), while 4.2% reported severe anxiety symptoms (females: 5.6%, males: 2.2%) [25]. In addition, the PHQ-9 was used, where 20.4% of females compared to 6.6% of males reported moderate depressive symptoms and 5.6% of females and 0.7% of males reported severe depressive symptoms [25]. Lastly, 29.1% of athletes (females: 37.8%, males: 16.8%) sought help more commonly outside their medical support staff with the national team [25]. A licensed psychologist/psychotherapist, sport psychologist or a health care center was the most common point of contact for such concerns [25]. This pertains to the present study as many elite athletes have already indicated a history of mental health disorders with anxiety and depression symptoms being the most common.

A systematic review of 60 studies published by Rice et al., reported on outcomes such as anxiety, anger and aggression, eating disorders and body image, general-prevalence of mental health, substance use, and stress of elite athletes [28]. For the general-prevalence category, one study reported that the highest mental health issue was anxiety/depression (26%) [28 30]. Other prevalence rates included adverse eating behavior (26%), alcohol behavior (19%), distress (10%),

increased smoking habits (7%), burnout (5%), and low self-esteem (3%) [28 30]. In another study that took place in Slovakia, female athletes reported greater anxiety than men [28]. Although eating disorders and body image issues have increased prevalence in more athletes that emphasize lower body weight, such as rowers, distance runners, figure skaters and gymnasts, women overall are at an increased risk. To summarize, society places a great deal of stress on athletes to maintain an ideal body image and this expectation is higher for sports that are concerned with the body fat or leanness of that individual. Almost half of the subjects in the one study met the criteria for at least one mental health issue with a majority of these cases including women.

### 1.2.4 Nutrition Needs for Sports Performance in Female Athletes

Nutritional needs for sport performance and injury prevention vary from the general population and even vary between men and women. Athletes participating in an endurance-based sport require a different diet compared to strength athletes and even positions within the same sport require different needs. Energy requirements depend on multiple factors, including temperature, medications, fat-free mass, activity, and menstrual cycle, as energy needs may need to increase during the luteal phase or decrease during the follicular phase [31]. While protein is important and is often the macronutrient required for performance and recovery, other macronutrients, such as carbohydrates, micronutrients and vitamins play a key role in overall function.

Nutrients can be split up into either macronutrients, which are needed in larger amounts, and micronutrients, which are required, but in smaller amounts. Carbohydrates, proteins, and fats make up macronutrients while vitamins and minerals make up micronutrients. Protein and carbohydrates have 4 kcal per gram and fat has 9 kcal per gram [32]. Proteins are the building blocks for muscle, tendons, and other soft tissues made up of nine essential and eleven non-

essential amino acids [33]. Next, carbohydrates generate more ATP per volume of oxygen compared to fat, making it an especially critical macronutrient for endurance athletes [33]. In addition, carbohydrates are essential in hormonal balance, which is important for a female athlete [34]. The oxidation of glycogen provides only about 2,500 kilocalories of energy before depletion, while the oxidation of fat provides at least 70,000-75,000 kilocalories of energy [33]. Finally, fats are used for many processes in the body including cell membrane structure, absorption of fat-soluble vitamins, hormone regulation, brain health, and energy for muscle metabolism [33].

For macronutrient consumption, it is recommended that athletes consume 1.2-2.0 grams per kilogram of bodyweight per day of protein [31] [35]. For endurance athletes, it is recommended that they consume 1.2-1.4 grams per kilogram, while a strength athlete would want to consume closer to 1.7 grams per kilogram [36]. The average protein intake for Australian female athletes is 1.6 g per kilogram of bodyweight a day [35]. The recommendations for carbohydrate intake are as follows; 5-7 g/kg for moderate exercise lasting about one hour and 6-10 k/kg for moderate to intense exercise lasting one to three hours [31] [35]. During the menstrual cycle, specifically during the follicular phase, it may be even more important to make sure sufficient amounts of carbohydrates are consumed as carbohydrates are needed to support the increase in glycogen utilization [34]. There has been an increasing popularity with low-carbohydrate diets for fat loss in the general population in recent years and this can translate to deficiencies in female athletes. About 20-35% of an athletes diet should consist of fat and saturated fat should account for <10% total energy [37]. In addition, consuming more unsaturated fats (monounsaturated fats and polyunsaturated fats) compared to saturated fats is recommended for overall health and performance [37]. Saturated fats, cholesterol, and trans fats, should be kept to a minimum to reduce

the risk of heart disease [37]. Consuming a deficient level of fat could lead to reductions in essential fatty acids and fat-soluble vitamins [31].

Carbohydrates are especially important for athletes as that is the main energy source used in sports that are 'stop and go.' Eating a high glycemic index carbohydrate meal that was 2.5g/kg of body mass about three hours before exercise, provided the athlete with an increased muscle glycogen level of 11-15% [38]. In addition, guidelines for athletes competing in intermittent sports recommend ingesting carbohydrates at a rate of 30-60 g/h during training or competition that is over an hour in length [39]. In a study looking at *Nutritional Aspects of the Female Athlete,* the recommended carbohydrate intake per day was stated to be 8 g/kg [34]. However, subjects were only consuming 6.5 g/kg per day [34]. It has been found in several research studies that female athletes do not meet their carbohydrate needs and even one study reported that female athletes consume 30% less carbohydrates per kilogram of bodyweight compared to males in the same sport [34]. It is even more important for females to increase their carbohydrate intake during the follicular phase of the menstrual cycle to support the increase in glycogen utilization [34]. Recommendations for female athletes 36 to 48 hours leading up to the event is 10-12 g/kg of bodyweight per day [34]. In regards to fats, fat oxidation is higher in females than males and that could be due to the higher percentage of type I muscle fibers in females [34]. That would make women better suited for endurance events compared to males, but those results would not be the same for anaerobic activities, such as football [34]. Lastly, protein recommendations are not differentiated between male and female athletes [34]. Protein ranges are 1.2 to 2.0 g/kg of bodyweight per day and usually females meet that requirement [34].

Nutrition for team sport athletes, like football, is an important aspect to consider regarding performance. Diet should be individualized as positional athletes, such as a linebacker and running

back, require different energy needs. A systematic literature review was done by Jenner et al. to evaluate the dietary intakes of professional and semi-professional team sport athletes [37]. After inclusion and exclusion criteria were established, 21 studies were included in the review. Results indicated that mixed gender athletes from team sports like football (n=175), rugby (n=139), rugby union (n=88), volleyball (n=11), and rugby league (n=10) did not meet the recommended carbohydrate intake [37]. Recommendations for carbohydrate intake is 5-7 g/kg for moderate exercise lasting about one hour and 6-10 k/kg for moderate to intense exercise lasting one to three hours [31] [35]. However, eight of the studies with similar athletes as mentioned above, consumed an excess amount of protein [37]. The same was found for fat in nine of the studies [37]. Cholesterol was also a concern in male American football athletes as six of the studies reported elevated intake levels of >300 mg/day [37]. During a rugby union and Australian football preseason, energy intake was not met to meet training demands [37]. It was suggested that the low energy intakes were related to the body composition goals of decreasing body fat [37]. It was hypothesized that in order for the athletes to meet body composition goals, total calories were restricted around the time the dual-energy X-ray absorptiometry (DXA) was being used [37]. In summary, diet should be individualized as men and women and aerobic and anaerobic athletes require different nutritional needs. Emphasis is placed on protein intake, but other macronutrients such as carbohydrates and fats and micronutrients should hold equal importance.

Certain micronutrients, including vitamin D, iron, and calcium, may also need to be increased via supplementation for female athletes to meet specific requirements [35]. In a study outlining the nutritional intake, sports nutrition knowledge and energy availability in female Australian football players, results indicated that although protein was in line with current recommendations, calcium and iron intake was below population recommendations for females

(1000-1,500 mg/d and 18 mg/d, respectively) [35]. These nutrients are especially important for females in order to maintain bone health and carry oxygen to appropriate areas. In addition, 30% of players fell in the at risk category for low energy availability with a mean energy intake lower than other studies [35]. It was reported from this study that female Australian football players do not have a high level of sports nutrition knowledge, which could lead to an increase risk for injury [35]. Athletes who train indoors, have a darker complexion, train with increased equipment that block UV rays, and have a high body fat content may be at an increased risk of vitamin D deficiency [31].

In addition to the previous study, Sim et al., investigated the role of iron for athletes [40]. Many athletes are deficient in iron with females reporting a prevalence of 15-35% possibly due to the demand of iron during menstruation [40]. Active women are also estimated to be twice as likely to present with iron deficient non-anemia compared to sedentary women [40]. Iron deficiency is described in the article as having depleted iron stores in the bone marrow, liver and spleen, which could progress to iron deficient non-anemia or iron-deficient anemia [40]. It was stated that the iron regulatory hormone, hepcidin, increases post exercise, which would decrease iron absorption and recycling from the gut [40]. While the current recommended dietary intake for iron is 18 mg for females, it is likely that athletes have a higher iron requirement than the general public due to exercise [40]. In conjunction with that statement, iron losses in athletes are increased by 30%-70% due to physical activity, so iron intake should be stressed [34].

The next micronutrients that female athletes prove to be deficient in is vitamin D and calcium. The Institute of Medicine considers vitamin D levels greater than 20 ng/mL sufficient and levels greater than 40 ng/mL optimal [34]. In conjunction with that statement, female naval recruits reported fewer stress fractures with supplementation of 800 IU vitamin D and 2000 mg

calcium [34]. A study on NCAA athletes (66% female athletes) in the south, showed that 23% were insufficient and 9% were deficient [34]. On the other hand, the Adequate Intake (AI) of calcium is not met in 72% to 90% of all females [34]. In regards to female athletes, a study on female endurance runners showed that only 45% of those athletes met the recommended dietary allowance for calcium [34]. Both of these deficiencies could be related to disordered eating or restricted energy intake. Deficiencies in calcium, iron, and vitamin D are common in women and when intake recommendations are not met, supplementation of these may be warranted.

### 1.3 Research Problem

There are numerous research studies on male football athletes with regard to nutrition and injury risk factors, however, it is limited in female football athletes. There are also some research studies regarding mental health of football athletes after a concussion. However, few studies have reported on professional female football athletes. Additionally, studies have reported on nutrition as it relates to wound healing and injury prevention as deficits in micronutrients and macronutrients can lead to injury. Most of the literature includes elite soccer female athletes and while there may be some similarities with the level of play, conclusions should not be made comparing the two. Female soccer, rugby, and football athletes all differ with regard to physiological factors such as how an athlete feels, physical health, fatigue, age, and consumption of foods or drink. Overall, women have different nutritional needs when compared to men and variables such as mental health and menstrual cycle, play a role in their performance. Female professional football players often balance both their sport and full-time job, whereas that may not be the case for professional male football players. Therefore, this study aims to describe age,

education, sport participation, injuries, mental health, menstrual status, oral contraceptive use, and nutrition in female football athletes.

## 1.4 Study Purpose

The purpose of this study was to describe variables related to performance and injury risk in professional women's football teams and investigate the relationship among some of these variables, including age and injury, region and mental health, and division and mental health counselor access.

## 1.5 Specific Aims

Specific Aim: To describe gender-specific risk factors for performance and injury in professional women's football athletes. Data was categorized by demographics and characteristics, sports participation and injury, mental health, menstruation status, contraception use, and nutrition. Further analysis of the relationship between age and injury, region and mental health, and division and mental health counselor access was also assessed.

## 1.6 Study Significance

By assessing variables such as activity level, menstrual cycle, contraceptive use versus disuse, mental health issues, nutrition, sport participation history, and previous injuries, this study will outline areas that may require more focus in future research. With a variety of variables being assessed from various teams across the league, we will gain insight into the trends of these characteristics related to injury and performance in an understudied population.

