AN EXPLORATION INTO THE KNOWLEDGE, UNDERSTANDING AND MANAGEMENT OF THE FEMALE ATHLETE TRIAD AND THE TRIAD RISK FACTORS AMONG ELITE SWIMMERS IN KWAZULU-NATAL (KZN)

By

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I, Erin Seals, do declare that this dissertation is entirely my own work in both conception and execution (except where acknowledgements indicate to the contrary)

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ABSTRACT

Background

The Female Athlete Triad (FAT) includes a spectrum of dysfunction referring specifically to three health complications, which primarily are energy deficiency, menstrual disturbances, and low bone mineral density. Women's participation in sport has drastically increased over the last four decades but women are still facing stereotyping and are often expected to look a certain way, on and off the sporting grounds. The female athlete triad is common and is widely researched in land sports, such as athletics and endurance running, but the majority of the studies focus on the prevalence of the condition, instead of its knowledge and/or management. Despite FAT being widely researched in various sporting disciplines, there was an apparent gap in the literature, and especially under investigated in elite swimmers. Despite swimming being a popular endurance-type discipline, with similar outcomes to land sporting disciplines, there is paucity in the current literature on FAT in swimmers in South Africa.

The benefits of understanding the knowledge of FAT in an elite swimmer includes optimizing energy availability by ensuring adequate caloric intake whilst exercising, encouraging regular weight bearing exercise, improving the triad's identification, and preventing its occurrence.

Aim of the study

The aim of this study was to explore the knowledge, understanding and management of FAT and the triad risk factors among elite swimmers in KwaZulu-Natal (KZN).

Methodology

A qualitative, exploratory, descriptive approach was used to guide the study. A semi-structured interview guide was used to conduct in-depth interviews with nine elite female swimmers in KwaZulu-Natal (KZN). The main research questions for this study were "Describe your understanding of the female athlete triad", "Can you expand/elaborate on what makes an individual at risk for the triad?" and "Describe

the management options that you, or someone that you know that has had FAT used". The data were analysed using Tesch's (Creswell 2007) method to identify themes and sub-themes.

Results

The main themes that emerged from the study were the lack of knowledge on the female athlete triad, the understanding of the female athlete triad risk factors, the understanding of the impact of fat on health and performance, the lack of education surrounding the management of FAT and the lack in choice of healthcare. The participants had poor knowledge of the term the Female Athlete Triad however, the understanding of the triad risk factors was well understood. Participants in this study lacked appropriate choices in healthcare, if they were to have been presented with components of the triad.

Conclusion

The findings that emerged from this study indicate that there is a lack of knowledge and understanding surrounding the female athlete triad, its associated risk factors and the appropriate management interventions needed if an athlete were to be diagnosed with FAT. Therefore, it is necessary for not only the chiropractic community but for all health practitioners who may deal with elite female athletes to educate and inform this population about the potential long term health consequences of FAT.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The Female Athlete Triad (FAT) includes a spectrum of disorders resulting in a syndrome of negative health consequences that primarily affect women participating or competing in high intensity activities (Slater *et al.* 2017). The triad was initially recognised in 1992 by the American College of Sports Medicine, which revealed its components to be disordered eating, amenorrhea, and osteoporosis (George, Leonard and Hutchinson 2011). It has since been updated and includes a spectrum of dysfunction referring specifically to three health problems, which primarily are energy deficiency, menstrual disturbances and low bone density (Skorseth *et al.* 2020).

Over time the term the female athlete triad has evolved to give broader insight into the potential health and performance consequences of having low energy availability, not only in the female athlete population, but including males and those with disabilities. Thus, the term Relative Energy Deficiency Syndrome in Sports (RED-S) was introduced (Warrick, Faustin and Waite 2020). The female athlete triad still exists despite including males. For the purpose of this study, the term FAT was utilised, as the focus was on elite female swimmers.

Torstveit and Sundgot-Borgen (2005) showed that FAT was prevalent in young females of the ordinary population, pre-menopausal and athletic. However, later research by Horn, Gergen and McGarry (2014) and Folscher *et al.* (2015) showed FAT to be more prevalent in female athletes across multiple different sporting activities when compared to the non-athletic population.

Laframboise *et al.* (2013) revealed that FAT is equally more common in endurance sports such as long distance running and athletics. Similar to land sports, endurance is also required for swimming. There are limited studies in the domain of swimming as FAT is commonly researched in land sports. Due to the lack of research on swimmers, an investigation into this population group was warranted. Female swimmers are also

required to wear revealing or tight clothing and experience pressure to conform to social and sporting norms concerning body weight and image (Kong and Harris 2014) to emphasize a lean appearance. This thereby increases their risk for development of FAT. The knowledge of FAT is poor despite athletes being at risk for it (Folscher *et al*. 2015).

It is vital to ensure female athletes have knowledge and are aware of the triad, especially those competing at an elite level. If there is evidentially poor knowledge amongst athletes, it is likely that their nutritional knowledge is inadequate to prevent the condition from presenting (Folscher *et al*. 2015).

1.2 CONTEXT OF THE STUDY

The female athlete triad is a widely researched area in sporting disciplines. Studies both locally and globally have investigated various aspects of the triad with great emphasis on prevalence. Although FAT shows a high prevalence worldwide (Gibbs *et al.* Williams and De Souza, 2013) evidence in literature shows a lack of knowledge on the condition from athletes, coaches, and health practitioners.

Studies in South Africa by Folscher *et al*. (2015), and in Russia by Krick, Brown and Brown (2019) have explored the knowledge of FAT in female athletes where both studies revealed similar outcomes of poor knowledge, high prevalence, and increased presence of risk factors. Recommendations of these studies suggested that further investigation on knowledge of FAT was required. Investigating the knowledge and understanding of FAT and the concept of low energy availability, along with its associated negative adverse effects on the female athlete would enhance the ability to identify, manage and prevent the long-term consequences of the triad (Slater *et al*. 2017).

From studies done in the USA on the long term effects of FAT on high school female athletes, the recommendations were to investigate the research and education among female athletes, and its long-term effects (Lanier 2020). Skorseth *et al.* 2020 also recommended that awareness and education regarding FAT is needed for athletes, coaches, and health practitioners.

Swimming is an organised sport emphasizing endurance and leanness, thereby making swimmers at greater risk of developing triad components (Torstveit and Sundgot-Borgen 2005; Schtscherbyna *et al.* 2009; Sawai *et al.* 2018). Most studies have focused on assessing field athletes, such as runners (Goodwin *et al.* 2014; Folscher *et al*. 2015) instead of water sport athletes, such as swimmers. Despite FAT being widely researched in various sporting disciplines, there was an apparent gap in the literature as it was under investigated in elite swimmers. Despite swimming being a popular endurance-type discipline with similar outcomes to land sporting disciplines, there is paucity in the current literature on FAT in swimmers in South Africa.

The benefits of understanding the knowledge of FAT in an elite swimmer includes optimizing energy availability by ensuring adequate caloric intake whilst exercising, encouraging regular weight bearing exercise, improving the triad's identification, and preventing its occurrence (Thein-Nissenbaum and Hammer 2017).

1.3 PROBLEM STATEMENT

FAT is common and is widely investigated in land sports, such as athletics and endurance running (Goodwin *et al*. 2014; Folscher *et al*. 2015). Majority of the studies focus on the prevalence of the condition instead of its knowledge, understanding or management (Nichols, Rauh and Lawson 2006). Studies in an African context on the female athlete triad focused on prevalence and its risk factors and have not focused on other sporting disciplines besides long-distance endurance runners (Folscher *et al*. 2015; Goodwin *et al*. 2014). Swimming is a popular sporting discipline, which also requires endurance and has outcomes similar to land sporting disciplines. Despite this, there is a paucity of literature on FAT in swimmers in South Africa. With competitive swimming being one of the most renowned sports both internationally and locally, this sporting discipline warrants further investigation.

1.4 AIM OF THE STUDY

The aim of this study was to explore the knowledge, understanding and management of FAT and the triad risk factors among elite swimmers in KwaZulu-Natal (KZN).

1.5 OBJECTIVES OF THE STUDY

Objective 1: Explore the knowledge that female elite swimmers in KZN have regarding the athlete triad and its related risk factors.

Objective 2: Explore the understanding female elite swimmers in KZN have regarding the triad's risk factors (poor nutrition, increased training, eating disorders, performance pressure, body appearance).

Objective 3: Explore the understanding of management of the female athlete triad and triad risk factors in elite swimmers in KZN.

1.6 SIGNIFICANCE OF THE STUDY

Over the past forty years, the number of female participants competing in organized sports has increased exponentially (Laframboise *et al*. 2013). However, many women still face stereotyping and scrutiny because of social expectations and norms (Senne 2016).

The need for education around this condition is vital to ensure optimal health of young women who are at risk of FAT. There are many misconceptions about menstrual function and exercise training amongst endurance athletes (Folscher *et al*. 2015). Athletes are seeking treatment from various practitioners whilst knowledge of the female athlete triad among physicians, physical therapists, coaches, and trainers also has considerable gaps (Javed *et al.* 2013). Those who work with female athletes need to be attentive in the education, recognition, and treatment of athletes at risk (Folscher *et al*. 2015).

Prevalence of FAT and its risk factors amongst athletes has been broadly studied, however, studies on the actual knowledge of FAT by athletes themselves has a considerable gap in current literature. The awareness and understanding of this condition and its associated risks are not well recognised, especially in South Africa (Folscher *et al*. 2015) but these young females are still getting treatment from their health practitioners. The more research and investigations into the knowledge of FAT and its associated risk factors aids the development of prevention and treatment strategies to ensure women are able to compete and enjoy exercise without being at

risk for development of the triad (George *et al*. 2011). Not only will the increase in knowledge surrounding FAT help prevent long term health consequences, but it also aids in the excellence of the sport and the athlete. Continuation of restricted energy availability results in negative effects on performance (George *et al*. 2011).

Swimming is an Olympic sport and is a popular sporting discipline in South Africa. A study focused on implementation of sustainable development goals in BRICS countries revealed that the need to provide quality education is essential when it comes to meeting criteria for sustainable development goals in South Africa (Sajjad *et al.* 2018). Educators such as teachers, practitioners and coaches are in the position to influence an individual's mentality and actions. Thus, education surrounding female health in sport is necessary and will contribute to the goals of sustainable development. A multi-disciplinary approach should be utilized to optimize interactions between different individuals (Thein-Nissenbaum *et al*. 2017). Quality education does not only increase awareness but also promotes learning opportunities (Avelar, da Silva-Oliveira and da Silva Pereira 2019).

1.7 OUTLINE OF THE DISSERTATION

Chapter 1: The background, context and research problem are defined. The problem statement aims and significance of the study are presented in this chapter.

Chapter 2: The literature review pertaining to the topic is portrayed in this chapter.

Chapter 3: The research methodology, research design, data collection and analysis are described in detail in this chapter. Ethical considerations are also discussed.

Chapter 4: The findings obtained from the thematic analysis of the nine semi-structured interviews are detailed in this chapter.

Chapter 5: A discussion of the results and comparison to previous studies relevant to this dissertation are represented in this chapter.

Chapter 6: Overall conclusion of the study and its limitations are discussed in this chapter. Future recommendations for relevant studies are outlined.

1.8 CONCLUSION

This chapter unpacked the research topic under investigation by presenting its aim, objectives, and the significance of the study as well as an outline of the dissertation.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will reveal the global and local prevalence of the female athlete triad, as well as its associated risk factors. The impact that FAT has on the female athlete is outlined, followed by plans of management interventions that have been explored in current literature.

2.2 THE FEMALE ATHLETE TRIAD

FAT is a condition that is commonly found in adolescent girls and young women who participate in sports that have demands that gravitate towards leanness and aesthetics (Tosi *et al.* 2019). Not only are the three inter-related components of the triad counterproductive to their athletic performance goals but they are also associated with short-and long-term negative health effects (Tosi *et al*. 2019). The cause of the Female Athlete Triad is attributed to deficiency of relative energy due to the imbalance between dietary energy intake and energy expenditure (Horn *et al.* 2014). Eating disorders and poor nutritional habits combined with a low body weight and a hypoestrogenic state increases the risk of resulting low bone mineral density with its associated risks of fractures and osteoporosis (Tosi *et al*. 2019).