# 2.0 Methods

## 2.1 Experimental Design

This was a descriptive study that utilized a survey to gather information on a variety of variables in the female football population. To address each area of interest, the survey was administered through Qualtrics at the beginning of the 2022 season.

### 2.1.1 Co-Variates

There are several variables for this study, which include, age (years), body weight (lbs.), education, employment status, region of football team, division, football participation history, years of playing professional football, other sports participation, sports injuries, menstrual cycle, oral contraceptive use, mental health, nutrition.

## 2.2 Subjects

### 2.2.1 Subject Recruitment

Physically active females that play professional football between the ages of 18-50 were recruited for this study. The subject pool were athletes who played women's professional football in the WFA league at any point throughout their career. Participation in the survey was voluntary and athletes could drop out of the study at any time.

### 2.2.2 Subject Consent

Ethical approval for this study was acquired from the University of Pittsburgh Institutional Review Board (IRB). Upon meeting the criteria, subjects reviewed a consent statement including the study purpose and explained that responses were anonymous [41]. After reviewing the consent statement, they began the survey through Qualtrics.

### 2.2.3 Power Analysis

Few studies have examined professional female football athletes as most of the literature included elite soccer athletes instead of American football. Even fewer studies observed the diversity within a female football team or strength and conditioning practices in this population [42] [43]. The number of subjects included for this study were selected based on their participation on the women's football team in the WFA league from any time until the present. The roster can vary from year to year and to include more subjects, coaches were informed they could send the survey to past or current players. The sample size was set at 3,000 subjects. This number was selected based off the teams indicated on the Women's Football Alliance website. Division 1 (D1) reported 9 teams, Division 2 (D2) reported 15 teams, and Division 3 (D3) reported 38 teams in the league. Some teams had a roster linked in which roughly 65 players from D1, about 50 players from D2, and 40 players from D3 were listed. In total, a maximum number of participants expected to complete the survey was 3,000.

### 2.2.4 Inclusion Criteria

Subjects were identified in this study if they participated in professional women's football in the WFA league from any point until the present with ages between 18 to 50 years. Subjects were also be included regardless of their current participation.

### 2.2.5 Exclusion Criteria

As this survey was only sent to female football players in the WFA league by their respective coaches, no exclusion criteria was warranted.

## 2.3 Instrumentation

### 2.3.1 Professional Female Football Player Survey

A survey was sent out to participants via Qualtrics (an SAP America Inc. company) that assessed both demographic background with other questions pertaining to football participation. Qualtrics is a web-based software that is used for surveys, feedback and polls and a variety of distribution means. This survey was meant to gain insight into the diversity within female football teams in the WFA league [44]. The first few questions gathered information on athletes' demographics such as division, age, weight, education, and occupation. The survey was centered around the female athlete, so areas such as menstrual cycle, oral contraceptive us, mental health,

and nutrition were the areas of focus. Questions regarding injuries include any time from April 2019 until the time of study due to the year with football participation being minimal with COVID-19. The contraception questions were implemented from the Hormonal Contraception Self-Screening Questionnaire that several states use as a self-screening tool to identify patient risk factors before the pharmacist initiates discussing self-administered hormonal contraception. Most of the medical history questions were left out of the survey as they did not pertain to the specific aim of the study. Next, the menstruation questions were implemented from the Menstrual History Questionnaire used by the University of Cincinnati Department of Environmental and Public Health Sciences. Basic questions regarding menstruation were pulled from this questionnaire and used in the current study. All questions regarding mental health were used from the Patient Health Questionnaire (PHQ-9). This is a widely used questionnaire for depression with a reported sensitivity ranging from 28% to 95% and a specificity of 61% to 98% from a systematic review conducted by El-Den et al. [45]. Lastly, the Short Form FFQ was used for the nutrition questions implemented. In one study, a short form FFQ was compared to a long form FFQ and 24 hour diet recall to assess the effectiveness between the three methods. Results indicated that although the short form FFQ is not suitable for estimating absolute dietary intake, it is suitable for ranking people according to diet quality and gain a general understanding of diet in particular populations [46].

## 2.4 Testing Procedures

### 2.4.1 Professional Female Football Player Survey

All WFA coaches team names and emails were collected from the WFA website and a document was created for distribution purposes. Due to the coaches being the only public form of contact for each team, they were the ones who received the survey from the primary investigator and distributed it to their respective team. Participants were asked to complete the survey via Qualtrics, which was available to complete during February 2022. They were prompted to complete this survey within two weeks of it being sent out to allow for ample completion time. After the initial email was sent, two reminder emails were also sent to make sure the coaches distributed the survey to their athletes. The survey was set up so that it could be completed and submitted without having answered every question, giving the athlete the option to skip questions if they did feel comfortable filling out the survey in its entirety. All data was collected electronically at the time the survey is completed.

## 2.5 Data Reduction

At the completion of the survey window, data was filtered through and deleted if respondent had not answered any of the questions. After cleaning up the responses, data was exported from Qualtrics to Excel. If a question allowed for similar answers to be grouped, a 0 or 1 was assigned and another column of data was added for easier frequency distribution later on.

Data was then imported into SPSS for analysis. As some data was processed as string, it was then changed to numeric for final reduction.

## 2.6 Statistical Analysis

Data was entered into SPSS Version 28.0 (IMB Corporation, Armonk, NY, 2019). Each question was analyzed for the best format to allow for the most data extraction and ease of completion. A majority of the questions were multiple choice to allow for the athlete to complete the survey in a timely manner. The aim of this study was to describe gender-specific risk factors for performance and injury in professional women's football athletes, so frequency distributions were used for most variables. Association between age and injury prevalence was also analyzed by using an independent sample t-test. Fisher Exact Test was used to investigate if there was an association between region of the football team association and having been diagnosed with a mental health disorder. It was also use to examine if there was an association between division of the football team and having access to a mental health counselor.

# 3.0 Results

## 3.1 Descriptive Data Examining Demographics and Characteristics

Participants (n=87) from Division 1, Division 2, and Division 3 from the WFA league completed the survey and the data from these participants was analyzed and displayed in tables. Participants were able to complete the survey without having to answer every question, so some tables do not include all participants. Frequencies for all demographic variables are reported in the tables below starting with age in Table 1. The average age and standard deviation of participants was 32.56 ± 7.47 years old (range 17-59 years old) with most participation from athletes who are 30 years old. The original inclusion criteria for participants was between the ages of 18-50 years. However, one participant was 17 years old and one was 59 years old, and upon approval from the Human Research Protection Office, data from these participants were also included.

**Table 1 Frequency Distribution of Age for Participants**

| | **Age (years)** |
|---|---|
| Mean | 32.56 |
| Median | 31.00 |
| Mode | 30 |
| Standard Deviation | 7.47 |
| Percentiles | 25 – 27.00<br>50 – 31.00<br>75 – 26.00 |
| **Total** | **87** |

The average weight and standard deviation of participants was 190.50 ± 51.328 lbs. (Table 2). Most participants were 140 lbs.

**Table 2: Frequency Distribution for Weight in Participants**

| | **Weight (lbs.)** |
|---|---|
| Mean | 190.50 |
| Median | 185.00 |
| Mode | 140.00 |
| Standard Deviation | 51.328 |
| **Total** | **85** |

The total for this question is N=85 instead of N=87 because two people chose not to answer it.

Frequency distribution of respondents for education level is displayed in Table 3. Only 1 (1.10%) participant indicated that they had less than high school experience for their education level. A high school graduate was indicated by 3 (3.40%) of participants. Several participants indicated they had some college experience with 20 (23.0%) respondents for that level. A total of 11 (12/6%) had a two-year degree, while 30 (34.5%) had a four-year degree. A professional degree was obtained by 18 (20.7%) of participants, while 4 (4.60%) participants indicated a doctorate degree.

**Table 3: Frequency Distribution of Education Level of Participants**

| Education Level | Frequency Distribution (count, percent) |
|---|---|
| Less than high school | 1/87 = 1.10% |
| High school graduate | 3/87 = 3.40% |
| Some college | 20/87 = 23.0% |
| 2-year degree | 11/87 = 12.6% |
| 4-year degree | 30/87 = 34.5% |
| Professional degree | 18/87 = 20.7% |
| Doctorate | 4/87 = 4.60% |

The frequency distribution of employment status for participants is displayed in Table 4. Most of the participants, 74 (85.1%), indicated that they are employed at a full-time job, while 5 (5.7%) participants indicated they are employed at a part-time job. Few participants indicated that they were unemployed looking for work with a frequency of 2 (2.3%), while 1 (1.1%) participant indicated they are unemployed not looking for work. Two (2.3%) participants indicated that they are retired, 3 (3.4%) participants indicated they are a student, and 0 (0.0%) participants indicated that they are disabled.

**Table 4: Frequency Distribution of Employment Status for Participants**

| **Employment status (other than football)** | **Frequency Distribution (count, percent)** |
|---|---|
| Employed full-time | 74/87 = 85.1% |
| Employed part-time | 5/87 = 5.7% |
| Unemployed looking for work | 2/87 = 2.3% |
| Unemployed not looking for work | 1/87 = 1.1% |
| Retired | 2/87 = 2.3% |
| Student | 3/87 = 3.4% |
| Disabled | 0/87 = 0.0% |

Frequency distribution of respondents in each division is reported in Table 5. Most respondents were from Division I with 42 participants or 48.3% of athletes completing the survey. Division III had a total of 33 participants or 37.9% of athletes complete the survey and Division II had 12 participants or 31.8% of athletes complete the survey.

**Table 5: Frequency Distribution of Participants per Division**

| Division | Frequency of Respondents per Division (count, percent) |
|---|---|
| I | 42/87 = 48.3% |
| II | 12/87 = 31.8% |
| III | 33/87 = 37.9% |

Participants selected their competitive region from four categories, with the majority of participants selecting the Midwest and Northeast regions. A total of 40 participants played on a team in the Northeast region, which had the highest region participation (Figure 1). Less participants (32) chose the Midwest, and nine and six participants selected the South and West, respectively.

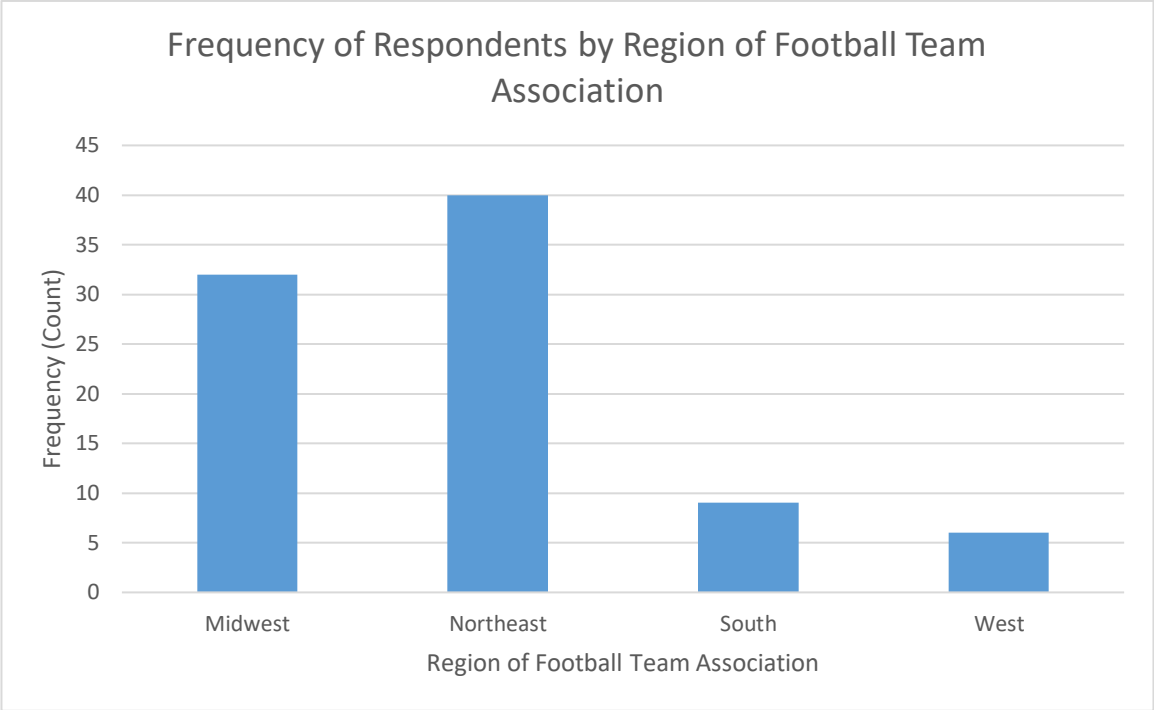


**Figure 1: Frequency of Respondents in Regions of Football Team Association**

Midwest includes Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota;
Northeast includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, and Pennsylvania;
South includes Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, Washington D.C., West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, Texas;
West includes Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming, Alaska, California, Hawaii, Oregon, Washington.

### 3.2 Descriptive Data Examining Sports Participation and Injury

The frequency distribution of years playing professional football is displayed in Table 6. Most respondents, 37.9% (n=33), played less than a year of professional football with 21.8% (n=19) of participants playing one to two years. Respondents that played three to four years of professional football comprise of 12.6% (n=11) of total respondents and athletes that played over four years comprise of 27.6% (n=24) of total respondents.

**Table 6: Frequency Distribution of Number of Years Playing Professional Football**

| **Years playing professional football** | **Frequency Distribution of Number of Years Playing Professional Football (count, percent)** |
|---|---|
| <1 year | 33/87 = 37.9% |
| 1-2 years | 19/87 = 21.8% |
| 3-4 years | 11/87 = 12.6% |
| >4 years | 24/87 = 27.6% |

Frequency distribution of the year the participants started playing professional football is indicated in Table 7. Thirty-five (40.7%) indicated that they started playing professional football in 2018 or before, while 13 (15.1%) participants indicated starting in 2019. Seven (8.1%) participants started in 2020, 12 (14.0%) participants started playing in 2021, and 19 (22.1%) started playing in 2022.

**Table 7: Frequency Distribution of the Year the Participants Started Playing Professional Football**

| Year Participant Started Playing Professional Football | Frequency Distribution (count, percent) |
|---|---|
| 2018 or before | 35/86 = 40.7% |
| 2019 | 13/86 = 15.1% |
| 2020 | 7/86 = 8.1% |
| 2021 | 12/86 = 14.0% |
| 2022 | 19/86 = 22.1% |

The total for this question is N=86 instead of N=87 because one person chose not to answer it.

Participants were asked about positions they played, so more than one position could have been chosen in the survey for Table 8. Most of the participants have either played offensive line, 35.6%, or defensive line, 34.5%, and kicker, punter, and snapper were the positions where the least amount of respondents played with 5 (5.7%) participants.

**Table 8: Frequency of Respondents by Position**

| Frequency of Respondents by Position | |
|---|---|
| **Position** | **Count (Percentage)** |
| Quarterback | 8/87 = 9.20% |
| Running back | 16/87 = 18.4 |
| Wide receiver | 25/87 = 28.7% |
| Tight end | 13/87 = 14.9% |
| Kicker | 5/87 = 5.75% |
| Punter | 5/87 = 5.75% |
| Snapper | 5/87 = 5.75% |
| Safety | 9/87 = 10.3% |
| Offensive line | 31/87 = 35.6% |
| Defensive line | 30/87 = 34.5% |

*Percent do not add up to 100% because some respondents reported more than one position.

Frequency distributions for the sports played at the recreational or club level is displayed in Table 9. A total of 30 (38.0%) participants played soccer, 49 (62.1%) participants played basketball, 20 (25.3%) participants played volleyball, 6 (7.59%) participants swam, 2 (2.53%) participants played lacrosse, 21 (26.6%) participants played football, 4 (5.06%) played rugby, and 28 (35.4%) participants ran track and field or XC. Forty-eight (60.8%) participants indicated that they played another sport at the recreational or club level. These include boxing, karate/taekwondo or martial arts, flag football, golf, softball, gymnastics, handball, hockey, tennis, competition dance, ultimate frisbee, and wrestling.

**Table 9: Frequency Distribution of the Sports Played at the Recreational or Club Level by Participants**

| Sports played at the recreational/club level (age 12 and up) | Frequency Distribution (count, percent) |
|---|---|
| Soccer | 30/79 = 38.0% |
| Basketball | 49/79 =62.1% |
| Volleyball | 20/79 = 25.3% |
| Swimming | 6/79 = 7.59% |
| Lacrosse | 2/79 = 2.53% |
| Football | 21/79 = 26.6% |
| Rugby | 4/79 = 5.06% |
| Track and Field/XC | 28/79 = 35.4% |
| Other | 48/79 = 60.8% |

*Percent do not add up to 100% because some respondents reported more than one sport. N=79 instead of N=87 as eight people chose not to answer this question.

Frequency distributions of the sports participants played at the high school level are displayed in Table 10. A total of 23 (26.5%) participants played soccer at the high school level, 38 (45.8%) participants played basketball, 18 (21.7%) participants played volleyball, 3 (3.61%) participants swam, 2 (2.41%) participants played lacrosse, 10 (12.1%) played football, 0 (0.00%) participants played rugby, 31 (37.3%) participants ran track and field or XC, and 44 (53.0%) participants indicated that they played a different sport in high school. Those include softball, cheerleading, competition dance, handball, hockey, golf, taekwondo, tennis, and wrestling.

**Table 10: Frequency Distribution of the Sports Played at the High School Level by Participants**

| Sports played at the high school level | Frequency Distribution (count, percent) |
|---|---|
| Soccer | 23/83 = 26.5% |
| Basketball | 38/83 = 45.8% |
| Volleyball | 18/83 = 21.7% |
| Swimming | 3/83 = 3.61% |
| Lacrosse | 2/83 = 2.41% |
| Football | 10/83 = 12.1% |
| Rugby | 0/83 = 0.00% |
| Track and Field/XC | 31/83 = 37.3% |
| Other | 44/83 = 53.0% |

*Percent do not add up to 100% because some respondents reported more than one sport. N=83 instead of N=87 as four people chose not to answer this question.

Frequency distribution of the sports participants played at the collegiate level is displayed in Table 11. A total of 7 (16.3%) participants played soccer at the collegiate level, 14 (32.6%) participants played basketball, 1 (2.33%) participants played volleyball, 1 (2.33%) participants swam, 2 (4.65%) participants played lacrosse, 2 (4.65%) participants played football, 2 (4.65%) participants played rugby, 4 (9.30%) participants ran track and field or XC, and 17 (39.6%) participants indicated that they played a different sport at the collegiate level. These include taekwondo, cheerleading, crew, hockey, rowing, softball, golf, tennis, and none.

**Table 11: Frequency Distribution of the Sports Played at the Collegiate Level by Participants**

| Sports played at the collegiate level | Frequency Distribution (count, percent) |
|---|---|
| Soccer | 7/43 = 16.3% |
| Basketball | 14/43 = 32.6% |
| Volleyball | 1/43 = 2.33% |
| Swimming | 1/43 = 2.33% |
| Lacrosse | 2/43 = 4.65% |
| Football | 2/43 = 4.65% |
| Rugby | 2/43 = 4.65% |
| Track and Field/XC | 4/43 = 9.30% |
| Other | 17/43 = 39.6% |

*Percent do not add up to 100% because some respondents reported more than one sport. N=43 instead of N=87 as forty-four people did not indicate a sport at the collegiate level.

Table 12 displays the number of absences from training, or participation in competitions since April 2019 due to football injuries. There were 42 (48.3%) participants that did not sustain any football injury. Thirty-six (41.4%) participants sustained one or two injuries, 6 (6.90%) participants sustained three or four injuries, and 3 (3.40%) participants sustained five or more injuries since April 2019.

**Table 12: Frequency Distribution of Number of Absences From Training, or Participation in Competitions Since April 2019 Due to Football Injuries in Participants**

| **Number of absences from training, or participation in competitions since April 2019 due to football injuries** | **Frequency Distributions (count, percent)** |
|---|---|
| No, not at all | 42/87 = 48.3% |
| Yes, once or twice | 36/87 = 41.4% |
| Yes, three or four times | 6/87 = 6.90% |
| Yes, five or more times | 3/87 = 3.40% |

Table 13 displays the number of days absent from training or participation in competition due to football injuries since April 2019. A total of 13 (15.3%) participants indicated that they were absent from training or competition one to seven days, 11 (12.9%) participants were absent eight to fourteen days, 10 (11.8%) participants were absent fifteen to twenty-one days, 10 (11.8%) participants were absent twenty-two or more days, and 41 (48.2%) participants were not absent any day from training or competition since April 2019.

**Table 13: Number of Days Absent From Training or Participation in Competition Due to Football Injuries Since April 2019**

| Number of days absent from training or participation in competition due to football injuries since April 2019 | Frequency Distributions (count, percent) |
|---|---|
| 1-7 days | 13/85 = 15.3% |
| 8-14 days | 11/85 = 12.9% |
| 15-21 days | 10/85 = 11.8% |
| 22 or more days | 10/85 = 11.8% |
| None | 41/85 = 48.2% |

N=85 instead of N=87 as two people did not indicate an answer for this question.

As multiple injuries can be sustained throughout a season, Table 14 frequency distributions do not add up to 100%. Players were asked about injuries and the most common type of injury was a soft tissue strain or sprain including a ligament, muscle, or tendon with 55.2% of respondents reporting the injury. A total of 14 (16.1%) of participants either had a fracture or dislocation, 8 (9.20%) had a concussion, and 2 (2.30%) had some general medical condition. From April 2019 until time of the study, 31 (35.6%) participants indicated that they have not sustained any football injuries.

**Table 14: Frequency of Type of Football Injuries Sustained since April 2019**

| **Types of Football Injuries Sustained since April 2019** | **Frequency Distribution of Football Injuries (count, percent)** |
|---|---|
| Bone (fracture or dislocation) | 14/87 = 16.1% |
| Soft tissue sprain or strain (ligament, muscle, tendon) | 48/87 = 55.2% |
| Concussion | 8/87 = 9.20% |
| General Medical Conditions (Appendicitis, MRSA, pneumonia, tonsillitis, urinary tract infection, etc.) | 2/87 = 2.30% |
| None | 31/87 = 35.6% |

*Percent do not add up to 100% because some respondents reported more than one type of injury.

Association between age and injury prevalence was analyzed. Of the 87 total participants, 44 (50.6%) were injured during that time period and 43 (49.4%) were not injured (Table 15). Of the injured athletes, the mean and standard deviation age was 33.0 ± 6.7 years, while the mean and standard deviation for the athletes that were not injured, was 32.2 ± 8.2 years. Age was not significantly different between injured and uninjured participants (p=0.624).