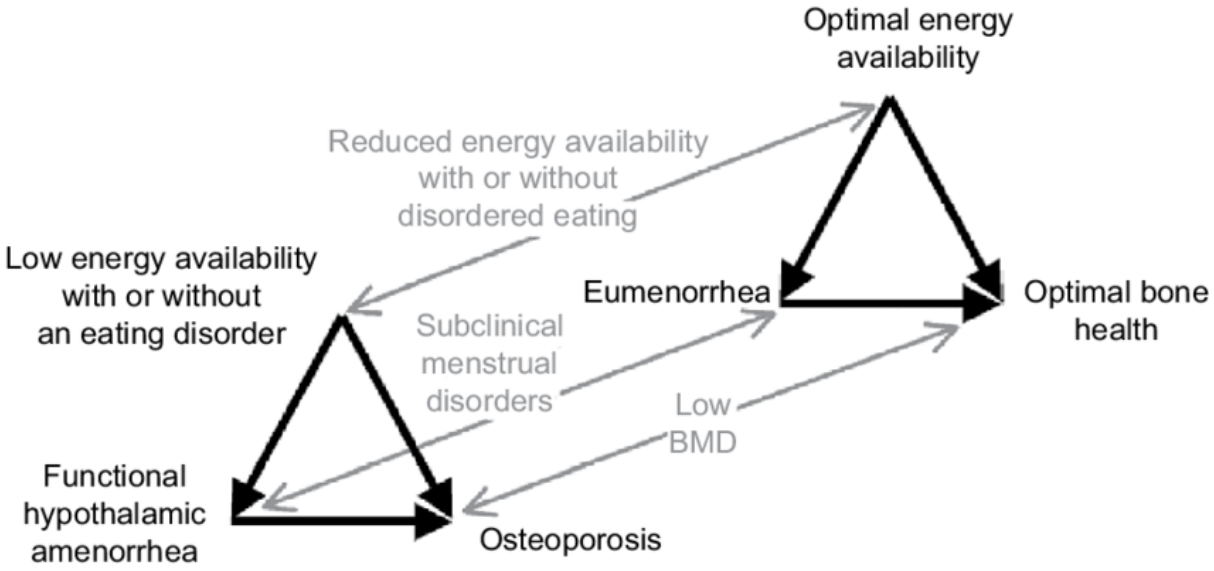

Figure 2.1: Diagram of the spectrum of dysfunction called the female athlete triad (Thein-Nissenbaum and Hammer 2017).

2.3 THE FEMALE ATHLETE

Women have been breaking the barriers in traditional male roles ever since the feminist movement developed in the 1960s and 1970s. Over the past forty years, the acceptance of female participation in sports has grown and the number of female participants competing in organized sports has increased exponentially (Laframboise *et al.* 2013). Once equal opportunities for women in sport were created, there has been a monumental shift in women's participation in competitive sports, but women still face stereotypes, scrutiny, and pressures because of social norms. Women have previously been defined as fragile, less capable and passive, seen as intruding on male boundaries with regards to sporting activities. Although there has been a positive increase in women's opportunities in competitive sports, they are still fighting against the stereotypes (Senne 2016).

Female athletes competing nationally or internationally in swimming teams across KZN were focused on in this study. The participants all competed at a high-level and are at risk for developing components of the triad (van Niekerk and Card 2018).

2.4 THE PREVALENCE OF THE FEMALE ATHLETE TRIAD

2.4.1 Global Prevalence of FAT

The prevalence of FAT varies across the globe. A 2005 study done in Norway investigated the prevalence of the triad in elite female athletes competing in sixty-six different sporting disciplines. These included land and water sports, aesthetic, and non-aesthetic sports, and compared the results to a control group. The results of the study revealed that when the participants were assessed for two components of the triad, the prevalence ranged from 5.4% to 26.9% in the athletic population and from 12.4% to 15.2% in the control group (Torstveit and Sundgot-Borgen 2005). Studies across the world have shown incidences to vary amongst different nations. Nichols *et al.* (2006) performed a study on the prevalence of the individual components of FAT in female athletes competing on inter-scholarship teams from different high schools in America. The participants consisted of track and field, cross-country, soccer, softball, swimming, volleyball, tennis, and lacrosse athletes. The study showed similar outcomes of high prevalence of each component of FAT. The statistics revealed that 18.2% of the participants met the criteria for disordered eating, 23.5% had menstrual irregularities and 21.8% of these participants were recorded to have low bone mass. 5.9% of the study population met the criteria for two components of the triad, and 1.2% for all three components. Although the percentage of athletes who met all three criteria for FAT was low, the data from the study verified its existence.

A systematic review of Triad literature done in 2013 focused on the prevalence of individual and combined components of the female athlete triad. This study revealed that the prevalence of each individual component of the triad increased in the adolescent population, especially those who participate in sports that emphasize leanness or aesthetics (Gibbs *et al*. 2013). When comparing the prevalence of the triad components, it was revealed that 1.5% to 6.7% of lean sport athletes and up to 2% of non-lean sports presented all three components.

Individual components of the triad are common in athletes at all competitive levels and ages (Javed *et al*. 2013). This was evident when a study done in Scandinavia in a competitive endurance sports club revealed that of the athletes aged between 18 and 38 who participated in the study, 63% had low energy availability, 25% had eating disorders and 60% had impaired bone health (Melin *et al.* 2015).

A comparative study by Chumpalova-Tumbreva *et al.* (2019) was conducted on the prevalence of the female athlete triad in professional Bulgarian athletes versus non-athletes. 64% of the athletic sample reported disordered eating with only 36% of non-athletes reporting the same. 76% of the athletic population had menstrual dysfunction with only 24% of the control group presenting with similar disturbances. 16% of athletes had a reduced bone mass compared to 4% in the control group. All three components of the triad were found in 10% of the athlete sample compared to only 4% in the control group.

Similarly, an incidence survey done in India revealed results of high prevalence for individual components of the triad with 19% of its participants presenting with two components of the triad and 33% presenting with one component. A total of 6% of the sample reported to have suffered with FAT (Ranji, Alexander and Shetty 2019).

2.4.2 Prevalence of FAT In Africa

A study on elite Kenyan endurance athletes was carried out by Goodwin *et al.* (2014) in which the purpose of the study was to determine the profile of FAT among elite Kenyan female athletes. The prevalence of FAT in an African context was higher in athletes compared to non-athletes.

At the North-West University in South Africa a study was done by Robbeson, Havemann-Nel and Wright (2013) on track and field athletes where the aim of the study was to explore the triad components amongst this population group. The results revealed that 87.5% of athletes were classified with one (37.5%) or multiple (50%) components of the triad. There was a noticeable positive association between the drive for leanness and intentional dietary limitation as well as body dissatisfaction, thus the need for education on healthy weight control methods and close monitoring of weight loss (Robbeson *et al*. 2013). Another study conducted in South Africa by Folscher *et al.* in 2015 assessed ultra-marathon athletes and their risk for developing FAT. It was revealed that 44.1% of the participants were at risk, with one third reporting disordered eating habits. Although definitive diagnoses were not made on these participants, prevalence of the triad risk factors in South Africa exist. The lack of research in South Africa warranted an investigation into this population group. It is evident in the literature that FAT is prevalent in Africa, however in the spectrum of swimming it is yet to be explored.

2.5 RISK FACTORS OF FAT

There are a number of risk factors associated with FAT; if an individual has risk factors, she may experience some signs and symptoms of the condition. These include: weight loss, no period/irregular periods, fatigue/decreased ability to concentrate, pre-occupation with food and weight, low heart rate and blood pressure, heart irregularities and chest pain, cold sensitivity, frequent vomiting, dental cavities (bulimia affects tooth enamel), brittle hair and nails, stress fractures or other overuse injuries and anaemia (Gavin 2014).

FAT risk factors are not individualised based on their components. The triad risk factors are linked to disordered eating, overtraining, competitive anxiety, level of participation, poor nutrition, education and poor health management. Exploration into current literature revealed that eating disorders are the most pertinent risk factor (van Niekerk *et al.* 2018). The exploration of risk factors is essential as not all athletes always present with all three components

Based on the literature that has been explored in **Table 2.1** below, it is evident that disordered eating is a common triad risk factor that contributed to the development of the female athlete triad, seen across all sporting disciplines which include land and water sports. It was evident that from disordered eating, low energy availability exists which results in a loss in bone mineral density, further manifesting development of the full triad.

Table 2.1a: Literature on risk factors associated with the female athlete triad and the influence it has on the female athlete

Author	Title of Study	Study Objective	Outcome
Sundgot-Borgen (1993)	Prevalence of eating disorders in elite female athletes.	This study examined the prevalence of eating disorders (ED) and the possible difference between ED symptoms and true ED by using questionnaires as compared with an interview and clinical evaluation in Norwegian elite female athletes from 35 sports and nonathletic controls.	603 Norwegian female athletes to participate in a study to determine the prevalence of pathogenic weight control methods and self-reported eating disorders among elite female athletes and non-athlete controls. The results of this study showed a non-significant tendency for athletes to be at less risk of an eating disorder than controls. However, a significantly higher percentage of athletes competing in aesthetic sports and weight-dependent sports were found to have an eating disorder compared with athletes competing in field sports where leanness may be less important.
Martinsen and Sundgot-Borgen (2012)	Changes in physical fitness, bone mineral density and body composition during inpatient treatment of underweight and normal weight females with longstanding.	The aim of this study was to observe changes in physical fitness, BMD and body composition during an inpatient treatment period for underweight and normal weight patients with longstanding eating disorders.	Most of the adult elite athletes who met the criteria for an eating disorder reported having started dieting and developing an eating disorder during puberty or adolescence.
Chu, Gustafson and Leiszler (2013)	Female athlete triad: Clinical evaluation and treatment	This study aimed at examining the research and latest advancements in recognizing and understanding the female athlete triad and explored the most current recommendations for treatment and prevention.	This study revealed that those who diet are more likely to develop clinical eating disorders later in life. Comorbid psychological disorders such as depression and anxiety also played a role in the development of eating disorders. Constricting calories or not adjusting the caloric intake relative to an increase in energy expenditure will have a direct effect on the energy availability in the female athlete.
Slater *et al.* (2017)	Low energy availability in exercising women: Historical perspectives and future directions.	This review aimed to provide an overview of this research and identify directions for future work.	Cellular maintenance, thermoregulation, growth, and reproduction are impaired when energy availability is too low because the brain responds to this by altering the range of metabolic hormones in the body that suppress energy-consuming physiological processes. Physiological mechanisms will reduce the energy needed for these processes impairing one's health. Low energy availability can be caused by reducing the energy consumed (example is binge-eating) or increasing the exercise activity, or a combination of the two. Energy availability differs from energy balance. Energy balance considers total energy intake compared with all energy expended irrespective of fat free mass. Physical activity and exercise are promoted to enhance a healthy lifestyle through optimal bone health, improved lipid profiles that help to maintain muscle mass. However, due to a state of low energy availability women will be at risk for developing the negative health effects associated with the female athlete triad.
Brown *et al.* (2017)	The female athlete triad: special considerations for adolescent female athletes.	The purpose of this review was to focus on the diagnosis known as the female athlete triad.	The term "disordered eating" was broadened and to recognise that an athlete does not need to have an officially diagnosed eating disorder to suffer the consequences of FAT. The use of pathogenic weight loss methods, such as vomiting and the inappropriate use of diuretics and laxatives results in negative energy that is available for the body' functions.
Mehta, Thompson and Kling (2018)	The female athlete triad: It takes a team.	The purpose was to review the current definitions, appropriate screening tools and how to intervene and treat FAT.	Sustained low energy availability is often associated with eating disorders and subsequent low self-esteem, depression, and even anxiety disorders. The consequences of low energy availability include altering the amount of Gonadotropin Releasing Hormone (GnRH) that is released from the anterior pituitary gland. GnHR is responsible for the release of follicle stimulating hormone (FSH) and leuitinizing hormone (LH). A hypoestrogenic state (as a result of low energy availability) can contribute to menstrual irregularities and a decrease in bone mineral density.