**Table 15: Independent Sample Test for Comparison of Age and Football Injuries since April 2019**

| | Injured | | | Not Injured | | | Group Comparison |
|---|---|---|---|---|---|---|---|
| | N | Mean ± SD | Median | N | Mean ± SD | Median | p-value |
| Age (years) | 44 | 33.0 ± 6.7 | 31.5 | 43 | 32.2 ± 8.2 | 31.0 | 0.624 |

### 3.3 Descriptive Data Examining Mental Health

The responses for the questions regarding mental health status during the two weeks prior to taking the survey are displayed in Table 16. A total of 45 (51.7%) participants indicated that over the previous two weeks, they have been tired or had little energy for several of those days. 29 (33.3%) and 6 (6.9%) of participants indicated that they had little interest or pleasure in doing things several of those days and nearly every day, respectively. A total of 26 (29.9%) of participants had trouble falling asleep, staying asleep, or sleeping too much over several days, and 12 (13.8%) more than half of the days. Over the past two weeks, 26 (29.9%) of participants felt bad about themselves, that they were a failure, or let themselves or their family down. More than 50% of respondents said "Not at all" for the following questions: "Having little interest or pleasure in doing things", "Feeling down, depressed, or hopeless", "Having trouble falling asleep or staying asleep, or sleeping too much", "Having a poor appetite or overeating", "Feeling bad about yourself – or that you're a failure or let yourself or your family down", "Having trouble concentrating on things, such as watching television or reading the newspaper", and "Having moved or spoke so slowly that other people could've noticed? Or the opposite – being so fidgety or restless that you've been moving around more than usual."

**Table 16: Distribution of Self-Reported Mental Health Concerns Over the Past Two Weeks Among Respondents (Count, Percentage)**

| Mental Health Question | Not at all | Several days | More than half the days | Nearly every day | Total |
|---|---|---|---|---|---|
| Having little interest or pleasure in doing things | 47 (54.0%) | 29 (33.3%) | 5 (5.7%) | 6 (6.9%) | 87 (100%) |
| Feeling down, depressed, or hopeless | 55 (63.2%) | 27 (31.0%) | 2 (2.3%) | 3 (3.4%) | 87 (100%) |
| Having trouble falling asleep or staying asleep, or sleeping too much | 44 (50.6%) | 26 (29.9%) | 12 (13.8%) | 5 (5.7%) | 87 (100%) |
| Being tired or having little energy | 26 (29.9%) | 45 (51.7%) | 12 (13.8%) | 4 (4.6%) | 87 (100%) |
| Having a poor appetite or overeating | 54 (62.1%) | 21 (24.1%) | 8 (9.2%) | 4 (4.6%) | 87 (100%) |
| Feeling bad about yourself – or that you're a failure or let yourself or your family down | 51 (58.6%) | 26 (29.9%) | 7 (8.0%) | 3 (3.4%) | 87 (100%) |
| Having trouble concentrating on things, such as watching television or reading the newspaper | 54 (62.1%) | 23 (26.4%) | 5 (5.7%) | 5 (5.7%) | 87 (100%) |

Table 16 continued

| | | | | | |
|---|---|---|---|---|---|
| Having moved or spoke so slowly that other people could've noticed? Or the opposite – being so fidgety or restless that you've been moving around more than usual | 69 (79.3%) | 14 (16.1%) | 3 (3.4%) | 1 (1.1%) | 87 (100%) |

Frequency distributions for the number of participants diagnosed with a mental health disorder any time in the past are indicated below in Table 17. Of the 87 total participants, 48 (55.2%) have not been diagnosed with a mental health disorder and 39 (44.8%) have been.

**Table 17: Frequency of Respondents with a Diagnosed Mental Health Disorder Any Time in the Past**

| **Diagnosed with a Mental Health Disorder** | **Frequency of Athletes with a Mental Health Disorder (Count, Percent)** |
|---|---|
| Yes | 39/87 = 44.8% |
| No | 48/87 = 55.2% |
| **Total** | **87** |

Responses for frequencies of mental health disorders is indicated in Table 18. As 39 of the total 87 respondents answered "Yes" to the question presented in Table 17, those participants were then prompted to complete a follow-up question. A total of 29 (74.4%) participants indicated that they have diagnosed anxiety, while 16 (41.0%) of participants indicated that they have depression. Post-traumatic stress disorder was common in 11 (28.2%) of participants. A total of 3 (7.69%) respondents indicated they had obsessive compulsive disorder, 2 (5.13%) had an eating disorder, and 7 (17.9%) indicated other. Not shown are the other mental health disorders that were indicated in the survey, which include borderline personality disorder, post-partum depression, substance use disorder full remission, and attention-deficit hyperactivity disorder (ADHD).

**Table 18: Frequency of Mental Health Disorders Any Time in the Past**

| **Mental Health Disorder** | **Frequency Distribution (count, percent)** |
|---|---|
| Anxiety Disorder | 29/39 = 74.4% |
| Depression | 16/39 = 41.0% |
| Obsessive Compulsive Disorder | 3/39 = 7.69% |
| Eating disorders | 2/39 = 5.13% |
| Post-traumatic stress disorder | 11/39 = 28.2% |
| Other | 7/39 = 17.9% |

*Percent do not add up to 100% because some respondents reported more than one mental health disorder.

The relationship between participants' region of football participation and mental health diagnosis were analyzed to see if that had an effect on whether the likelihood of having a mental health disorder was more prevalent in certain regions (Table 19). Of the 32 participants from the Midwest, 19 (59.4%) indicated they had a mental health disorder. Of the 40 participants from the Northeast, 17 (42.5%) indicated they had a mental health disorder. The South had nine total participants and 1 (11.1%) indicated they had a mental health disorder. Finally, the West had six total participants and 2 (33.3%) indicated they had a mental health disorder. Fisher Exact Test was used to investigate if there was an association between region of the football team association and having been diagnosed with a mental health disorder. There was no statistically significant differences between portion of respondents with a diagnosed mental health disorder among regions (p=0.060).

**Table 19: Association Between Region of the Football Team and Having a Diagnosed Mental Health Disorder**

| **Region of Football Team Association** | **Frequency of Participants that Have a Mental Health Disorder (Count, Percent)** |
|---|---|
| Midwest | 19/32 = 59.4% |
| Northeast | 17/40 = 42.5% |
| South | 1/9 = 11.1% |
| West | 2/6 = 33.3% |
| **Total** | **87** |

Midwest includes Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota;
Northeast includes Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, and Pennsylvania;
South includes Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, Washington D.C., West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, Texas;
West includes Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming, Alaska, California, Hawaii, Oregon, Washington.

A participants' division and access to a mental health counselor were analyzed to see if that had an effect on whether the likelihood of having access to a mental health counselor was more prevalent in a certain division. Those results are displayed in Table 20. Of the 41 participants from Division I, 32 (78.0%) indicated they had access to a mental health counselor. Of the 12 participants from Division II, 7 (58.3%) indicated they had access to a mental health counselor. Division III had 33 total respondents and 25 (75.8%) of those respondents indicated that they had access to a mental health counselor. N=86 instead of n=87 for this frequency table as one participant chose not to answer if they had access to a mental health counselor. Fisher Exact Test was used to investigate if there was an association between division of the football team and having access to a mental health counselor. There was no statistically significant difference between proportions of respondents with mental health counselor access among divisions (p=0.391).

**Table 20: Frequency of Respondents in Each Division That Have Access to a Mental Health Counselor Whether That Be Through a Job, Team, Programs, etc.**

| **Division of Football Team** | **Frequency of Having Access to a Mental Health Counselor (Count, Percent)** |
|---|---|
| Division I | 32/41 = 78.0% |
| Division II | 7/12 = 58.3% |
| Division III | 25/33 = 75.8% |
| **Total** | **86** |

Table 21 indicates the frequency of respondents from all three divisions that either do or do not have access to a mental health counselor. A total of 22 (25.6%) of participants indicated that they do not have access to a mental health counselor and 64 (75.6%) indicated they did. N=86 instead of n=87 for this frequency table as one participant chose not to answer if they had access to a mental health counselor.

**Table 21: Association Between Division and Having Access to a Mental Health Counselor**

| **Access to a Mental Health Counselor** | **Frequency Distributions (count, percent)** |
|---|---|
| Yes | 64/86 = 75.6% |
| No | 22/86 = 25.6% |
| **Total** | **86** |

The total for this question is N=86 instead of N=87 because one person chose not to answer it.

Frequency distribution of participants that meet with a mental health counselor on a regular basis is displayed in Table 22. Of the 87 participants, 17 (19.5%) participants meet with a mental health counselor on a regular basis, while 70 (80.5%) participants do not.

**Table 22: Frequency Distribution of Particpants That Meet With a Mental Health Counselor on a Regular Basis**

| **Meet with a Mental Health Counselor on a Regular Basis** | **Frequency Distributions (count, percent)** |
|---|---|
| Yes | 17/87 = 19.5% |
| No | 70/87 = 80.5% |

### 3.4 Descriptive Data Examining Menstruation and Contraception

The frequency of ages when participants started their menstrual cycle is displayed in Table 23. Four (4.6%) participants started their menstrual cycle at an age younger than 10. A total of 48 (55.2%) participants were in between the ages of ten and twelve and 30 (34.5%) participants were in between the ages of thirteen and fifteen. Lastly, 5 (5.7%) participants were sixteen or older when they first started their menstrual cycle.

**Table 23: Frequency of Ages When Participants Started Their Menstrual Cycle**

| **Age (years)** | **Frequency Distribution (count, percent)** |
|---|---|
| Younger than 10 | 4/87 = 4.6% |
| 10-12 years | 48/87 = 55.2% |
| 13-15 years | 30/87 = 34.5% |
| 16 or older | 5/87 = 5.7% |
| **Total** | **87** |

Table 24 indicates the frequency of respondents describing their current menstrual cycle. N=86 instead of n=87 for this frequency table as one participant chose not to answer what their current menstrual cycle was. Three (3.5%) of participants are currently in menopause and 1 (1.2%) of participants indicated that they are currently pregnant or their last pregnancy ended within the past two months. A total of 59 (68.6%) of participants are still having regular periods and 23 (26.7%) are irregular.

**Table 24: Frequency of Respondents Describing Their Current Menstrual Cycle**

| **Current Menstrual Cycle** | **Frequency Distributions (count, percent)** |
|---|---|
| I'm in menopause | 3/86 = 3.5% |
| I'm pregnant, or my last pregnancy ended within the past 2 months | 1/86 = 1.2% |
| I'm still having regular periods | 59/86 = 68.6% |
| My periods are irregular | 23/86 = 26.7% |
| **Total** | **86** |

The total for this question is N=86 instead of N=87 because one person chose not to answer it.

Table 25 indicates the frequency distributions of the number of times the participants has been pregnant. Six (6.9%) participants have been pregnant once, 7 (8.0%) participants have been pregnant twice, 5 (5.7%) participants have been pregnant three times, 8 (9.2%) participants have been pregnant four or more times, and 61 (70.1%) participants indicated that they have never been pregnant.

**Table 25: Frequency Distribution of Number of Times the Participant Has Been Pregnant**

| Number of Times the Participant Has Been Pregnant | Frequency Distributions (count, percent) |
|---|---|
| 1 | 6/87 = 6.9% |
| 2 | 7/87 = 8.0% |
| 3 | 5/87 = 5.7% |
| 4 or more | 8/87 = 9.2% |
| None | 61/87 = 70.1% |

Table 26 indicates the frequency of respondents that have used some form of contraception. A total of 46 (52.9%) of participants indicated that they have used contraceptives and 41 (47.1%) of participants indicated that they have never used contraceptives.

**Table 26: Frequency of Respondents Having Ever Used Contraceptives**

| Have ever used contraceptives | Frequency Distributions (count, percent) |
|---|---|
| Yes | 46/87 = 52.9% |
| No | 41/87 = 47.1% |

The frequency of respondents that are currently using contraception is displayed in Table 27. Only 46 respondents were prompted to answer this question as they answered "Yes" for ever having used contraception. Of the 46 total respondents, 7 (15.2%) participants are still currently using contraception and 39 (84.8%) participants are not using contraceptives.