Table 2.1b: Literature on risk factors associated with the female athlete triad and the influence it has on the female athlete

Author	Title of Study	Study Objective	Outcome
Van Niekerk and Card (2018)	Eating attitudes: The extent and risks of disordered eating among amateur athletes from various sports in Gauteng, South Africa.	To determine the extent of disordered eating behaviours among amateur athletes to identify the athletes at risk of developing an eating disorder.	Disordered eating is a major concern when it comes to being at risk for the triad. Methods such as dieting, bulimia and food preoccupation, as well as oral control, all contribute to the development of low energy availability. A total of 20.4% of the participants in this study performed binge eating, 12.4% used purging, 21.9% used laxatives and only 5.8% used exercise as a method of weight loss.
Skorseth *et al.* (2020)	Prevalence of female athlete triad risk. factors and iron supplementation amonghigh school distance runners.	To evaluate the prevalence of triad risk factors and iron supplementation in high school distance runners and pilot a screening tool for Triad risk score.	A total of 38 high school distance runners completed a survey which revealed 76.3% of the participants having disordered eating or eating disorders. The average body mass index (BMI) was 19.8kg/m2. The prevalence of this particular triad of risk factor was high in this study.

Although disordered eating is the pertinent risk factor for triad symptoms, overtraining or competitive anxiety also put an individual at risk (van Niekerk *et al.* 2018). With the combination of poor nutritional health and overtraining, not only does it negatively affect the overall performance of the athlete but also the menstrual function and bone mineral density.

Evidence in the literature is explored in **Table 2.2**.

Table 2.2a: Literature on the affect that low energy availability due to disordered eating, overtraining and competitive anxiety has on menstrual function and bone mineral density

Author	Title	Study Objective	Outcome
Nichols *et al.* (2006)	Prevalence of the female athlete triad syndrome among high school athletes.	To estimate the prevalence of the female athlete triad (disordered eating, menstrual irregularity, and low bone mass) among high school athletes.	170 high school female athletes representing eight different sporting disciplines participated in a study in southern California. From its results, those participants who reported habits of disordered eating (18 participants) had lower bone mineral density compared to those without eating disorders.
Ivkovic *et al.* (2007)	Overuse injuries in female athletes.	This article reviewed the most frequent overuse injuries in female athletes in the context of anatomical, physiological, and psychological differences between genders.	Overuse injuries may be defined as an imbalance caused by overly intensive training and inadequate recovery, which subsequently leads to a breakdown in tissue reparative mechanisms. FAT leads to menstrual disorders and hypoestrogenism, which is responsible for a decline in bone mineral density and osteoporosis.
George *et al.* (2011)	The Female Athlete Triad: a current concepts view.	This article reviewed the current definitions of the triad components, epidemiology, pathophysiology, diagnosis and treatment.	A widespread decrease in bone mass is known as osteoporosis. This can be caused due to age related changes but can also be attributed to “inadequate bone accumulation during growth and development” resulting in a lower bone density. Second clinical risk factors included chronic malnutrition and eating disorders. This study explored how undernutrition has a directly negative effect on menstrual and skeletal health. “Increased exercise combined with low calorie intake seems to decrease immunocompetence”. An immunocompromised, state will directly affect the athletic performance and endurance. The longer the female athlete goes with more intense exercise in a low energy state, the chances of her performance being affected increases exponentially. These affected athletes are more likely to report frequent musculoskeletal injuries.

Table 2.2b: Literature on the affect that low energy availability due to disordered eating, overtraining and competitive anxiety has on menstrual function and bone mineral density

Author	Title	Study Objective	Outcome
Javed *et al.* (2013)	Female athlete triad and its components: toward improved screening and management.	This article reviewed the current definitions of the triad components, epidemiology, pathophysiology, and recommended screening and management guidelines.	Caloric restriction and weight fluctuations have been associated with loss of bone density. An increasing duration of amenorrhea causes further decline in bone mineral density impairing skeletal health. This impairment will predispose an athlete to stress fractures and overuse injuries.
Javed *et al.* (2013)	Female athlete triad and its components: toward improved screening and management.	This article reviewed the current definitions of the triad components, epidemiology, pathophysiology, and recommended screening and management guidelines.	Evidence supports that in runners, as the distance increases so does menstrual dysfunction.
Weiss Kelly and Hecht (2016)	The Female Athlete Triad.	This report outlined the current state of knowledge on the epidemiology, diagnosis, and treatment of the triad conditions.	With appropriate nutritional intake and subsequent weight bearing exercises, bone health will maximise during childhood and adolescence.
Sawai *et al.* (2018)	Risk of female athlete triad development in Japanese collegiate athletes is related to sport type and competitive level.	This study was aimed to examine FAT risk factors in Japanese female athletes of various sports as well as examine the impact of competitive level on FAT.	The intensity of the sport showed a positive correlation with delayed menarche and poor nutrition. Repetitive high-training volume sports put an athlete at risk of musculoskeletal injuries.
Williams *et al.* (2019)	Female athlete triad and relative energy deficiency in sport: A focus on scientific rigor.	This research study highlighted key differences in the Triad and RED-S models with a focus on scientific rigor and quality of evidence.	Exercising women who chronically experience low energy availability will experience repartitioning of metabolic fuel that is characterized by a decrease in resting metabolic rate and a shift in key metabolic hormones, and upregulation of growth hormone and cortisol in an effort to preserve energy. The repartitioning of metabolic fuel results in the suppression of reproductive function and growth, negatively affecting the menstrual function of the female, impairing bone health. Amenorrhea in adolescent athletes should be considered a potential problem, emphasising the importance of investigating and discovering an underlying eating problem. Young women of today need to be educated about the risks associated with FAT syndrome as it has a negative impact on their health status as well as their activity performance.
Finn *et al.* (2021)	Markers of low iron status are associated with female athlete triad risk factors	To explore whether markers of low iron status may be associated with indicators of low EA including triad risk factors.	There was a link found between lean/endurance sports and being at risk for developing FAT. Out of 181 participants, 28 athletes performing in endurance type sports reported a low iron status, which is associated with low energy availability.

2.6 RISK FACTORS OF FAT IN ELITE SWIMMERS

An elite athlete would be defined as an individual who participates in sports for two or more years of accumulative practice, inter-varsity athletes, members of national squads and/or Olympic champions as well as those who simply are part of a competitive team (Swann, Moran and Piggott 2015).

A study of the nutritional knowledge and eating behaviours of female collegiate swimmers was conducted by Hoogenboom *et al.* (2009). The study suggested that athletes do lack knowledge of nutrition, healthy food choices, components of a well-balanced diet and the side-effects that nutrition has on energy availability and performance, which is seen to predispose an athlete to developing the triad. The study revealed that the prevalence of FAT in adolescent elite women swimmers is high. Of the 78 participants, 47.4% met one criterion, 15.4% met two criteria and 1.3% met all three criteria for FAT. Competing in endurance sports, such as swimming, present a higher risk for developing FAT than other sports (Hoogenboom *et al.* 2009).

According to Schtscheryna *et al.* (2009) a lean body facilitates displacement and is considered to be an asset in different sports. A study by Laframboise *et al.* (2013) revealed that the female athlete triad is common in endurance sports and those that require athletes to wear revealing or tight clothing, as seen in swimming, thus predisposing an individual for developing the triad. Appearance in aesthetic sports (such as swimming) may lead to alterations in certain behaviours, such as lowered self-esteem and weight management (Wheatley *et al.* 2012). Social media plays a role in influencing young athletes, especially when it is pertaining to body weight and image. This can negatively affect the female athlete if she compares herself to fellow sports athletes (van Niekerk *et al.* 2018). Athletes competing in sports of a high level participation are also at risk for development of the triad (van Niekerk *et al.* 2018). Therefore, in swimmers, the risks for developing triad components are high due to the competitive nature of the sport and the requirement to wear tight and revealing clothing (Laframboise *et al.* 2013).

2.7 IMPACT OF THE FEMALE ATHLETE TRIAD

2.7.1 Impact on Sport Performance and Swimmer

Having a low caloric consumption and an increased exercise energy expenditure can lead to deficiency in the energy that is available and required for health and activities of daily living, growth, normal physiological function as well as sporting activities (George *et al.* 2011). Kong and Harris (2014) have found that the symptoms and risk

factors of the triad are counterproductive to athletic performance goals and can lead to long term negative health outcomes.

Energy availability is defined as dietary intake minus exercise energy expenditure (De Souza *et al.* 2013). To ensure adequate energy availability this needs to be balanced. Energy availability is the amount of dietary energy remaining for other body functions after exercise training. FAT causes dysfunction of energy availability as most women try to lose weight to enhance their performance.

According to De Oliveira *et al.* (2018) in a study done on the female athlete triad in high performance sports, it was evident that if an athlete presents with one component of the triad, the overall performance goals were shown to have decreased. Triad components together, potentiate harmful effects on the overall health status of the athlete. Coaches, trainers, and sponsors act as external pressures on the athlete that contribute to physical and mental stress to train or compete at a higher standard for maximum performance. This kind of stress is associated with dietary restrictions and weight loss which further manifest into menstrual dysfunction and low bone mass (De Oliveira *et al.* 2018). It is evident from the literature that weight loss in thin individuals can result in negative health effects and less optimal sports performance (Griffin *et al.* 2017).

2.7.2 Impact on Daily Life

Low energy availability causes an interruption in the metabolic hormones that will disturb normal menstruation, as well as the initiation of puberty (Brown *et al.* 2017). According to Chamberlain (2018) in an article about the recommended treatment for FAT, short- and long-term health consequences were identified. The immediate health consequences included an increased chance of developing musculoskeletal injuries such as sprains, strains, and tendonitis as well as infertility and stress factors which in turn also directly affect performance. Alterations to the adrenal, thyroid, and gonadal axes may not only have immediate consequences in athletes but could have detrimental health consequences on future pregnancies (Brown *et al.* 2017). The long-term health consequences included lifelong eating disorders, osteoporosis as well as psychiatric disease (Chamberlain 2018).

2.7.3 Impact on Mental Health

Low energy availability does not only have an impact on the individual's performance and daily life, but also has a psychological impact on the female athlete. Female athletes tend to develop clinical eating disorders through self-induced vomiting, laxative and/or diuretic abuse. These pathogenic weight control behaviours can be attributed to those athletes who strive for perfectionism and those who experience pressure from the coaches and teammates to perform a certain way (De Souza *et al.* 2017). There is a link between eating disorders and the need for thinness, putting the female athlete at risk for developing traits of body dissatisfaction, low self-esteem, a distorted body image, depression, and anxiety. Eating disorders are usually co-existing with other psychological disorders such as obsessive-compulsive disorder, substance use, mood disorders and schizophrenia (De Souza *et al.* 2017).

2.8 KNOWLEDGE OF FAT

Knowledge is an important factor in identifying and being able to appropriately manage the female athlete triad and its adverse health effects. A study by Troy, Hoch and Stavrakos (2006) focused on the awareness of the triad and explored if its participants could identify all three components of the triad. Triad knowledge amongst physicians (48%), physical therapists (43%), athletic trainers (38%), medical students (32%) and coaches (8%) was low. Similarly, Brown, Wengreen and Beals (2014) also explored the knowledge of the female athlete triad and its associated risks, specifically amongst athletes and their coaches. This study revealed that most coaches had seen signs of the female athlete triad in their athletes, but did not have the knowledge of its consequences. Pantano (2017) focused on the knowledge that high school coaches had on FAT. Coaches completed a survey where only 14% of the participants had heard of the triad. This study showed an evident gap in the current literature surrounding the knowledge about the triad's existence.

In South Africa, Folscher *et al*. (2015) investigated ultra-marathon female athletes who were asked about the knowledge around FAT and were assessed on the associated risk factors. The study revealed that the knowledge of the triad risk factors was poor with 92.5% of the participants had not heard of it before. Of the 306 athletes included

in the study, 44.1% were found to be at risk for FAT. Knowledge of the syndrome is very poor among Ultra-Marathon runners in South Africa as there are many misconceptions about menstrual function and exercise training (Folscher *et al.* 2015). The study concluded by expressing the importance of “education and regular screening programmes” as they are overdue. In 2019 the Journal of Paediatric and Adolescent Gynaecology published an article comparing the knowledge and risk factors in teenage and young female athletes (skaters, dancers, and runners). It was shown that only 12% of its participants knew about the triad (Tosi *et al.* 2019). Awareness and knowledge are necessary and needs to be emphasized in the physician, athlete, coaching and parent populations.

Education and regular screening programmes are essential for the prevention of the triad amongst endurance female athletes (Sawai *et al.* 2018). Knowledge for the athlete through programmes with information available is essential as it enables them to train and compete with caution and allows for appropriate management approach on behalf of the female athlete if the triad is suspected. The consequences of the triad should be explained to the female athletes to prevent the development of energy deficiency which in turn compromises the athletic performance and increases the risk of musculoskeletal injuries (Javed *et al.* 2013).