**Table 27: Frequency Distribution of Respondents Currently Using Contraception**

| Currently Taking Contraceptives | Frequency Distribution (count, percent) |
|---|---|
| Yes | 7/46 = 15.2% |
| No | 39/46 = 84.8% |
| **Total** | **46** |

The total for this question is N=46 instead of N=87 because they were only prompted to answer this question if they answered "Yes" to having ever used contraception.

Frequency distribution of length of time participants have been taking contraceptives is displayed in Table 28. Only 7 participants indicated that they were still currently taking contraceptives in Table 27, so those were the only respondents that were asked the preceding question. One (14.3%) participant indicated that they took contraceptives for less than a year and no participants indicated that they were taking contraceptives for one to two years. One (14.3%) participants indicated that they took contraceptives for two to three years, while 4 (57.1%) participants indicated that they took contraceptives for three or more years. Lastly, 1 (14.3%) participant indicated that they have never taken contraceptives.

**Table 28: Frequency Distribution of Length of Time Particpants Have Been Taking Contraceptives**

| **Length of Time Taking Contraceptives** | **Frequency Distributions (count, percent)** |
|---|---|
| Less than 1 year | 1/7 = 14.3% |
| 1-2 years | 0/7 = 0.00% |
| 2-3 years | 1/7 = 14.3% |
| 3 or more years | 4/7 = 57.1% |
| Never have taken oral contraceptives | 1/7 = 14.3% |

The total for this question is N=7 instead of N=87 because they were only prompted to answer this question if they answered “Yes” to having ever used contraception.

Figure 2 illustrates the forms or types of contraception the participants have used any time in the past. With this question being a follow-up to results from Table 26, not every participant was prompted to answer this question. A total of 39 participants have used a pill for contraception. A total of nine participants have used an IUD, six participants have used a shot, and two participants have used a vaginal ring and two participants have used an implant.

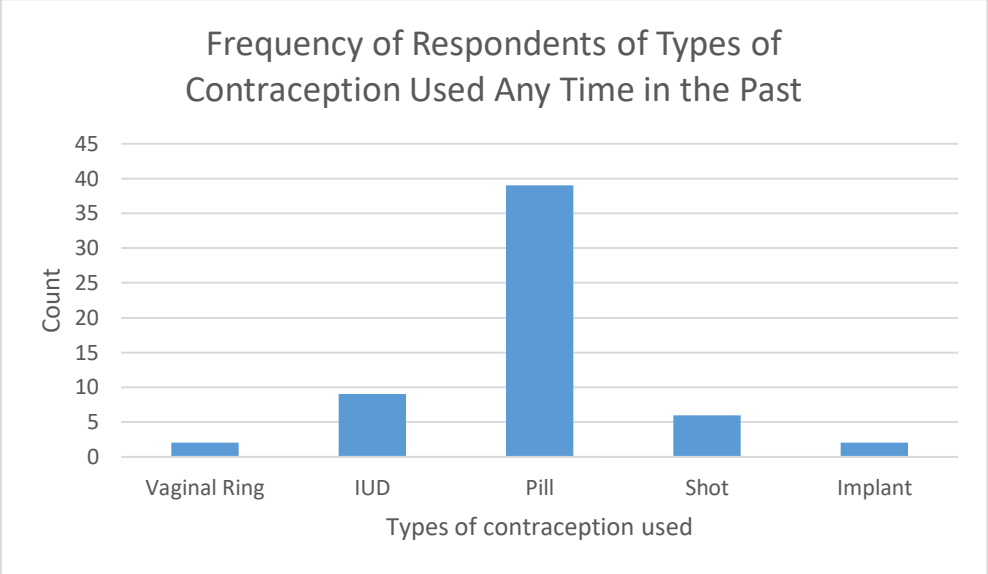


**Figure 2: Frequency of Respondents of Types of Contraception Used**

*Count does not add up to n=87 because some respondents reported more than one type of contraception used. N=43 were not prompted to answer the question.

Frequency distributions of participants having ever had negative reactions or side effects to contraceptives is displayed in Table 29. A total of 20 (43.5%) participants indicated that they have had negative side effects from contraceptives, while 26 (56.5%) participants indicated that they have never had side effects from contraceptives.

**Table 29: Frequency Distribution of Participants Having Ever Had Negative Reactions or Side Effects to Contraceptives**

| Ever Had Negative Reactions or Side Effects to Contraceptives | Frequency Distribution (count, percent) |
|---|---|
| Yes | 20/46 = 43.5% |
| No | 26/46 = 56.5% |

The total for this question is N=46 instead of N=87 because they were only prompted to answer this question if they answered "Yes" to having ever used contraception.

### 3.5 Descriptive Data Examining Nutrition

The average number of proportions of fruit eaten in a day are displayed in Table 30. A total of 21 (24.1%) of participants eat less than one portion of fruit in day and the majority of respondents, 30 (34.5%), indicated they consume one portion of fruit per day. Twenty-six (29.9%) participants eat two portions of fruit per day, 9 (10.3%) eat three portions, and 1 (1.1%) person eats four or more portions of fruit in a day.

**Table 30: Frequency of the Portions of Fruit Eaten in a Day**

| **On average, the number of portions of fruit eaten in a day** | **Frequency Distribution (count, percent)** |
|---|---|
| <1 | 21/87 = 24.1% |
| 1 | 30/87 = 34.5% |
| 2 | 26/87 = 29.9% |
| 3 | 9/87 = 10.3% |
| 4 or more | 1/87 = 1.1% |
| **Total** | **87 = 100%** |

*Examples given were a handful of grapes, an orange, a handful of dried fruits

The average number of vegetables eaten in a day are displayed in Table 31. Eleven (12.6%) participants eat less than a portion of vegetables in a day and 27 (31.0 %) of participants consuming one portion per day. Thirty-four (39.1%) participants eat two portions per day, 12 (13.8%) participants eat three portions per day, and 3 (3.4%) participants eat four or more portions per day.

**Table 31: Frequency of Portions of Vegetables Eaten in a Day**

| **On average, the number of portions of vegetables eaten in a day** | **Frequency Distribution (count, percent)** |
|---|---|
| <1 | 11/87 = 12.6% |
| 1 | 27/87 = 31.0% |
| 2 | 34/87 = 39.1% |
| 3 | 12/87 = 13.8% |
| 4 or more | 3/87 = 3.4% |
| **Total** | **87 = 100%** |

*Examples given were a half a cup of carrots, a side salad, two spears of broccoli

Table 32 indicates the responses for questions regarding nutrition and how often certain categories of foods are consumed. Participants were asked to mark which portion best suited their intake for each of the following foods or drinks. Notably, some of the nutrition questions were structured differently in that the portions were not exactly the same for each question. N/A indicates that that portion was not an option for the participant to pick during that particular question.

Twenty-five (28.7%) participants indicated that they consume cheese or yogurt four to six times a week while the second most common was one to two times a day with 22 (25.3%) participants. A total of 32 (36.8%) participants ate one portion of chicken or turkey two to three times a week with 31 (35.6%) having eaten four to six portions a week. Of interest was the category pertaining to oily fish and white fish as 53 (60.9%) and 46 (52.9%) participants indicated that they rarely or never eat those foods, respectively. Seventeen (19.5%) participants ate oily fish less than once a week and 18 (20.7%) ate less than one portion of white fish. The portion of beef, lamb, pork, and ham that was most common was two to three times a week with 35 (40.2%) of participants indicating they fell under that category. Twenty-seven (31.0%) participants indicated that they rarely or never ate wholemeal or wholegrain bread while 22 (25.3%) of participants ate it two to three times a week. With regard to sweet biscuits, cakes, chocolate, sweets, 23 (26.4%) of participants at two to three portions a week with 22 (25.3%) having eaten those once a week.

**Table 32: Description of Portions of Food or Drink Consumed by Respondents**

| Please tick how often you eat at least ONE portion of the following foods and drinks | Rarely or never | Less than 1 a week | Once a week | 2-3 times a week | 4-6 times a week | 7+ times a week | 1-2 times a day | 3-4 times a day | 5+ times a day |
|---|---|---|---|---|---|---|---|---|---|
| Cheese/Yogurt | 6/87 =6.9% | 7/87 =8.0% | 7/87 =8.0% | 17/87 =19.5% | 25/87 =28.7% | N/A | 22/87 =25.3% | 2/87 =2.3% | 1/87 =1.1% |
| Chicken or Turkey | 4/87 =4.6% | 3/87 =3.4% | 6/87 =6.9% | 32/87 =36.8% | 31/87 =35.6% | 11/87 =12.6% | N/A | N/A | N/A |
| Oily Fish – like herrings, sardines, salmon, trout, mackerel, fresh tuna | 53/87 =60.9% | 17/87 =19.5% | 9/87 =10.3% | 7/87 =8.0% | 1/87 =1.1% | 0/87 =0.0% | N/A | N/A | N/A |

Table 32 continued

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| White Fish not in batter or breadcrumbs | 46/87 =52.9% | 18/87 =20.7% | 11/87 =12.6% | 11/87 12.6% | 1/87 =1.1% | 0/87 =0.0% | N/A | N/A | N/A |
| Beef, Lamb, Pork, Ham | 11/87 =12.6% | 8/87 =9.2% | 11/87 =12.6% | 35/87 =40.2% | 17/87 =19.5% | 5/87 =5.7% | N/A | N/A | N/A |
| Wholemeal bread or other whole grain bread | 27/87 =31.0% | 10/87 =11.5% | 14/87 =16.1% | 22/87 =25.3% | 11/87 =12.6% | N/A | 1/87 =1.1% | 1/87 =1.1% | 1/87 =1.1% |
| Sweet biscuits, cakes, chocolate, sweets | 19/87 =21.8% | 11/87 =12.6% | 22/87 =25.3% | 23/87 =26.4% | 5/87 =5.7% | N/A | 7/87 =8.0% | 0/87 =0.0% | 0/87 =0.0% |

Frequency distributions for type of milk used to drink or in foods consumed by participants is displayed in Table 33. A total of 14 (16.1%) participants used whole/full-fat milk, 12 (13.8%) participants use skim milk, 22 (25.3%) participants use almond milk, 10 (11.5%) participants use oat milk, 14 (16.1%) participants rarely or never use milk, and 15 (17.2%) participants use another type of milk. These include 1%, 2%, coconut, half and half, homemade cashew milk, lactose free, organic milk, soy, and vegan.

**Table 33: Frequency Distrubtion of Type of Milk Used to Drink or in Foods by Participants**

| **Type of Milk Used to Drink or in Foods** | **Frequency Distributions (count, percent)** |
|---|---|
| Whole/full-fat milk | 14/87 = 16.1% |
| Skim milk | 12/87 = 13.8% |
| Almond milk | 22/87 = 25.3% |
| Oat milk | 10/87 = 11.5% |
| Rarely/never use milk | 14/87 = 16.1% |
| Other | 15/87 = 17.2% |

Table 34 indicates the average units of alcohol consumed over a seven-day week by participants. Twenty-nine (33.3%) participants consume less than seven units a week, 6 (6.9%) participants consumed seven to fourteen units, 2 (2.3%) participants consume between fourteen and twenty-one units, no one consumes more than twenty-one units a week, 47 (54.0%) participants rarely or never consume alcohol, and 3 (3.4%) participants decided not to answer.