2.9 MANAGEMENT OF FAT

The three components of the FAT further influence clinical manifestations which include anorexia or bulimia, pathological fractures, and primary amenorrhoea (Horn *et al.* 2014).

The goal in managing female athletes with FAT is to restore energy availability by modifying the diet and adjusting exercise behaviour (Brown *et al.* 2017). Decreasing exercise intensity until menses resumes is vital. Optimal bone mineral density can be reached by adequate and sufficient nutrition, vitamin D, and calcium along with moderate physical activity with the inclusion of weight-bearing exercises. According to Malczewska-Lenczowska *et al.* (2017) it was stated that a series of illnesses and pathological conditions can be traced back to a vitamin D deficiency, which has attributed to the decline in musculoskeletal health, immunity, heart disease and mental

health. Increasing the calorie intake in one's diet and ensuring adequate calcium and vitamin D (as this increases bone mineral density) intake is occurring daily as this is needed to maintain energy availability. Another important mineral to ensure is adequately included in the diet is iron. Iron is essential in several physiological processes in the body, including DNA synthesis, production of red blood cells, ATP, and myoglobin. Women of reproductive age, children and adolescents are common populations that iron-deficiency can be found. The lack of iron is the major factor associated with anaemia (Malczewska-Lenczowska *et al.* 2017).

It is vital to ensure there is recovery of the athletes lost weight, and to ensure the menstrual cycle is in normal function relative to her weight (Nose-Ogura *et al.* 2018). Encouraging weight bearing exercises to increase bone density can prevent overuse injuries and stress fractures.

Gynaecological interventions should be suggested in athletes with amenorrhea (Javed *et al.* 2013). Hormone replacement therapy should also be considered for girls over 16 years of age if the above interventions do not produce positive outcomes when the diet is regular. Widespread educational effort is required to prevent the occurrence of FAT and to improve its identification. Physicians, therapists, family members and coaches need to be highly aware of this condition and its consequences. Ensuring the athlete's compliance is essential; meal plans can be set with a qualified dietician/chiropractor but must be followed by discipline and not the patient's appetite. However, severe eating disorders should be referred to a mental health professional for further treatment and management. Although the estimated prevalence for the triad is low, individual components of the triad are common in athletes at all competitive levels and ages. (Javed *et al.* 2013). Nose-Ogura *et al.* stressed the importance that body weight or muscle mass is associated with bone density. Weight gain would therefore be the best treatment option for low bone density or osteoporosis. Hormonal therapy also has benefits on the cardiovascular system as well as skeletal muscle (Nose-Ogura *et al.* 2018). Biological, psychological and social components play an important role in each individual treatment and/or management plan (Coleman and Spain 2020). These components need to be addressed as it will aid in discovering the underlying cause of low energy availability. Coleman and Spain (2020) added that a multidisciplinary team consisting of a physician, mental health professional and registered dietician is needed. It is vital that the athlete actively partakes in their

treatment programme. Another important aspect of the management plan for each individual athlete is their return to play protocol. Return to play is primarily based on clinical judgment with the aid of screening tools (Coleman and Spain 2020), therefore the idea of a multidisciplinary approach is favourable. Depending on the severity of triad components in an individual athlete, will determine when she will be able to return to play. This ensures no further manifestation of adverse effects.

According to (Nichols *et al.* 2006) 5.9% of the athletes met criteria for two components and approximately 20% met criteria for only 1 component of the triad. A substantial number of these young athletes may be at increased risk for the full triad over time. Women who are evaluated for one component of the triad should always be screened for the other two. A study on nutritional knowledge and eating behaviours of female collegiate swimmers in Michigan, USA, by Hoogenoom *et al.* (2009), suggested that swimmers may benefit from education regarding the importance nutrition has on energy availability and performance. The need for education and awareness around this condition is vital to ensure optimal health of young woman who may be potentially at risk of FAT. The benefits of knowing about FAT are not only confined to the female athletes themselves but also to the health practitioners that are treating sports women. Athletes with knowledge on FAT can train with caution and get appropriate treatment and management quickly and correctly when presenting with risk factors. The practitioners who are treating athletes, such as chiropractors (all part of a multi-disciplinary team) may be responsible for providing education surrounding FAT and its consequences. It is these practitioners who commonly act as first-line contact for females at risk for developing the triad and will benefit from knowing all components of the triad and its risk factors to ensure appropriate referrals or management of such patients with correct interventions. Early detection is important for preventing serious consequences and to enable proper evaluations, diagnosis, and management of such athletes. A re-evaluation after 12 months is required in those with persistent triad disorders.

2.9.1 The Role of the Chiropractor

Chiropractors are likely to see these patients more commonly in practice due to the increased female population in sporting activities in recent years, together with the social pressures these females experience to look a certain way. There is importance of the Female Athlete Triad in the musculoskeletal and chiropractic domain as

treatment outcomes for these patients primarily focuses on education and treating of any musculoskeletal pain. The loss of menstrual function, frequent musculoskeletal injuries, and weight loss are red flags signalling a major health concern that those involved in the athlete's life should be able to identify (Perkins 2019).

According to an article published by Laframboise (2014) on the Dynamic Chiropractic Canadian website, the best way to manage FAT is a multi-disciplinary team approach to surround the athlete and make a difference. A case series by Laframboise *et al.* (2013) presented different scenarios of FAT presenting to chiropractors with musculoskeletal pain. Being able to identify components of the female athlete triad, chiropractors can manage cases of FAT with education, communication, and possible dietary advice. Female athletes of all ages and levels lack education of the triad's existence (Hoch *et al.* 2009). According to a study done by Troy *et al*. 2006 FAT can be attributed to the lack of awareness among health professionals and coaches. Only 48% of physicians could identify all the components of the female athlete triad. There is controversy in the literature surround the current management of FAT. Currently there is little knowledge about the clinical management of the female athlete triad therefore multi- disciplinary practitioners who are treating athletes, such as chiropractors, will benefit from knowing all components of the triad and its risk factors to ensure proper management of such patients with correct interventions and appropriate referrals. "Prevention, recognition and treatment of the triad must be a priority to ensure that these athletes maximise the benefits of regular exercise and achieve optimal health as well as optimal performance" (Laframboise *et al.* 2013).

Chiropractic management of these patients is necessary in order to treat musculoskeletal pathologies (stress fracture/overuse injury prognosis due to low bone density) and to ensure adequate nutritional advice is given to these young athletes.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

This chapter addresses the systematic approach used in implementing this study design and describes how information was obtained. It includes the research procedure, sample population, size and qualitative data collection and analysis. It also provides a description of the ethical considerations applied to this study.

3.2 RESEARCH DESIGN

3.2.1 Qualitative Research

A qualitative, exploratory, descriptive approach was utilized in this study. According to Baxter and Jack (2008) a qualitative study design allows the researcher to explore individuals or organizations, simple through to complex interventions, relationships, communities, or programmes. This design was appropriate for this study because it allowed for an in-depth exploration of the knowledge, understanding and management of FAT in elite swimmers. It is a commonly used tool and is valuable in health science research to “develop theory, evaluate programs, and develop interventions because of its flexibility and rigor” (Baxter and Jack 2008).

3.3 POPULATION

The population of this study were elite female swimmers between the ages of 15 and 30 years old.

3.4 SAMPLE TECHNIQUE

Purposive and snowball sampling, often used in qualitative research, was used in this study. Handcock and Gile (2011) defined snowball sampling as, “collecting a sample

from a population in which a standard sampling approach is either impossible or prohibitively expensive, for the purpose of studying characteristics of individuals in the population". Purposive sampling strategies are designed to enhance understandings of selected individuals or groups' experience(s) or for developing theories and concepts (Devers and Frankel 2000). This technique was utilised in the study. Krefting (1991) stated that all purposive sampling is done with a purpose in mind. In this study, twelve participants were purposively sampled with the majority of the participants attained via snowball. After nine interviews, data saturation was attained. The three additional interviews were also done to confirm saturation.

3.5 SAMPLE SIZE

A sample of nine (9) elite swimmers were interviewed and data collection was guided by data saturation (Creswell 2007). Data saturation is different from witnessing repetitive events or stories. The common use of the term when collecting data through interviews refers to nothing new happening (Charmaz 2006). After the nine participants were interviewed by the researcher, data saturation was attained due to the identification of common themes and subthemes mentioned by the participants.

3.5.1 Inclusion Criteria

- Female elite swimmers between the ages of 15 and 30 years old.
- Participant must represent a national (e.g., KZN) or international (South Africa) team.
- Completion of a letter of information (Appendix A) and informed consent (Appendix B).

3.5.2 Exclusion Criteria

- Participants who do not consent to voice recording.
- Female elite swimmers younger than 15 years and older than 30 years.
- Consider male swimmers regardless of age and professional status.

3.6 PARTICIPANT RECRUITMENT

Permission from the KZN Aquatics Association to recruit the athletes via email was attained prior to the interviews (Appendix F). Advertisements (Appendix C) were emailed to the selected female athletes in order to recruit participants. Once ethical clearance was obtained and the clearance number (111/20) was given from the Institutional Research Ethics Committee (IREC) (Appendix H) and necessary gatekeepers, participant recruitment began. After a participant expressed interest from seeing the advertisement (Appendix C), a telephonic confirmed appointment was made.

3.7 RESEARCH SETTING

Permission from the KwaZulu-Natal Aquatics Association to recruit the athletes via advertisement distribution was attained prior to the interviews (Appendix F). Advertisements (Appendix C) were emailed to female athletes in order to recruit participants. Athletes who met the inclusion criteria and agreed to participate in the research were asked to schedule a meeting time to conduct the interview at the Durban University of Technology (DUT) in the research room, where all personal information could be kept confidential and safe.

3.8 PRIOR TO INTERVIEWS

- The purpose of the study was explained to each female elite athlete, as well as their role in the study.
- The letter of information (Appendix A) and informed consent (Appendix B) were given to each willing participant.
- The aim of the interview was explained to each participant – the interviewer was to use their information for research purposes only.
- The above points were explained to the participants in detail to inform them throughout the study and to ensure the athletes understood their role in the study as well as their rights as participants.

3.9 DATA COLLECTION

Once participants responded to the advertisement and an interview date and time were confirmed, semi-structured interviews took place. A letter of information (Appendix A) and informed consent (Appendix B) were signed by each willing participant. Digital recordings of each interview were taken once the participant gave the researcher permission to do so. Consistency of questions was maintained when conducting each interview. An interview guide was utilized to collect data (Appendix G).

The intention of these interviews was to explore the knowledge and understanding of the female athlete triad, and its risk factors in elite swimmers in KwaZulu-Natal. The researcher conducted semi-structured interviews with the female athletes at DUT in the research room.

Semi-structured interviews were utilised in this study. These were in-depth interviews where the respondents answered pre-set open-ended questions and thus widely employed by different healthcare professionals in their research (Jamshed 2014). The researcher used an interview guide (Appendix G) which consisted of open-ended questions on FAT knowledge, risk factors and the management of the triad. The interviews were recorded as it made it easier for the researcher to focus on the interview content and verbal prompts. This enabled the transcript to generate “verbatim transcript” of the interviews (Jamshed 2014). To acquire an in-depth understanding of phenomena it was necessary that the researcher made personal contact and engaged with the participants during the data collection process (Antwi and Hamza 2015).

3.9.1 Open Ended Questions

Opened-ended interviews were conducted in this study to obtain information on the knowledge and understanding of the female athlete triad and its appropriate management. Standardized open-ended interviews are likely the most popular form of interviewing utilized in research studies because of the nature of the open-ended questions, allowing the participants to fully express their viewpoints and experiences (Turner 2010).

Each participant was asked three identical questions. The questions were worded so that the participants’ responses were “open-ended”. The open-endedness of the

questions allowed the participants to contribute as much detailed information as they desired, and it also allowed the researcher to ask probing questions as a means of follow-up (Turner 2010).

The disadvantages associated with open-ended interviewing would include difficulty coding the data (Creswell 2007), as well as it being a lengthy process and deemed time consuming (Yilmaz 2013). However, the chances of researcher bias reduce as the participants provide detailed information (Turner 2010).

Elite female athletes were asked open-ended questions to obtain information regarding the female athlete triad and its associated risk factors; this was highly beneficial as it allowed for a better insight into this population's knowledge and awareness around this medical condition.

3.10 THE TRANSCRIPTION OF INTERVIEW DATA

3.10.1 Process of Transcription of Interview Data

Once audio recordings were attained, the data were transcribed into word documents by the researcher. Each recorded interview was listened to carefully, verifying all details obtained in the original interview. The researcher's supervisor verified the original interviews to ensure that no pertinent information was excluded.

3.10.2 The Coding of Subjects

Each interview subject was coded to facilitate representation of their words in writing, while protecting their identities and to maintain participant confidentiality. The coding utilized reflected the elite athlete and their placement within the sequence of nine interview pairs. The coding sequence was:

1. Elite swimmer participant (P= Participant).
2. Age of the individual.
3. Provincial or international competing level (KZN or SA).

3.11 DATA INTERPRETATION

3.11.1 Data Analysis

Data were analysed using Tesch's method to identify themes and sub-themes (Creswell 2007). Data analysis forms part of the analytical phase and is aimed at answering the research questions (Polit and Beck 2010). The research questions in this study were aimed at exploring the knowledge, understanding and management of the female athlete triad and the triad risk factors in elite swimmers in KZN. The data collected during the interviews, through audio recordings, were transcribed verbatim into a Microsoft Word document. Only the researcher and supervisor had access to the collected data. Tesch's eight steps of thematic analysis was employed to analyse the data as this method of data analysis is common among researchers who are becoming familiar with qualitative research (Creswell 2007). Tesch proposed eight steps in thematic data analysis (Creswell 2007).

The data were analysed using Tesch's eight step method (Creswell 2007):

Step 1: Familiarizing oneself with the data:

Interviews were transcribed verbatim and analysed by the researcher.

Step 2: Generating initial codes:

The researcher read each transcript and compared them with the audio recorded interviews.

Step 3: Searching for themes:

The transcript was read for the second time by the researcher to gain insight into the content of the interviews and to identify the underlying meaning.

Step 4: Reviewing themes:

The researcher applied themes and topics to the data collected. The themes or topics were coded, and the researcher looked for new categories.

Step 5: Defining and naming themes:

Similar topics were grouped together under topics.

Step 6: Final coding:

From these topics, the researcher formed themes and sub-themes.

Step 7: Producing a report:

The supervisor of the research study, an experienced person in the field of qualitative research, analysed the data separately and identified themes which were discussed with the researcher.

Step 8: Recoding:

The literature was reviewed to verify the findings and the researcher recoded the data if it was necessary.

3.12 DATA STORAGE

The data were stored on a compact disc and will be kept in locked storage within the research supervisors archive for five years, after which it will be physically destroyed. The data will only be accessed by the researcher and the supervisor. Physical transcripts and audio recordings will be kept within the researcher supervisor's archive for five years, after which they will be physically destroyed.

3.13 TRUSTWORTHINESS

The trustworthiness of the research process refers to the accuracy and adequacy in qualitative research (Schwandt, Lincoln and Guba 2007). The criteria used to establish trustworthiness (Schwandt, Lincoln and Guba 2007) are credibility, dependability, confirmability, and transferability. Guba's model of trustworthiness will be used to ensure validity and reliability of the research project (Krefting 1991)

3.13.1 Credibility

In qualitative research, truth value, or also known as credibility, is obtained from exploring lived human experiences (Krefting 1991). Leininger (1985) noted the importance of identifying and documenting recurrent features such as patterns, themes and values in qualitative research. The emphasis on recurrence suggests the need to spend sufficient time with informants to identify repeating patterns. An important strategy is to spend an extended period with the participants when conducting interview (Krefting 1991). This will enhance relevant findings through

intimate familiarity and discovery of hidden facts (Krefting 1991). Member checks were used to determine if the data obtained by the researcher were interpreted in alignment with the participants' views.

3.13.2 Transferability

Guba (1981) presented the second perspective on applicability in qualitative research by referring to fittingness, or transferability. Transferability can compare characteristics of the participants to demographic information on that group being studied (Krefting 1991). The researcher's responsibility is to provide a sufficient database to allow judgements to be made by others (Lincoln and Holloway 1981). Although the person might not be completely representative of a group, their experience is considered important. The goal of reliability is the value of repeatability, that replication of the testing procedures does not alter the findings. The research setting and processes were described in detail.

3.13.3 Dependability

Reliability is the criterion concerned with the stability, consistency, and equivalence in the study (Sandelowski 1986). Dependability refers to "the responsibility of the person wanting to transfer the findings to another situation or population than that of the researcher of the original study" (Krefting 1991). The researcher ensured dependability by maintaining an audit trail of the data which involved safe storage of all recorded interviews as well as verbatim transcriptions.

3.13.4 Confirmability of Findings

Confirmability refers to neutrality in the research. Freedom from bias in the research procedures and results (Sandelowski 1986) may be achieved through the rigor of methodology, through which reliability and validity are established. The data analysis was reviewed, and the themes and sub-themes were identified and compared to those of the researcher.

3.14 ETHICAL CONSIDERATIONS

Autonomy, justice, non-maleficence, beneficence, and confidentiality are all principles of ethics that need to be considered and maintained throughout the study.

Autonomy states that participation in the study was completely voluntary and prospective participants were free to refuse participation in the study, may withdraw from the study at any point and may answer all questions within their comfort parameters. The participants were provided with a letter of information (Appendix A) and informed consent (Appendix B).

Anonymity and confidentiality were maintained using participant numbers. Participants' indemnity and names were not disclosed in this study to ensure their privacy. The data were numbered according to their participant number and will be stored at the Chiropractic programme for five years. The electronic data are password protected and stored on a USB at DUT. Thereafter, hard copies will be shredded, and the electronic data will be deleted. Only the researcher and supervisor have had access to the data. Confidentiality serves to preserve autonomy and justice.

Non-maleficence refers to the care and caution taken by the researcher to ensure no harm, risk or side effects will be suffered by the participants (Polit and Beck 2010). Participants were not harmed in any way during the interviews as the nature of the topic does did not pose any risk of psychological harm to the participant. The letter of information (Appendix A) given to each participant highlighted this. The researcher also reiterated this to each participant before the commencement of each interview.

Beneficence is the principal duty imposed on the researcher to maximise benefits and minimise harm to participants. It honours and upholds the physical, financial, social, emotional, and legal well-being of participants (Polit and Beck 2010). Participants were reassured of their confidentiality before being interviewed and they acknowledged this by signing the informed consent form (Appendix B). Participants and healthcare practitioners, such as chiropractors, may benefit from the knowledge around the topic following completion and release of the research.

3.15 CONCLUSION

This chapter explained the research methodology that was implemented in this study, clarifying the method of data used and analysed. The findings of the research study will be represented in the next chapter.

CHAPTER FOUR

RESULTS

4.1 INTRODUCTION

The findings obtained from the thematic analysis of nine semi-structured interviews conducted with elite female swimmers in KwaZulu-Natal (KZN), representing either South Africa or KZN, are presented in this chapter. The nine participants were asked demographic and swimming specific information questions prior to the interviews. **Table 4.1** presents the demographic and sports specific information provided by each participant. Three main themes and sub-themes that emerged from the interviews are presented in **Table 4.2.** The narratives of the participants were transcribed verbatim.

Table 4.1: Age, representing team, competitive distance, and years of competitive swimming of each participant

Participant Number	Age	Representing Team	Competitive Distance	Long distance (LD) or sprinter (S)	Years of competitive swimming	Code
1	22	KZN SA	100m	S	10	P122SA
2	24	KZN SA	50m 100m	S	13	P224SA
3	19	KZN SA	5km 10km	LD	7	P319SA
4	16	KZN	100m 200m	S	3	P416KZN
5	26	KZN SA	50m 100m	S	7	P526SA
6	18	KZN SA	100m	S	8	P618SA
7	15	KZN	400m 800m 3km	S LD	8	P715KZN
8	16	KZN	200m 400m 5km 7.5km	S LD	6	P816KZN
9	19	KZN SA	750m 1.5km	LD	5	P919SA

The participants who took place in the study were all elite female swimmers between the ages of fifteen and thirty years old. Of the nine participants, six participants represented KwaZulu-Natal (KZN) and South African teams, while three of the participants represented KZN only.

The competitive distances were classified into long distance (LD) and sprint (S). Any distance over 400 meters was classified as long distance and distances less than 400 meters were considered sprinters. Five out of the nine participants were sprinters, two were long distance swimmers and two did both long distance and sprints.

With regards to the years that each participant had been swimming competitively, eight of the nine females had been swimming competitively for over five years, with two of these participants competing for over ten years. One participant had been competing for only three years.

4.1.2 Themes and Subthemes

Semi-structured interviews were constructed with nine elite female swimmers representing KZN and/or SA. The interviews were transcribed verbatim and analysed which revealed five themes and ten subthemes. **Table 4.2** below presents the themes and subthemes used to encompass the knowledge and understanding of the female athlete triad, its associated risk factors, and appropriate management options.

Table 4.2: The domain, main themes, and sub-themes

Domain	Themes	Subthemes
Knowledge	1. Lack of knowledge	
Understanding	2. Risk factors	2.1 Diet and eating disorders 2.2 Overtraining 2.3 Pressure to perform
	3. Impact of FAT on health and performance	3.1 Energy availability 3.2 Menstrual function 3.3 Bone health
Management	4. Lack of education	4.1 School and parents 4.2 Coaches and sports doctors
	5. Lack in choice of healthcare	5.1 GPs 5.2 Dieticians

4.2 THEME ONE: THE LACK OF KNOWLEDGE ON THE FEMALE ATHLETE TRIAD

Knowledge about female health in sport is an important aspect of ensuring that athletes competing at elite levels can train with caution and can identify any risk factors for a condition such as the female athlete triad. The participants were asked to describe their knowledge on the condition known as the female athlete triad. Two of the nine participants had a brief knowledge on FAT.

The following extracts are reflective of this:

> *"Um…I know that it's to do with females sort of overtraining and I know it affects your menstrual cycle, um and I think there's also something to do with bone or muscle density and just kind of negatively impacting females in terms of high-level sport and overtraining."* (P224SA).

> *"I know there's three things. I can't quite remember the three things. I have a feeling, correct me if I'm wrong, one of them is bone density. And then the other two, I can't. I can't remember."* (P319SA).

The majority of the participants who were female swimmers did not have knowledge on what the term female athlete triad was however, when probed with the question "Do you know of anyone that has presented with symptoms that would indicate that they have low energy availability, poor bone density and not having a nutritional diet?", the following statements presented these thoughts:

> *"I have definitely heard those, the low energy and the non-nutritionist diet, but I haven't really heard of the triad.*" (P122SA).

> "*Yeah, definitely heard of a few swimmers saying that, like, especially females, they say that sometimes they have the periods and then for months, sometimes they don't have any, they don't have their periods for long periods of time*." (P816KZN)

> *"No. Not at all. I assume it has something to do with diet and body image and body weight. I assume its three things since it's a triad, so maybe body weight, body image and diet."* (P919SA)

One participant gained information from her mother who stressed the importance of fuelling the body in order to perform optimally, whereas one other participant read an educational book focusing on nutritional and menstrual health.

The extracts are depicted below:

> *"Yeah, it's one of the first times I'm hearing about it like every now and then my mom would be like, you have to put the right food into your body, you have to be eating correctly, it's like that, you are like a car, you can't have no fuel in your body and expect it to run properly so I do hear a little bit about it."* (P816KZN)

> *"Yeah so, I read that book by Stacey Simms, the one to do with menstrual cycle and stuff and there was a lot in there about diet, but I assume you just need to eat correctly, eat stuff that nourishes you, but no not really."* (P919SA)

4.3 THEME TWO: THE UNDERSTANDING OF THE FEMALE ATHLETE TRIAD RISK FACTORS

Participants were asked to expand and elaborate on what makes an individual at risk for the triad. Although triad knowledge was low, understanding of its risk factors were well understood. From this, subthemes arose from the main theme included; dieting and eating disorders, overtraining and the pressure to perform.

4.3.1 Diet and Eating Disorders

When the female athletes were probed and asked questions around diet and eating behaviours, all participants stressed the importance of having a balanced diet.