**Table 34: Frequency Distribution of Average Units of Alcohol Consumed Over a Seven Day Week by Participants**

| Average units of alcohol consumed over a seven day week | Frequency Distributions (count, percent) |
|---|---|
| Less than 7 units | 29/87 = 33.3% |
| 7-14 units | 6/87 = 6.9% |
| Between 14 and 21 units | 2/87 = 2.3% |
| More than 21 units | 0/87 = 0.0% |
| Rarely/Never drink alcohol | 47/87 = 54.0% |
| Prefer not to answer | 3/87 = 3.4% |

One unit is a standard glass of wine, half a pint of beer or lager, a single measure of spirits

# 4.0 Discussion

In sports medicine research, female football players are an understudied population compared to male football players. Women have unique risk factors compared to men and some research has highlighted those, but not extensively in this population. For example, menstruation, nutritional needs, contraception use, and mental health are aspects that differ slightly between men and women. The confounding variables previously mentioned often exclude women from studies as researchers select subjects that will improve their studies reliability and validity. However, as opposed to classifying those variables as ones to exclude the athlete from a research study, those specific areas were the variables of interest for this study. The purpose of this study was to describe variables related to performance and injury risk in professional women's football teams and compare these variables.

## 4.1.1 Discussion of Demographics and Characteristics

The results indicated that most participants were 30 years of with an age range of 17-59 years for all participants. All three divisions were represented in this student, however, DI female professional athletes accounted for slightly under half of total respondents. Division II had the least representation from participants and Division III had 37.9% participants. In addition, four regions from the United States were included in this study with the colder regions like, Northeast and Midwest, recording a higher number of participants than the South and West. Years of playing professional football was recorded with most respondents indicating that they had less than a year of playing experience. This is in agreement with what the author had anticipated as the WFA has

seen promising growth in the sport, both in the number of teams and level of competition, over the past five years [47]. Nineteen (21.8%) participants had one to two years of experience and 11 (12.6%) had three to four years of experience. Twenty-four (27.6%) participants had over four years of experience. Men have the opportunity to play all the way up through high school, then college and professionally, while women often do not get the same chance. The WFA league was established in 2009, so the opportunity for women to play football has only been available for a few years. Women's football is drawing more attention and will continue to grow in the upcoming years with participation continuing to increase.

The last demographic or characteristic assessed was position. Respondents were able to choose from a variety of positions and could select all that applied to them. Thirty-one (35.6%) participants indicated that they played offensive line and 30 (34.5%) participants indicated that they played defensive line. This was expected, as the offensive and defensive line make up the majority of the athletes that are on the football field at a given time. There are several positions within the offensive or defensive line compared to quarterback that only offers one position. Five participants indicated they play at the positions of kicker, five at punter, and five at snapper, which was the least amount of respondents' answers. Positions that neither encompassed the most athletes nor the least athletes, but had some participation were quarterback, running back, wide receiver, tight end, and safety.

### 4.1.2 Discussion of Injuries

Due to the 2020-2021 football season taking place during the COVID-19 pandemic, participation was minimal during those years. Some teams decided to play during 2021 while others looked outside the WFA and got involved in flag football. For the injury portion of the

survey, rather than assessing just the past year, injuries sustained from April 2019 until February 2022 were included. A total of 44 athletes had an absence from training, or participation in competitions due to football injuries during that time-period, which was about half of the respondents. In conjunction with what the author had anticipated, soft tissue sprains or strains were the most common type of football injury as 48 (55.2%) participants sustained this injury in the given time-period. Data from the National Football League (NFL) indicates that up to 68% of NFL players may be injured in a season [48]. In a study published in 2021, former NFL players indicated that they had sustained at least one musculoskeletal injury at a frequency of 90.3% throughout their entire football career [48]. While one prevalence rate highlights one or two seasons and the other is for an entire career, this still shows the high risk of injury while playing professional football. Fourteen (16.1%) participants in the current study had a fracture or dislocation, 2 (2.30%) had some type of general medical condition and 8 (9.20%) participants had concussions.

These findings are similar to that of another study with regard to injuries of the first division of the Spanish Women's Soccer League. The type of injury that had the highest incidence rate was the joint/ligament, followed by muscle/tendon with no significant difference between them [49]. The incidence rate of fractures or other bone stress injuries were significantly lower than other types of injuries [49]. In the current study, specific locations of injuries were not reported on, however, lower leg injuries accounted for 86.8% of total injuries with the ankle, knee, and thigh recording greater incidence rates than any other location in the study involving women's soccer players [49]. There was also no difference between game positions in the injury incidence rates [49]. In another study, epidemiology of injuries in National Collegiate Athletic Association (NCAA) Women's Lacrosse was assessed. Division III recorded the highest number of injury rates when compared to Division I and II [50]. Again, an association was not made between Division

and rate of injuries in the current study, but could be the focus of future research. Time loss or absences from training was an area of concern in the present study with most participants having a time loss of one to seven days if an injury was sustained. When compared to the study involving women's lacrosse players, over one-third of all time loss injuries (35.0%) resulted in time loss of ten or more days, which was slightly higher than the current study [50]. As previously noted in the other study, sprains (19.9%), strains (19.2%), and inflammatory conditions (15.3%) were the most common injuries sustained [50].

#### 4.1.2.1 Association Between Age and Injury as They Relate to Performance and Injury Risk

The results from this study show that of the 87 total number of participants, 44 of them were injured at some point from April 2019 until the time of the study. In addition, the average age of those that were injured during that time was 33.0 ± 6.7 years. With teams being so diverse in age, the relationship between age and injury was assessed. However, there was no statistical significance when comparing age among injury status. This was contrary to what was expected as injuries were thought to increase as age increased. A study by Huebner et al. assessed training, lifestyle, health challenges, and gender differences in Master athletes (ages 34-87 years) in Olympic weightlifting [51]. The probability of having suffered shoulder issues increased with age for both men and [51]. Women at every age with more than five years of competition experience also had a greater probability of a shoulder injury [51]. Stress levels also hindered training more for women than men with 17.9% and 8.4%, respectively [51]. Lastly, other life circumstances, such as work, had a moderate or considerable effect on training in 52% of women [51]. There was a higher prevalence in women between the ages of 35-44 compared to women 60 years or older

[51]. This means that there may be more external factors effecting training for women in their 30s and 40s compared to the older population.

A question regarding type of injuries sustained since April 2019 was asked with possible answers including: Bone (fracture or dislocation), soft tissue sprain or strain, concussion, general medical conditions, or no injuries. Although 31 (35.6%) of respondents indicated they did not sustain an injury during that time, 48 (55.2%) indicated that they had a soft tissue injury. It was not indicated what specific soft tissue injury was sustained; however, several studies have focused on sex differences in neuromuscular control that could subject the athlete to a greater risk of injury. For example, it is known that ACL injuries are two to eight times more common in female athletes then male athletes [52]. Female athletes have demonstrated increased knee abduction and increased quadriceps-to-hamstring ratio during landing [52]. In addition, hormones are a risk factor for these types of injuries as there is increased ligamentous laxity and reduced tendon stiffness more often during the follicular and preovulatory phases [52].

### 4.1.3 Discussion of Mental Health

An adapted Patient Health Questionnaire (PHQ-9) was used in this study as it is a questionnaire that has been widely used in other research studies as a tool for assessment of the severity of depression [53]. Respondents answered the questions with regard to their symptoms over the previous two weeks of the survey date. More than 50% of respondents said “Not at all” for the following questions: “Having little interest or pleasure in doing things”, “Feeling down, depressed, or hopeless”, “Having trouble falling asleep or staying asleep, or sleeping too much”, “Having a poor appetite or overeating”, “Feeling bad about yourself – or that you’re a failure or let yourself or your family down”, “Having trouble concentrating on things, such as watching

television or reading the newspaper", and "Having moved or spoke so slowly that other people could've noticed? Or the opposite – being so fidgety or restless that you've been moving around more than usual." Only one question had over 50% of respondents answer something other than "Not at all" and that was the question regarding feeling tired or having little energy. Forty-five (51.7%) participants indicated that they were tired or had little energy, which could come from a multitude of things relating to job, family, extra curriculars, etc. These results were not anticipated as it was expected that more respondents would at least answer "Several days" to a few of the questions. Due to the frequency of respondents in the current study indicating that 41.0% had a diagnosed mental health disorder of depression, we would have expected the results from the PHQ-9 to be slightly higher. The questionnaire typically has a scoring system of zero to three for each question and then the total score is added up to then indicate the severity of depression. However, data was looked at as a whole and each participants scores were not added up to assess each participant's score of depression severity.

We can, however, look at each category and note the responses and frequencies to each question. Of concern, are the answers pertaining to "More than half the days" or "Nearly every day." Six (6.9%) participants indicated that they had little interest or pleasure in doing things nearly every day. Seven (8.0%) participants indicated feeling bad about themselves more than half the days. Five (5.7%) participants had trouble concentrating on things such as watching television or reading the newspaper more than half of the days and the same amount of participants answered nearly every day. While these respondents do not make up the majority of total respondents, it is still worthwhile noting those responses.

About half, or 39 (44.8%), of the participants indicated that they had a diagnosed mental health disorder. The results from the current study were more than doubled when compared to

another study outlining the global prevalence of common mental health disorders [54]. Close to one in five respondents (17.6%) met the criteria for a mental health disorder in the previous twelve months and 29.2% met lifetime prevalence [54]. Additionally, the most common mental health disorder that participants indicated they had in the current study was anxiety as the frequency of respondents was 74.4%. In the study involving global prevalence, the highest twelve month prevalence rate was anxiety disorders, affecting one in fifteen people annually (6.7%) [54]. The next highest mental health disorder reported was depression, with a frequency of 41.0%. These two mental health disorders were anticipated to be the most common and highest occurring due to a previous study reporting similar results [28 30]. Another study using the General Health Questionnaire (GHQ-12) indicated that 66 (47.8%) participants scored ≥2 meaning they met the cut-off for showing signs of anxiety/depression [55]. This questionnaire is similar to the PHQ-9 in that there is a 4-point scale ('not at all,' ' no more than usual,' ' rather more than usual,' 'much more than usual') for participants to respond how they currently feel.

A study published in 1988 by Regier et al., looked at one-month prevalence rates of mental health disorders in the United States [56]. The five sites that were included in the report was New Haven, Connecticut, Baltimore, St. Louis, Durham, North Carolina, and Los Angeles [56]. Each site contributed about 4,000 to 5,000 subjects, totaling 18,571 subjects for this study [56]. From this sample, 41% were men, and 59% were women with ages that span from 18 years to 65 plus years of age [56]. Results showed that women (16.0%) had slightly higher total rates of mental health disorders than men (14.0%) [56]. The highest rates of any disorder was found in ages 18-24 with a prevalence rate of 16.9 and 25-44 years with a prevalence rate of 17.3 [56]. Anxiety disorders, with a rate of 7.3%, were the most prevalent of all major groups of mental health disorders [56].

Another article published in 2011 by Reeves et al. conducted a mental illness surveillance among adults in the United States [57]. It was reported that one fourth of adults in the United States have a mental illness, and nearly half will develop at least one mental illness during their lifetime [57]. In addition, the most common mental illness in adults is anxiety and mood disorders, which is in-line with the current study [57]. The CDC surveillance systems provide estimates for current depression using the PHQ-8 and PHQ-9 [57]. In 2006, 38 states were surveyed and about 8.7% of participants had depression currently, while 16 states were surveyed in 2008 and 8.2% had depression [57]. Notably, prevalence rates vary by states due to demographics, socioeconomics, and availability of and access to health-care services [57]. Contrary to the current study, however, southeastern states generally had the highest prevalence of depression, serious psychological distress, and mean number of mentally unhealthy days, which could be due to higher rates of chronic health conditions in that area [58] [57].

Eleven (28.2%) participants in the current study indicated that they had PTSD. Eating disorders were also surprisingly low as only 2 (5.13%) indicated they had an eating disorder. In a study of 522 elite female athletes and 448 non-athlete controls completing a disordered eating questionnaire, 18% of the athletes were diagnosed with and eating disorder compared to only 5% of non-athlete controls, so this disagrees with what the author had anticipated [59]. Three (7.69%) participants have obsessive compulsive disorder and 7 (17.9%) participants indicated other. A text box was provided to write what other mental health disorder participants had and borderline personality disorder, post-partum depression, substance use disorder full remission, and attention-deficit hyperactivity disorder were the ones mentioned.

Division of play was also assessed as it relates to having access to a mental health counselor. It was hypothesized that participants from Division I would have the most access to a

mental health counselor, followed by Division II and III. Participants from Division I did have the highest frequency of respondents with 32 (78.0%). However, 25 (75.8%) participants from Division III had access to a mental health counselor, while only 7 (58.3%) participants from Division II had access to a mental health counselor. These results could be due to having more survey participation from the Division I and III level as opposed to Division II. The Suicide Prevention Lifeline is a national organization created to help prevent suicide [60]. However, they also provide resources for therapists or support groups in your area, stories of hope and recovery, and locations of various crisis centers [60]. Mental health services are also provided by the University of Pittsburgh and many other universities to their student-athletes. These services include individual sessions with the athlete regarding mental health, care and referrals, and collaboration with Psychiatric Hospital services and providers [61].

#### 4.1.3.1 Association Between Region and Mental Health

Women's football encompasses a very diverse population, including age, position, and location and years of football experience. One specific aim of this study was to analyze the association between region of the football team and having a diagnosed mental health disorder. Vitamin D has been said to have a positive effect on behavior and regulate both peripheral and central nervous system immune responses [62]. Some studies have evaluated vitamin D levels and symptoms of depression according to seasonality. However, results are inconsistent as to whether vitamin D supplementation or light shows a reduction in depression symptoms. For example, when observing Old Order Amish in Pennsylvania, who live without electric light and follow the natural daylight cycle, their seasonal affective disorder (SAD) prevalence is lower than nearby populations [63]. This population has a prevalence rate of 0.84% while the SAD prevalence rate in Maryland

is 4.3%, which could indicate that exposure to light or seasonality has an effect on mental health [63].

In addition, twenty Antarctic residence were studied over a one year period to assess the alteration of vitamin D on bone mineral metabolism and mood [64]. At the start of the study, two participants already had mild vitamin D deficiency, which then increased to seven during the polar winter at six months [64]. The mean score on a depression screening was also significantly higher during midwinter ($4.8 \pm 3.9$) then when compared to baseline ($2.9 \pm 2.1$) [64]. In contrast, however, a study involving fifteen subjects with SAD were split into two groups with one group receiving 100,000 I.U of vitamin D and the other receiving phototherapy [65]. This light therapy uses wavelengths between 280-320 nm to allow the skin to then produce vitamin D [65]. All subjects that were receiving vitamin D supplementation improved in all outcomes, but no significant changes in depression scale measures were seen in the phototherapy group [65]. This study would be in-line with similar studies that reported on sunlight having a positive effect on mood and mental health. While the study was conducted during the winter months and more mental health symptoms may have been reported, the Midwest and Northeast still reported the highest frequency of mental health. These states would be experiencing less sunlight exposure compared to the South or West during this time period. In addition, SAD is a mood disorder typically occurring during the fall or winter [66]. This disorder is more common in females and people living at a more northern latitude [66]. With the survey taking place during the cold winter months, this could be the reason for 74.4% participants in the current study having anxiety and 41.0% having depression.

### 4.1.4 Discussion of Menstruation

Menstruation is an important risk factor for injury and performance in women. The age of menarche in the United States has been found to be between ten and sixteen years of age [67]. Median age of menarche of women who are between 18 and 79 years of age in all races is 13.08 ± 1.58 years [68]. Typically with active women, the start of menstruation happens later on in life compared to the general female population [67]. It has been suggested that intense physical activity prior to menarche may alter the rate of reproductive development [67]. However, the frequency of this population started their menstrual cycle slightly earlier than expected. Forty-eight (55.2%) participates indicated that they started their menstrual cycle between the ages of ten and twelve while 30 (34.5%) participants indicated that they started their menstrual cycle between the ages of thirteen and fifteen. A few outliers were present in this study as 4 (4.6%) participants started their menstrual cycle at an age younger than ten and five (5.7%) started at an age of sixteen years or older.

A study published in 1998 by Shierska identified the prevalence of oligomenorrhea and amenorrhea in top polish athletes. Participants were between the ages of 15 and 37 years and represented a variety of sports [69]. Participants were considered eumenorrheic if they reported ten or more menstrual cycles during the previous year, oligomenorrheic if they reported nine or less but more than three, and amenorrheic if they reported three or less cycles [69]. It has been suggested in several studies that the later menarche of athletes may result from early selection for sport [69]. The mean age at menarche of all athletes was 13.6 ± 1.3 years and was statistically later than that in the control sample, 12.9 ± 1.2 years [69]. In other words, there were significantly later ages at menarche of Polish athletes who started training before menarche compared with the ages

at menarche of athletes starting training after menarche [69]. Training prior to menarche reaffirms the idea stated in research that menstruation typically occurs later in physically active individuals, however somewhat inconsistent with our data. 79 participants indicated that they were involved in some sport at the recreational or club level at the age of 12 and up and 83 participants played sports in high school. However, there was no data collected during their late childhood and early adolescent years, so we do not know how physically active the participants were during that time.

Current menstrual cycle responses were also recorded. With the majority of participants still in their 30s, it was expected that they would still be experiencing regular periods as the median age of menopause among white women ranges between 50 and 52 years [70]. Results were in agreement with what the author anticipated as 59 (68.6%) participants indicated that they still were having regular periods. Twenty-three (26.7%) participants indicated that their periods were irregular. Of the two categories that presented with the least frequency of respondents was participants in menopause 3 (3.5%) and pregnant women or women who were pregnant in the last two months 1 (1.2%). This was expected as those categories would not be as common for most women and are narrower in spectrum.

Collecting data regarding menstruation is important to understand injury risk as estrogen and progesterone fluctuate throughout the menstrual cycle, and may influence physiological systems that alter exercise performance [10]. The early follicular phase has low levels of estrogen and progesterone, while the ovulatory and luteal phases have higher levels of estrogen and lower levels of progesterone [11] [18]. Assessing endurance performance by using tests like the Yo-Yo has shown significant differences during the luteal phase [18]. This indicates that the menstrual cycle could reduce endurance performance and athletes may respond differently depending on the

phase they are in. Due to over half of participants still having a regular cycle, consideration should be placed on performance outcomes as the participant moves from one phase to another.

### 4.1.5 Discussion of Contraception

Roughly half, or 46 (52.9%), respondents have used some form of contraception throughout their life. This is inconsistent with another study that reported 69.8% of athletes having used hormonal contraceptives at some point and 49.5% still currently using contraceptives [14]. Subjects included in the study were elite athletes who were older than 18 and competing at a national, international or professional level [14]. However, out of 46 respondents, only 7 (15.2%) are still currently using contraceptives in the current study. Some reasons for using hormonal contraceptives is to avoid pregnancy, control or regulate their cycle and to reduce menstrual-related pain [23]. The results can be understood because if the majority of participants are in their 30s, they might be thinking about conceiving or concerned for their increased risk of blood clots [71]. There are increased risk factors for women taking hormonal contraception with regard to venous thrombosis, especially for women with a body mass index at or over 30, smoking, and age older than 35 years [71]. In addition, 59 (68.6%) participants indicated that they still were having regular periods, so there would not be a need to regulate their cycle. The results from the current study were similar to another study involving females in the Australian Football League, Rugby Australia, and National Rugby League [23]. The 2021 study reported that about 50% of elite level athletes use contraceptives, but only 58/177 (32.7%) participants were currently using due to mood swings, weight gain, depression/anxiety, and headaches/migraines [23].

The type of contraception that was most commonly used was a pill with 39 participants using that form. The study previously mentioned by Martin et al. also had similar findings in that

oral contraceptives were the most widely used (78.4%), followed by implant (13.1%), injection (3.8%) IUS (2.8%) and vaginal ring (0.5%) [14]. It was reported that the specific type of hormonal contraception was chosen based of ease of use in 18.8% of participants [14]. That was in-line with what the author expected as it is the most well-known form of contraception. Nine participants have used an IUD and six participants have used a shot. These two methods are becoming more popular, but the prevalence rate is still low compared to other methods. Some studies have reported on the side effects of using an IUD and found that there is a risk of salpingitis, inflammation of the fallopian tubes caused by a bacterial infection, in association with IUD [72]. Irregular bleeding can also be expected with an IUD, so that may lead to decreased attraction [72]. With regard to a shot, Depo-Provera is a well-known brand name contraceptive injection that contains the hormone progestin [73]. The FDA only approved of this method in October 1992, so it is still somewhat relatively new to the United States [73]. It is said to have a 99% effective rate, but many users stop using it due to menstrual pattern changes, spotting, and weight gain [73]. Over half of the users stated that as time progressed, they became amenorrheic and an average weight gain of 2 kg was seen in the first year of use [73]. Finally, two participants have used the vaginal ring and two participants have used an implant.

Previous research studies have looked at the effects of contraception use on injury risk. Some studies have reported on possible effects of contraception on bone mineral density that would lead to an increase risk of osteoporosis and fracture [74]. Other studies have reported that combined oral contraceptive use has a favorable influence on bone mineral density [74]. Dombrowski et al. compared the risk of bone fracture in women using hormonal contraception with that in women who have never used hormonal contraception [74]. Results indicated that women without bone fractures were significantly more likely to have used oral contraception [74].

In addition, use of oral contraception was only associated with a significantly lower risk of developing bone fractures in patients that had used contraception for a period of at least five years [74].

In summary, slightly more than half of the participants have used contraceptives at some point throughout their life, while only seven of them are still using in the current study. Of those seven, four have used contraceptives for three or more years. In addition, 14 (16.1%) participants sustained a bone fracture or dislocation from April 2019 to the survey date. Future research could examine the relationship between contraceptive use and bone injury to assess if a relationship exists between reduced risk of injury with contraceptive use. Hormonal contraceptives, specifically the pill form, have been said to increase body mass and core temperature, which could lead to heat illness [19]. In addition, a decrease in VO2 max has been shown with hormonal contraception users, with no change in endurance, hemoglobin levels, maximum heart rate, RER, ventilation, or strength [20] [21]. While hormonal contraceptives are used for a variety of reasons like, regulating a period, reduce menstrual bleeding, and preventing pregnancy, consideration should be placed on the adverse effects associated with its use.

### 4.1.6 Discussion of Nutrition

In general, nutrition plays a crucial role for women for a variety of reasons. Adequate intake of macronutrients, micronutrients, vitamins and minerals is important for bone health and body healing, hormonal balance, energy, and prevention of various diseases. There are several implications if someone does not consume adequate fruit and vegetables in their diet. These products are usually consumed due to their high fiber content, and can impact energy balance

because of their higher energy density [75]. They are also helpful for anyone that is trying to lose weight as they can provide feelings of satiation, but still have a low caloric content [75].