This was reiterated by one participant who mentioned the following:

> *"I think for me its all about having a balance so its not like completely depriving yourself of you know, unhealthy foods like chocolate and stuff, like I do think once you start going down that track it can be quite of a negative impact on your mind, but for me I think in terms of health I think obviously a whole lot of vegetables, protein, um but ya I think its very important to have a balanced lifestyle as well not to be too strict on your diet…"* (P122SA)

Similarly, another participant emphasized the importance of a balanced diet. The following statement presents these thoughts:

> *"So the way I see it, I like to think of everything I eat in moderation, you know, and then it's kind of a whatever you crave, let your body have that, because obviously, your body's craving things that it needs, especially like, throughout my period, I want like the weirdest stuff, and so like, I'm not eating a slab of chocolate every day and eating tubs of ice cream, like for breakfast, like, that's not, I mean, like, as like an athlete, you kind of know what works for you and what doesn't, then it's a good combination of everything in moderation. When you feel like an ice-cream, go have an ice-cream, you know, if you feel like a burger, have a burger. If you feel like something greasy, your body's telling you something, you know, it's like listen to that. So definitely like my go to is like everything in moderation. Always have something, always have a colourful plate. Doesn't matter what it is always have greens and veggies and always, like, eat lots of fruit, like, everything, you know, like have, like don't just eat a whole lot of one thing. That's kind of my go to and it's not, it's not the best. Like, I mean, yeah, I don't know. It works for me."* (P526SA)

Four out of the nine participants mentioned that they had consulted with a dietician. The following extracts depict this:

> "*Balance I have had, well we have had talks with dieticians, and they have always, I mean, it's, it's always different. A lot of them have said, push the carb, some say push the protein. But for me, I've always tried to keep it balanced. And we tried to have, you know, in moderation."* (P319SA)

> *"Well I would say everything in moderation, but I do go to a dietician so she does actually work specifically with athletes and um so you just follow that." (P416KZN)*

> *"So I went to a dietician a while ago, I never really followed what she said. It was quite bad but like, she… I wasn't eating enough, and my body fat percentage was really low. I mean I thought I was eating enough nut instead of having like, I usually had like three or four meals a day, whereas I should be having like six or seven like smaller meals, so I wasn't getting in enough, I cant*

even remember what it was… oh, enough protein… is protein like milk and stuff?" The researcher probed the participant and mentioned diary. The response was, "Yeah that's what it was. I don't know why I said that. But diary, I wasn't getting enough diary, my bones weren't strong enough and stuff, but she said I had to drink like six cups of milk a day and that just wasn't sustainable or me, so I stopped doing it but yeah I think as long as you, I think going to a dietician is important. I definitely drank more milk and I started to feel better but then I kind of stopped doing that. But I kind of still felt nourished. I don't know maybe she gave me the wrong stuff or something, I don't know." (P919SA)

"As you get older, your coaches make you more aware, and your parents, and then you realize that to be like this elite athlete, you do need to have certain nutrients, like, need nutrient dense foods, so you eat cleaner. So probably from the like grade 10 from when I was 15, to about 17 I was very aware of like what I was eating and making sure I ate very strictly, you didn't really have a space for like junk food or unhealthy food, and now, as I've gotten older, I've come to realize that like that restriction is more unhealthy in your mindset than so that affects you more so than what you're actually having, and you just need to think that like food is just fuel, you don't necessarily have to worry about what's in it…and then training at such a high capacity and intensity, my body fat got really low and then it just got to a point where like, my immunity was so low, and then I got sick and I was, I mean, COVID happened, but it happened like right before my nationals I've been working so hard for so long and then so like, of course this is going to happen. It also happened now, where my body feels like a little bit too low so now I've like put on a little bit more body fat, just because and then because your immunity drops and then, you know, there's also concern about like losing your period and then potentially coming infertile." (P618SA)

Through exploring the understanding that the participants had on triad risk factors, they were asked "Do female swimmers or yourself in particular lose weight to meet any specific requirements for the sport? If so, elaborate on what methods are commonly used?"

Only one out of the nine participants admitted to previously having an eating disorder. The following extracts are reflective of this:

> *"So for probably from the like grade 10 from when I was 15, to about 17 I was very aware of like what I was eating and making sure I ate very strictly, you didn't really have a space for like junk food or unhealthy food, and now, as I've gotten older, I've come to realize that like that restriction is more unhealthy in your mindset than so that affects you more so than what you're actually having, and you just need to think that like food is just fuel, you don't necessarily have to worry about what's in it."* (P618SA)

> *"So I mean obviously there are the extreme cases where women, girls do throw up and all of that kind of thing, um but I do know they will lessen their intake of food throughout the day, um also cut out carbs. I think because we do go into a taper, we do, we tend to train less, we burn less energy so they may cut back completely on the food worried they are going to put on weight, um but ya main one is just depriving themselves of food I guess."* (P122SA)

> *"…girls will starve themselves in order to maintain a body image. It may not be just for this sport, and might be just social, you know, things you see on social media."* (P319SA)

> *"Um, bulimia is quite a big one. A lot of the girls that are fat, get like that, and verging on anorexia, just a lot of eating disorders."* (P416KZN)

> *"…if you have, like I often see younger girls, where they aren't, they don't have backing, they're not working with a nutritionist, they aren't educated a lot on the topic, but they just see that like well at that age, you also your body's still growing so like your body holds on to fat in certain areas and then, but then you look at these older girls, and they've gone to a stage where they're not growing anymore, so they're able to lean down their body and they want to look like their inspiration. And they think like, okay, I'm not lean enough, I need to cut down, I need to lose weight so that I can look like that and then perform like that. Except then they're doing it in an unhealthy way where they cut down too many calories and then goes into like eating disorders with anorexia, bulimia."* (P618SA)

"So [name], *I know she had an eating disorder; she spoke about it quite openly at lunch the other day when I went for lunch with her. So she is quite open about her eating disorder like, she had it for a couple of months and she saw her performance decline a lot because she was so… I mean she has like a really nice body and stuff, but she was obviously really concerned about her weight and she has like the nicest legs ever. I've never seen someone with such nice legs, but it just makes me think, why would she be worried about her weight if she looks so nice. But I mean it's obviously just like a, like a body image."* (P919SA)

"So she just wasn't eating. She was eating really small meals. She wasn't eating a lot of protein. She ate no junk food at all. I mean I love junk food, I mean I eat chocolate all the time. I get like a little bucket of sweets at night from my mom, like I love it, there is no ways I could go without it. She was so disciplined in not eating any, like even when she went out with her friends and stuff, not eating anything, I mean she is better now, but like not eating any junk food whatsoever. No sweets, no chocolate, no alcohol, even though she likes to go out and party. Probably for the amount if swimming she was doing, she should have been eating triple to what she was eating, and she obviously saw like a decline in her performance so she lost weight but she didn't have the energy and then she ended up… I think she kind of still has the eating disorder like she doesn't really eat a lot like even when we went out for lunch, like she had like a coffee or something and that's not lunch." (P919SA)

4.3.2 Overtraining

Another risk factor associated with FAT is overtraining. Each participant was asked if they or their teammates overtrain and if so, how often? Seven out of the nine participants admitted to overtraining. One participant said to a certain extent and the other said not at all.

The participants' responses are presented thus:

"I think they were, um just pushing themselves past where they were actually performing to where they would just sort of slogging through, getting injured, just maybe trying to keep up with the boys, and doing sets in the pool that just

weren't suiting them so, still coming back even though they would get out the pool, you know the last session they would be absolutely broken, and still not have enough rest to recover in time for the next session." (P224SA)

"Definitely, one hundred percent" (P122SA).

When the same participant was asked what overtraining looked like to her, her response was:

"So just complete exhaustion, just sleeping all the time, not performing well in training and just never being able to fully recover I guess…" (P122SA)

Other participants responded:

"To an extent maybe, but it's the kind of sport I'm in and the kind of swimming that I do. I need to be racking up the mileage. I need to be doing 12/13 K's a day, but it's, it's my sport. I mean, and I do look after myself, I can come home, I can rest I can eat well. It's Yeah." (P319SA)

"Um, there are definitely times where you are like jeez this is a lot, but it all evens out and I still race well. I do agree with my coach's methods." (P416KZN)

"That's a tough question. I want to say no because of how much of a hard-arse I am and I believe there's a point where, like, so the older I get, the more I started listening to my body more, okay, I'm starting to know things or like, when I'm tired, okay, that's my body telling me something, but there's a little bit of a give and there's a little bit of take, and there's a kind of like a point where you will feel really dog tired and you give yourself three days and what happens is…in the last two years, this is kind of what like what I have figured out about myself, but in the end, when you train train train train train and you work really, really hard, and you've hit that point, that kind of like breaking point, like I am dog tired, like I can barely get out of bed, I'm exhausted, I'm stiff, whatever. Give yourself three days and what usually happens, I'm not saying rest three days, but I'm saying, like, think about the little things that you've learned." (P526SA)

“Overtraining? Yeah. I think I struggled a lot with that before, like, when I was injured, and then I was so eager to get back into training so I was worried that I was falling behind and I wasn't doing enough as everyone else and then that would just hurt me in the long run because then like, I'd overwork my shoulders and all that.” (P618SA)

“Yeah. It's, it's kind of hard because sometimes I feel yes and sometimes, I feel no, because like, when we in our peak of our training, we are swimming twice a day like two hour sessions with school in between so sometimes it can catch up to you by the end of the day. You do feel very tired, and you feel overworked, yeah and that goes on for every single day of the week.” (P816KZN)

“I mean we are doing at the moment 19 hours, 20 hours a week which is quite a lot, but I talk to my coach often. I pretty much talk to her every day and when I do feel like I am doing too much then she pushes me, but she also doesn’t push me.” (P919SA)

The one participant who did not admit to overtraining responded:

“I personally don’t think so. I think we are doing okay now.” (P715KZN)

One participant acknowledged how her menstrual cycle would be altered dependent on how intense her training sessions were. The extract is expressed as follows:

“I have a really good routine but my period changes depending on how much I'm training so if I have really hectic training cycle and my periods, maybe two days, I don't really think anything of it, because I know what I've done to get there” (P526SA)

4.3.3 Pressure to Perform

Swimming is a highly competitive individualized sport when competing at the elite level. Participants were asked about their pressure to perform a certain way and whether they experience these pressures internally or externally. Five of the nine athletes’ responses claimed that the pressure experienced was their own internal pressure.

The responses are shown below:

> *“I don’t think the external pressure is there, but I do think I do create it myself because obviously I do want to perform well for my family, my coaches, my sponsors, so for me I do kind of tend to put that pressure on myself to try and always be in peak performance because I don’t want to disappoint them, so whether or how, I don’t feel it from them externally but I think I put that pressure on myself.”* (P122SA)

> *“I think to be honest there is more pressure from myself, I don’t, I think there is more internal pressure than external pressure.”* (P224SA)

> *“It's probably personal.”* (P319SA)

> *“Um no not me in particular, but I’m sure other swimmers do. I put more pressure on myself.”* (P416KZN)

> *“I think it was more what I was seeing other girls look like and it was like, well, if they swimming fast, I should look like that. You know, so it was more of like an internal, like my perception of what a fast swimmer looked like and then what I should be like. Then that completely changed when I started swimming and looking like myself, you know, because that was like a whole lot of self-reflecting, and figuring out what worked best for me. You know, I was never much of someone who like always changed my diet. Not very good with um… no one ever told me to eat differently, no one ever really told me to train differently but I always wondered what they doing that I wasn't and so then I was comparing myself to other people and that was hard. That was like, should I be skinny or should be smaller? Should I not lift as much? I think that was a big thing because I like I got very strong and I got very big and maybe in longer events it hurt me, because I was heavier, but I was really fast in short stuff so I couldn't understand what was… yeah.”* (P526SA)

Two participants mentioned that pressures experienced during training sessions and galas were directly from the coaches, as well as the perceived internal pressure:

> *“Probably myself and my coach, because if I don't do a set properly and my coach will say, you need to focus and you need train hard.”* (P715KZN)

> *“Gosh, okay. I've had a big problem with this. I've always been a very high achieving person because like I'm not just swimming I'm also a very academic person, like I'm the top of the grade. And, and like in primary school I was swimming captain and netball captain, I always wanted to be the best and I've realized now that's just not sustainable, like as you get older, you can't devote so much time to so many things. So I think I had a lot of like, internalized pressure on myself where, like, you think that well, I've always been so high achieving at the top of everything and I think that like, okay, if I don't keep working and maintaining this and like people are gonna think that I'm a failure and like, they're gonna think like, oh, okay, like what happened there, you know, you know, you're going to drop, like, even when I was in grade seven or something I wasn't particularly as competitive in academics only you really became competitive with that in high school and now I'm not really but that's because in America, they only really care about my swimming and my scholarships for my swimming. They don’t really care about my academics, but when I was in grade seven, they were like oh, no, you get A's now, but like, I just wait till High School, and there's always like, and you always have people that are trying to take you down, and I'm thinking like, oh, yeah, you're successful, but just wait. I even had that, that's why I don't particularly like being friends with people at training, or swimmers because it's just not really a genuine relationship. Like, they will be friendly, but then they're kind of just thinking like, okay, no, but I hope you fail. You know, it's very two faced, which is kind of sad I wish that wasn't like that. Yeah. Like, my view on sport, I wish that people would support one another and like…”* (P618SA)