The frequency of fruits and vegetables were assessed in this survey to see what the average number of portions of each were consumed per day. According to the USDA, women between the ages of 19-30 years should consume 1.5 to 2 cups of fruits per day, and women between the ages of 31-59 years should also consume 1.5 to 2 cups of fruit per day [76]. The average portions of fruit were assessed first with examples of portions given including a handful of grapes, an orange, a handful of dried fruits. According to the American Heart Association, four servings of fruit should be consumed per day [77]. Thirty (34.5%) participants indicated that they consume one portion of fruit per day while 26 (29.9%) participants consumed two portions per day. Closely following behind those categories was 21 (24.1%) participants consuming less than one portion per day. Nine (10.3%) participants consumed three portions of fruit per day and 1 (1.1%) participants consumed four or more portions. The participants that consume two, three or four portions of fruit per day, would likely be meeting USDA recommendations, but may fall short for the American Heart Association recommendations. This data indicates that a majority of participants are consuming adequate amounts of fruit per day. For the twenty-one participants that consume less than one portion per day, they may not be meeting the USDA recommendations and could be deficient in certain nutrients. Frozen vegetables or packaged goods are often more affordable, so people might opt for one of those as opposed to fruit [75]. In addition, fruits are in season during particular months, so buying them fresh may not always be appropriate. If not consumed within a short period of time, it may also go bad.

The frequency of portions of vegetables eaten per day were assessed next. Examples of portions that were given for this question include half a cup of carrots, a side salad, and two spears

of broccoli. According to the USDA, women between the ages of 19-30 years should consume 2.5 cups to 3 cups of vegetables per day, while women between 31-59 years should consume 2 to 3 cups per day [76]. However, according to the American Heart Association, five servings of vegetables should be consumed per day, which is slightly higher than the previous recommendations [77]. The frequency of respondents recorded higher portions for vegetables when compared to fruit as 34 (39.1%) participants indicated they consumed 2 portions per day. Twenty-seven (31.0%) participants consumed one portion of vegetables per day, while 12 (13.8%) participants consumed three portions per day. Eleven (12.6%) participants consumed less than one portion per day, while 3 (3.4%) participants consumed four or more portions per day. For the participants consuming, two, three or four portions of vegetables per day, they would likely be meeting the USDA recommendations. However, the frequency of participants meeting those recommendations would be lower if they were following the American Heart Association serving size. However, the participants that only consumed one portion per day, could be deficient in certain nutrients. As previously mentioned, frozen vegetables can be an affordable way to still consume vegetables, so participants that are lacking vegetable consumption, can still add those sources in on a budget [75]. In addition, if they are frozen, they will not go bad as quickly making them more desirable to be purchased.

Participants were then asked how often they ate at least one portion of the following foods or drinks with questions coming from the Short Form FFQ. They were able to respond with, “Rarely or never,” “Less than one a week,” “”Once a week,” “2-3 times a week,” “4-6 times a week,” “7+ times a week,” “1-2 times a day,” “3-4 times a day,” or “5+ times a day.” For the boxes with N/A, that category was not an option for that particular question (Table 19). Twenty-five (28.7%) participants consumed at least one portion of cheese or yogurt four to six times per week

and 22 (25.3%) participants consume at least one portion one to times a day. The USDA recommends that women between the ages of 19-30 years and 31-59 years of age should consume 3 cups of dairy per day [76]. With chicken and turkey being an affordable protein source that can be prepared several different ways, it was hypothesized that those would be the most common types consumed. The USDA recommends that women between the ages of 19-30 years of age consume 5 to 6.5 oz of protein per day, while women between the ages of 31-59 years of age should consume 5 to 6 oz [76].

Thirty-two (36.8%) participants indicated they had two to three portions of chicken or turkey a week and 31 (35.6%) participants indicated they had four to six portions a week. Beef, lamb, pork or ham was consumed by 35 (40.2%) participants two to three times a week and 17 (19.5%) participants consumed it four to six times a week. The dietary guidelines for adults ages 19 to 59 for meats, poultry and eggs is 26 oz a week for a diet that is based off of 2,000 calories [78]. A normal portion size of meat is 3-4 oz, so participants would need to consume six to eight portions of meat a week to meet that recommendation [79]. As all meats were in the same category for the dietary guidelines and the current study separated certain meats, no conclusion can be made if participants consumed more or less than the recommendations. With regard to oily fish, 53 (60.9%) participants indicated they rarely or never consumed this food product and 46 (52.9%) participants also indicated that they rarely or never consumed white fish. The dietary guidelines for adults ages 19 to 59 for seafood is 8 ounces a week for a diet that is based off of 2,000 calories [78]. Since the majority of participants reported they rarely or never consume fish, it is likely these participants are not meeting the recommendations.

Emphasis is placed on certain nutritional components, specifically for women, as deficiencies in an area can have negative effects on health. For example, Omega-3 fatty acids are

important for the prevention and treatment of diseases [80]. They also have been shown to be important in the prevention and treatment of postmenopausal osteoporosis [80]. An insufficiency of fish and fish products in the daily diet has led to a decrease in our intake of omega-3 fatty acids by 80% during the last century and a deficiency of omega-3 fatty acids in the cells is still common today [80]. In addition, women who eat the most fish tend to have the lowest rates of breast cancer [80]. The results from the current study indicate that of the 87 participants that took the survey, 53 (60.9%) rarely or never eat oily fishlike herring, sardines, salmon, trout, mackerel, and fresh tuna. White fish that is not in batter or breadcrumbs was also rarely or never consumed by 46 (52.9%) of participants. There is concern that the majority of these women are not getting sufficient levels of omega-3 fatty acids through their diet, which could lead to health problems down the road.

Additionally, the most common micronutrient deficiency worldwide is iron with more than 20% of women experiencing it during reproduction [81]. The recommended daily intake of iron or women is 18 mg per day for women and 27 mg per day during pregnancy, but only 8 mg per day is recommended for men [81]. While 40.2% participants consume animal-based sources high in iron such as beef and other red meats 2-3 times a week, oily fish and white fish intake is low. Wholemeal or whole grain bread consumption was also low as 27 (31.0%) participants indicated that they rarely or never ate it and 22 (25.3%) of participants ate it two to three times a week. This is another good source of iron that participants are missing out on to increase their daily intake. The results of this study were similar to those seen in female Australian football players as protein was in line with current recommendations, but calcium and iron intake were below population recommendations for females (1000-1,500 mg/d and 18 mg/d, respectively) [35].

Wholemeal bread or other whole grain bread had a wide range of responses with 27 (31.0%) participants indicating they rarely or never eat it to 22 (25.3%) participants indicating they

eat it two to three times a week. The USDA recommends that women between 19-30 years should consume 6 to 8 oz in total of grains with 3 to 4 oz being whole grains [76]. In addition, women 31-59 years of age should consume 5 to 7 oz in total grains with 3 to 3.5 oz being whole grains [76]. For the participants that rarely or never consumed whole grain products and the ones that only consumed them two to three times a week, would likely not be meeting recommendations. A similar trend was noticed for sweet biscuits, cakes, chocolate, and sweets as wholemeal bread or other whole grain bread. Twenty-three (26.4%) participants consumed two to three portions a week, 22 (25.3%) participants consumed those once a week, and 19 (21.8%) participants rarely or never consumed them.

### 4.2 Limitations

While this study highlights areas in an understudied population, it is not without limitations. Studies that are survey-based have disadvantages such as participants not providing accurate or honest answers. Since the survey was administered online, the participant could have selected an answer without reading it in its entirety. Questions were also created so that the participant did not have to answer every question in order to submit the survey, so some participants did not complete each question of the survey. Some of the questions may have been difficult to answer accurately. Specifically, the nutrition questions asked how many times a day or a week certain foods were consumed, which may be difficult to recall. With surveys, there is an ideal length in which the researcher can ask an appropriate amount of questions, but also does not want to fatigue the respondent. If the participant feels overwhelmed with the number of questions,

they may choose just to stop the survey completely or then only answer certain questions that do not require as much thought.

Another limitation present in this study was that this survey asked participants about injuries that they had sustained from April 2019 until February 2022. Usually only a year's worth of data is used due to recall bias, however, due to COVID, not many teams played during the years 2020 and 2021. In order to assess injuries most accurately, a full participation and regular year was warranted.

In addition, questions regarding menstruation could have been tailored differently to be more inclusive. The survey could have included additional answer options to be inclusive for transgender individuals. Keeping in mind every aspect of how someone may answer a question is important and while it may not have affected the overall survey results, it is still worth noting.

Nutrition questions were asked, to identify daily and weekly consumption of certain foods. Some areas of deficiencies were noted in consumption of fish, whole grains, and potentially the lack of diary. However, questions only included certain food sources and a comprehensive list was not used to outline food groups. In addition, the survey did not ask about use of vitamins and other supplements.

There are many professional women's football teams across the United States, but forms of communication with each athlete is limited. Participants could only be contacted through their respective coaches' email as that was the only form of communication listed. It was the responsibility of each individual coach to disseminate the survey by forwarding it to their athletes. Some coaches sent an email response back saying they sent it to their respective team, but there is no way of indicating who actually sent it to their team. Also, five of the coaches' email addresses bounced back and there was no way of finding their contact information otherwise.

### 4.3 Future Research

Based on the findings of the current study, there a few considerations as future research is conducted in this population. Mental health is becoming an area more talked about with regard to athletes and should be explored further in future research. A study by Kroshus et. al reported on mental health and substance use of sexual minority college athletes. This was a survey-based study that had particular interest in NCAA student athletes and their nonathlete counterparts. Results indicated that sexual minority student athletes reported experiences of negative mental health in the last twelve months in significantly greater numbers than their heterosexual peers [82]. Also, female sexual minority student-athletes reported lower rates of negative mental health outcomes when compared with their nonathlete peers [82]. Identifying as a sexual minority had an increased risk for poor mental health but being a student-athlete resulted in consistent and reduced odds of reporting negative mental health. The results from the current study indicated that about 75% of the respondents had access to a mental health counselor. Future studies should be conducted involving gender and race to see how mental health of professional female football players of sexual minority compare to their nonathlete counterparts. In addition, almost half of the participants in the current study indicated that they had a diagnosed mental health disorder. Future research should be conducted to see if sustaining an injury during their football career plays a role in their mental health after their professional football career is over. If athletes are reporting injuries while still actively playing, are they still being affected by injury and activities of daily living after their football career is over.

There were no statistically significant findings between any of the variables that were compared. This research provided some preliminary data in areas such as mental health, menstruation, contraception, and nutrition. Future research is needed to further examine the

relationship between these variables with injury and performance in female athletes. Specific focus should be placed on nutrition as deficiencies in iron, calcium, and vitamin D are common in female athletes [35 81]. Further analysis in supplementation or more specific food consumption questions, can pinpoint the areas that may be deficient in these athletes.

### 4.4 Conclusion

This study was designed to highlight the female athlete and focus on risk factors unique to female athletes, which include mental health, menstruation, contraception use, and nutritional needs. These variables were described as they relate to performance and injury risk in professional women's football teams. In conclusion, results did not demonstrate a significant association between age and injuries or region of the football team and having a mental health disorder. To the authors' knowledge, this is the first study to examine specific risk factors for injury in professional women's football players. WFA football teams may benefit from additional resources to promote health and reduce injury, such as access to a team athletic trainer, registered dietitian, and mental health counselor. By having a health care provider present at practices and games, they are able to assist with injury prevention strategies and rehabilitation protocols. Also, when an injury is sustained, the athletic trainer can evaluate the player and make a decision about the plan of care needed, in which a referral may need to be made. In addition, a registered dietitian for each team would be beneficial to provide recommendations on pre-game and post-game fuel sources or how to improve their diet by implementing nutritional education for sport performance. Lastly, having a mental health counselor that the athlete can be referred to should be an area of focus moving forward as about half of the athletes had a mental health disorder. Overall, this study may

provide a foundation for future research to establish the relationship between these variables and injury and performance in female football athletes.

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