When participant six was asked to elaborate if her coach was putting her under pressure to perform in a certain way, her response revealed her feelings on the matter:

> *"I think that well, I think that* [coach] *actually used to be a lot more of a hard coach before he had his daughters and he was very strict. But uh, he's his coaching method, he doesn't like congratulate you he doesn't compliment you he'll criticize you or he won't say anything. So he will say something small and then it's a weird it's a weird power dynamics, then you like crave that attention from him. The pressure from him? He does it he does put pressure on us but it's never harsh. It's never too harsh. It's like in a way that you need to be pushed because there's a difference between being like, I almost want to say toxic…"* (P618SA)

One participant admitted that pressure was experienced internally, as well as externally, specifically by parents and coaches:

> *"Yeah, definitely. Every now and again, you kind of look in the mirror and realize you're not looking as fit as you should be. Also, like with your parents, with swimming, everyone's there to support you and sometimes you might be eating too much cake or eating too many sweats and ice cream and it might show especially… yeah so definitely sometimes that happens."* (P816KZN)

> *"Sometimes the coach lets it out, lets it slip… especially over Christmas our coach tends to… says don't eat too much um but yeah."* (P816KZN)

Lastly, one participant expressed that her pressures were directly related to herself and her parents:

> *"I used to definitely when I was younger, I put a lot of pressure on myself and like we were talking about it last night. One of the school galas I went to, like I didn't perform like I wanted to at all and I'm just not a sprinter I'm long distance and that's what suits me, and my dad was so upset with how I did. I mean he apologized and stuff but they put a lot of pressure on me in that gala and I just didn't perform and that obviously made me very upset but that was grade 9 so a very long time ago."* (P919SA)

4.4 THEME THREE: THE UNDERSTANDING OF THE IMPACT OF FAT ON HEALTH AND PERFORMANCE

4.4.1 Energy Availability

Participants in this study were asked questions surrounding energy availability and its effect on performance. When athletes were asked whether or not a coach/parent had told them to do more exercise, or eat more or less when they have been experiencing light-headedness, the responses were as follows:

> *"So there was a stage where ah my coach was quite intense with that stuff and if we did feel dizzy and were completely exhausted we were just told to carry on like just get over it, move on kind of thing, um but now I do think, I don't know what changed but when we do feel dizzy or exhausted then he will kind of tell us to either get out or rest for a bit then try and see if we can swim again, um so he is kind of relaxed with that kind of thing, but I know a lot of the other swimmers it is dependent on the swimmer as well because I know if another swimmer had to complain about being tired he would probably push them, depending on the swimmer."* (P122SA)

> *"Um, I have had one or two experiences where I will either ask to get out and they will oblige but then afterwards they will kind of express that they weren't happy that I got out. So they would let you, if there was something wrong or if I wasn't feeling well but if they thought that it wasn't legit they would tell me. You know they would be disappointed."* (P224SA)

> *"So I think his first step because I have done that before and his first step would be swim easy and then if it doesn't go away then get out."* (P416KZN)

> *"Yeah, so my old coach said I could get out if I was feeling all of that stuff, but my new coach is hardcore and he'll make me swim."* (P715KZN)

> *"Well no to be honest, no. If I do ask… like one time I swallowed a bug and my coach told me to carry on swimming. So, our coach usually tells us to swim straight through it. And our coach is hardcore."* (P816KZN)

“Well if I'm ever feeling dizzy, I will stop and I'll drink or if I'm really not feeling well I'll tell my coach and more often than not would tell me to get out.” (P319SA)

“So we had that as well. It’s a little bit of both. Especially in college it was more, you would definitely show up, swim 1000 and see how you feel. If you don’t feel well then hop out then go check with [sports doctor] or whatever. Here, I have not had any coach tell me what to do. My coach and I, Wayne was very good. We communicate really, really well so if I feel tired, I tell him. He's like, okay, well do something else.” (P526SA)

“I've never, [coach] always been accommodating. He's always said like, no, he knew that if that's a problem, then you can relax. Although, but I think that's it's become more accepted now compared to the past. I think he used to be a lot more strict and kind of just like, you know what, if you don't feel like that, then you're not working hard enough, you know? Uh huh. Yeah. But [coach] has gotten better. I feel like he's not as strict on the girls as he is with the guys but I think with a lot of the guys, he can be a lot of tomfoolery, and they just like being lazy, but you can kind of distinguish, you can distinguish when someone is just messing around and they're being lazy.” (P618SA)

“Oh no, she would definitely make us get out, she always places emphasis on like, I mean even if I’m maybe performing well but not feeling well, she would make me get out. She wouldn’t make me carry on with it. But there has been coaches, like [coach], he made me cry in my goggles so many times and I gave up swimming for like two years because, or like a year maybe two years because I just hated it. I hated going to swimming. The pool was not that warm, it was dark especially in winter and I hated it and he just didn’t care. I don’t think he even knew what a period was.” (P919SA)

The above data suggest that these elite athletes are expected to train long and hard hours. When signs of low energy availability arose, such as light-headedness, the coaches would often make the swimmers continue their training. Two of the nine participants admitted that their coach is “*hardcore*” and would make them swim through a state of low energy availability.

4.4.2 Menstrual Function

General questions surrounding menstrual health were utilized in order to gain an understanding of each participant's knowledge about the relationship between overtraining and menstrual dysfunction. Each participant was asked what a regular menstrual cycle is for them, what the duration of a period is as well as the average onset of menarche. All nine swimmers gave correct answers pertaining to regular cycles, duration and age of onset.

One of the nine participants mentioned that in the athletic population she was unsure what a normal cycle should be:

> *"Well, yeah, I mean, mine's quite irregular. Mine's quite a short cycle. Mine's like 21 days, and then it'll be four or five days. But, I mean, the generic normal cycle is like, 28 days with four- or five-days bleeding. But I mean, I'm not too sure about athletes, I've always been told that, like, they might have a shorter cycle, because they are so active or I'm not sure."* (P618SA)

The most pertinent question regarding menstrual health was "Does missing a period (due to overtraining) raise concerns about your health?". The responses were reflected below:

> *"Just because, well for me personally I'm very regular so I kind of always know when I'm going to have my period, um and a lot of my friends are, my one friend you know was 9 months when she didn't have it and I know obviously when your body fat percentage is too low you're not going to get your period and I know a lot of swimmers tend to feel like they need to drop their body fat percentage, um but I do agree when it gets to a certain point when you lose your periods its quite dangerous."* (P122SA)

> *"Um no, so I would definitely say that's a red flag, yeah I know some girls obviously they are on contraceptive or whatever, that can happen and have an impact and some girls do take like contraceptives or the Mirena, those little IUD's, specifically for swimming to kind of ease that. But if they were not on that and were stopping their period, I would definitely think something is wrong."* (P224SA)

“Yes, but then there's like, multiple things that you have to think about. It's not just, it's like if they are like sexually active, like that kind of stuff. But in terms of, I know very small people who have very irregular periods, and they all live a very healthy life. So it could be some underlying like, it could be something with their body that they just have like a day period, or they might even like, not have periods, I don't know if you know but for me, it's like, if you feel healthy, like your body will tell you, like I really, I'm like a huge things is like your body's going to tell you when something's wrong. You know, like, if you are sleeping 15 hours every night, and you struggle to get up and you're always lethargic, something's wrong. You know, like, but if you having nine hours of sleep, and like I'm training six hours a day, I'm like, I feel good. I like, wake up in the morning, I have a really good routine but my period changes depending on how much I'm training so if I have really hectic training cycle and my periods, maybe two days, I don't really think anything of it, because I know what I've done to get there, if that makes sense?” (P526SA)

“Well, it's a, it's a natural process, all women go through it. I mean, when, when you come of age, it's a natural process that your body goes through and so if you've had it, if you've had problems before, then, you know, whatever that is, but if you hadn't, it's been consistent and then now, you've done some kind of drastic change and you lose it, then obviously something is not right.” (P618SA)

“Yeah. Because I've always been told by my mom that it's healthy to have a period each month, and it's a good thing and you should, you should be worried, like sometimes it's okay to miss like once or twice, but if it's regular, and you miss months at a time, it can be quite damaging for your health.” (P816KZN)

”Well in that book I read it just said a lot about when you do miss a period, its obviously because of overtraining but then also said because when your body isn’t getting enough nutrients, it performs the vital functions like breathing and stuff like that and then when you do miss your period its because your body is performing the vital functions and that’s not one of the most important things that it has to do, is your period.” (P919SA)

One participant initially responded no, but, when asked why does missing a period due to overtraining not raise concerns, her answer changed as her response was:

> *"Well actually it would raise concern, because you're supposed to be having your period, and it does indicate that something is wrong, so I would go see someone about it."* (P416KZN)

Two out of the nine participants did not have a substantial understanding of the dangers and effects of missing a period due to overtraining. The responses were shown below:

> *"It hasn't really been much of a concern for me because I've never really been normal, um I only started, I started like grade nine, I think is quite late, and my sister only started in matric I mean she was really bad, but she went to a gynaecologist and got it checked out."* (P319SA)

> *"I don't particularly know, because that's never happened to me but if it did happen to me, I'll go to my mom and I'll ask her like, what happened?"* (P716KZN)

4.4.3 Bone Health

Six of the participants in this study could give an explanation into the understanding of the term bone mineral density. Of the athletes who attempted to give an explanation, responses were as follows:

> *"Okay I was about to say, ya the amount of minerals you have in your bone, I don't know."* (P122SA)

> *"Um, I don't have a lot of knowledge about that but I think it is in terms of training really hard but your diet isn't actually supplying the minerals you need for building healthy bone and especially as you get older and in terms of being a female."* (P224SA)

> *"I would imagine the amount of minerals per something in your bones. And yeah."* (P319SA)

“Probably like the nutrients that you put into your body and how that is in your bone marrow and so then how that reaches out, fuels the rest of your body.” (P618SA)

“The probably the density, density and weight of your bones.” (P816KZN)

“So how strong your bones are.” (P919SA)

The remaining three participants had no understanding of the term bone mineral density, but once probed with the question “Have you heart of brittle bone disease and low vitamin D”, slight knowledge existed as their responses were:

“So I would assume that your bones are not in their strongest form or not as health as they should be.” (P416KZN)

“So is that like, is that related to osteoporosis when you get older, so that your bones become like super porous and then like, get very fragile, right?” (P526SA)

“Is it when your bones are very fragile, and they can break easily?” (P715KZN)

4.5 THEME FOUR: THE LACK OF EDUCATION SURROUNDING THE MANAGEMENT OF FAT

Participants were asked if advice or education had ever been given to them with regards to the female athlete triad, appropriate eating habits and regular check-ups. Seven out of the nine participants had never been given advise or education surround FAT and its associated risk factors. One of the seven had a brief understanding into the triad due to her participation in another study.

Two subthemes were established as follows:

4.5.1 School and Parents

Participant number 8 had been given minimal nutritional advise from her mother for training in the environment of elite athletes.

Her response was:

> *"Yeah, it's one of the first times I'm hearing about it like every now and then my mom would be like, you have to put the right food into your body, you have to be eating correctly, it's like that, you are like a car, you can't have no fuel in your body and expect it to run properly so I do hear a little bit about it."* (P816KZN)

Participant 9 gained most her knowledge around nutrition from a book she read:

> *"I read that book by Stacey Simms, the one to do with menstrual cycle and stuff and there was a lot in there about diet, but I assume you just need to eat correctly, eat stuff that nourishes you, but no not really."*

4.5.2 Coaches and Sports Doctors

Participant number 9 was the only swimmer whose coach had expressed the importance of nutrition, but the education was minimal:

> *"Um, Lucy my coach now she places a lot of emphasis on nutrition and eating*." (P919SA)

When the participant was asked why nutritional education is important and what advise the coach had given her, her response was:

> *"No just to make sure you are fuelled for the next session is kind of what she says."* (P919SA)

4.6 THEME FIVE: THE LACK IN CHOICE OF HEALTHCARE

Each participant in this study was asked what their first line of approach would be in terms of managing a condition such as FAT. Subthemes were discovered as follows:

4.6.1 GPs and Dieticians

Eight out of the nine participants mentioned they would approach a general practitioner or sports doctor along with coaches, parents and a dietician.

"Ah we have sports doctor that a lot of the swimmers go to, and I kind of pretty much go to him for anything so I think I would prefer to start there" (P122SA)

The participant continued:

"He's a GP, ya so he just pretty much does you know if we have the flu he helps us out with antibiotics and that kind of thing, um I don't know it's just, I'm trying to think, I would see him. I would need to re-evaluate everything and kind of like swipe the table of everything I thought I knew and just get information that I need in order, how to fix myself, well not fix myself but how to get back on the right track, like how must I change my diet I would go see a dietician um, ya I think that's the most important part is the nutritional side" (P122SA)

Another participant said:

"I would probably recommend a sports doctor, um in Stellenbosch I would see a GP that was specializing in sports." (P224SA)

When the participant was asked about regular check-ups, her response was:

"Ah no. There weren't um, sort of even annual check-ups. I think at Stellenbosch there was a high performance unit. There were old a few swimmers on that. It was more, here's a dietician, if you would like to go and see them we can make it part of your plan, if not, we will budget for whatever else you need as part of your package. In fact, in terms of south African tea, before every major competition we have to have a health screen, so then I would go to my sports doctor." (P224SA)

"Um, its I can try and find the form for you if you want but its basically a quick questionnaire with all your details, they do an ECG, they take your height and weight, work out your BMI. Um I think they do your blood pressure. Um, I think there might be a urine sample, I'm not sure if that's Stellenbosch or south Africa. Um, they check if you have any injuries, so they check your… I don't actually know what the checks are, they check your flexibility…" (P224SA)

The other participants elaborated:

> *"I've just been injured recently actually, and I just went there about four or five times and I just do rehab with them and they just, you know, needle and I only really go to physio's I don't really go to bio's or anything else."* (P319SA)

> *"I guess I'm not really sure in terms of like the period thing. I don't really know who I'll go to for that, because I don't really struggle with like, any period issues of that and that kind of stuff. In terms of like injuries and stuff, I always go to my GP. He's kind of like a chiro, but he's always been our doctor for everything. He does needling he's, like our general and whenever I've had an injury of always gone to him, he's been amazing."* (P526SA)

> *"My coach and then I go to my, well, then I started seeing a dietician, so coach, then dietitian then like your strength coach or bio, because my strength coach and my bio is the same person, and then if you find that it's this problem is from something else, like a mental problem where you're struggling then to go and see a therapist."* (P618SA)

> *"It was one of the worst time trial I had ever had, I didn't want to do that time I just blew completely and Lucy could see there was something wrong so she sent me to their team doctor that everyone in the team goes to that doctor, she's very good. I had Bilharzia and I had another food bug thing, H-pylori."* (P919SA)

4.6.2 Parents and Coaches

From the interview data, most participants expressed that instead of approaching health practitioners for advice with regards to the triad, parents and coaches were the first to be approached if risk factors were suspected.

These thoughts were expressed below:

> *"Well, first of all I would go to my mom. I would approach her, talk to her about it and see what she thinks. I would go to my sister, she's studying medicine, so she would know how to help me she would know where to point me in what direction and then I'll talk to my coach about it. Maybe not necessarily for*

advice, but I'd tell him what's going on. So keep him in the loop. And maybe go to someone to help like a doctor or something." (P319SA)

"So obviously I'd first go to my parents first and speak to them about it and see if it also raised concerns for them, and then move forward from there with the guidance of a doctor or someone who specializes in that." (P416KZN)

"I would personally go to my mom first and then she'll probably help me find like a specialist doctor to help me sort this out." (P715KZN)

"Probably, to be honest, either my coach or my mom because I'm sure my mom has a lot of wisdom on her side so I'm sure she would know what to do." (P816KZN)

"Yes. I think when you've initially realized that it's a problem, this whole thing like I've been through this entire thing but, like, for me, I noticed that I was training as hard as I could, I just didn't have energy, because I wasn't eating enough but it's because I didn't know how much I was supposed to be eating. And I first spoke to Graham, my coach, and I said, look, I'm trying because he's even like, you do these times, I want you to hold this. And I just said like, no, I can't, like I'm literally my body can't go anymore. So speak to your coach and then he said to me, okay, you need to look into your diet and then you need to look into your strength training, because maybe you're pushing too hard or doing too many sessions, or you need to see whether you're eating enough and so I first talked to my coach so he was aware, so like he knows that I have a problem in training." (P618SA)

CHAPTER FIVE

DISCUSSION

5.1 INTRODUCTION

This chapter discusses and interprets the findings of the study in context of the existing literature on the knowledge of the female athlete triad and its associated risk factors.

5.2 OVERVIEW OF THE RESEARCH DISCUSSION

The aim of this study was to explore the knowledge, understanding and management of FAT and the triad risk factors among elite swimmers in KwaZulu-Natal (KZN). Five main themes were identified:

Theme one: The lack of knowledge on the female athlete triad.

Theme two: The understanding of the female athlete triad risk factors.

Theme three: The understanding of the impact of FAT on health and performance.

Theme four: The lack of education surrounding the management of FAT.

Theme five: The lack in choice of healthcare.

The themes as well as subthemes are discussed below:

5.2 THEME ONE: THE LACK OF KNOWLEDGE ON THE FEMALE ATHLETE TRIAD

It is important to have knowledge on the female athlete triad as athletes competing in sports of a high-level participation are at risk for development of the triad (van Niekerk *et al.* 2018). The participants who took part in this study competed internationally, representing South Africa at the 2021 Olympic Games or at a provincial level (KZN) and were asked to describe their understanding of the condition itself. Despite the participants not having initial knowledge, when probed for a better understanding only

two could name components of the triad. Seven out of the nine participants had never heard of the triad before. The results surrounding the lack of knowledge of the female athlete triad are synonymous with the studies by Folscher *et al*. (2015) and Tosi *et al*. (2019). In the study done in South Africa on ultra-marathon runners, 92.5% of the participants had no knowledge on the female athlete triad, only three of the 306 athletes included in the study could name all three components of the triad (Folscher *et al*. 2015). The interviews with the elite female swimmers revealed a common lack of knowledge on the triad. Similarly, the study by Tosi *et al.* (2019) on skaters, dancers and runners looked at their knowledge surrounding the female athlete triad. Here the results showed that only 87 out of the total 712 participants (12%) knew about the triad.

5.3 THEME TWO: THE UNDERSTANDING OF THE FEMALE ATHLETE TRIAD RISK FACTORS

The study into the knowledge and understanding was explored and triad associated risk factors were discussed. Although knowledge on the exact name of the condition barely existed, understanding of the risk factors were well understood, the number of participants that knew or did not know about the risk factors is similar to other studies, especially Folscher *et al.* (2015) and Tosi *et al.* (2019). Both these studies showed similar results of the study revealing that knowledge of the triad risk factors was poor. A study by Hoogenboom *et al.* (2009) on nutritional knowledge and eating behaviours of female collegiate swimmers suggested that athletes do lack knowledge of nutrition, healthy food choices, components of a well-balanced diet and the side-effects that nutrition has on energy availability and performance (Hoogenboom *et al*. 2009).

5.3.1 Diet and Eating Disorders

The results of this study revealed diet and eating disorders to be highly prevalent amongst female elite swimmers. Not all participants admitted to developing disordered eating behaviours but five out of the nine participants did mention that they do exist amongst other female swimmers. The results are similar to a study on Norwegian female elite athletes from thirty-five different sports. The study revealed that a significantly higher percentage of athletes competing in aesthetic sports were found to

have an eating disorder compared with athletes competing in field sports (Sundgot-Borgen 1993). However, it must be noted that the Norwegian study was on field athletes. Nevertheless, this similarity is significant as this can indicate that it is present across all sporting disciplines.

In the interviews, participants were asked what methods were used by elite swimmers to lose weight in order to meet specific requirements in the sport. Three out of the nine participants mentioned that restriction of certain foods or the amount of food intake is reduced as means of weight loss methods. Only one participant admitted to having an eating disorder. Two out of the nine participants revealed that vomiting/bulimia were prevalent amongst the female swimming population. These results can be compared to the study done in South Africa. This study revealed that 20.4% of participants reported purging, 21.9% used laxatives and only 5.8% used exercise as means of weight loss. Methods such as dieting, bulimia, food preoccupation as well as oral control or restriction all contributed to the development of low energy availability (van Niekerk *et al.* 2018).

5.3.2 Overtraining

Seven out of the nine participants in this study admitted to overtraining but explained that it was necessary for the sport. Majority of the participants agreed that during peak training they do feel overworked and exhausted. However, the athletes did agree with their coach's methods. One participant admitted that when she returned to training after an injury, the increased intensity of training would result in regression towards her previous injury. Endurance sports are already a risk factor associated with development of the triad.

The results of this research study revealed that overtraining does exist amongst the elite female swimming population putting an individual at risk for developing triad symptoms. Evidence suggested that in runners, as the distance increased, so did menstrual dysfunction (Weiss Kelly *et al.* 2016). When it comes to overtraining, a previous study done on Japanese collegiate athletes revealed that as the intensity of training increased, so did the risk of delayed menarche and poor nutrition (Sawai *et al.* 2018). Only one participant in this study admitted that as the intensity of training increases, her menstrual cycle became irregular.

5.3.3 Pressure to Perform

Competing at higher levels such as internationally or nationally places the athletes under pressure to perform in a certain way. The data suggested that the main source of pressure comes from within the athlete herself. Five out of the nine participants revealed that the only pressure perceived was internal. Remaining participants mentioned that although there was existing internal pressure, external pressures from coaches and parents did exist. Not only does the external pressure from coaches/sponsors and parents contribute to physical stress but also to mental stress to train or compete at a higher standard for maximum performance. Performance anxiety is associated with dietary restrictions and weight loss which further manifest into menstrual dysfunction and reduced bone mineral density (De Oliveira *et al.* 2018).

5.4 THEME THREE: THE UNDERSTANDING OF THE IMPACT OF FAT ON HEALTH AND PERFORMANCE

5.4.1 Energy Availability

A low caloric consumption together with increased energy expenditure results in a deficit of energy available for health and activities of daily living and sports participation (George *et al.* 2011). However, immediate health consequences do exist in which performance is directly affected. In an article about the recommended treatment for FAT, it was identified that there was an increased chance of developing musculoskeletal injuries such as strains, sprains, and tendonitis as well as infertility and stress fractures. All of the above-mentioned consequences will hinder the athlete's ability to perform at the best of her abilities (Chamberlain 2018).

Data from this study done on elite female swimmers showed that all nine participants had at some stage experienced symptoms of low energy availability, however majority of coaches would push the swimmers to stay in the pool and continue training even though feelings of dizziness and light-headedness were being experienced. Only three of the nine swimmers' coaches would tell them to get out the pool in order to recover or rest.

There was a study into the exploration of whether low iron levels may be associated with indicators of low energy availability. From the results, there was evidently a

positive correlation between lean and endurance sports and being at risk for development of the triad. 28 out of the 181 participants in this study reported low iron status which is associated with low energy availability (Finn *et al.* 2021).

5.4.2 Menstrual Function

Due to a state of low energy availability women are at risk for developing negative health effects associated with the female athlete triad. When energy availability is lowered, cellular maintenance, thermoregulation and reproduction are impaired (Slater *et al.* 2017). Once impairment of the reproduction system exists, the athlete enters a hypoestrogenic state which contributes to menstrual irregularities (Mehta *et al.* 2018).

In this study, general questions regarding menstrual health were asked. The overall knowledge of regular cycles, duration and age of onset were well understood. Seven out of the nine participants revealed that missing a period should raise concerns about an individual's health status. The majority of participants noted that menstruation is a normal physiological function and should be present monthly.

A study participants admitted that her menstrual cycle changes depending on how much training is done. Evidently, she noticed a reduced duration of bleeding on menstruation. Participant two stated clearly the link between low body fat and menstrual dysfunction and participant nine had read a book about nutrition and menstrual function and explained that the lack of nutrients together with overtraining results in the body focusing and redirecting its energy to preserve vital functions such as breathing.

5.4.3 Bone Health

Caloric restriction and weight fluctuations have been associated with loss of bone density. An increasing duration of amenorrhea causes further decline in bone mineral density impairing skeletal health. This impairment will predispose an athlete to stress fractures and overuse injuries (Javed *et al.* 2013).

An exploration into the understanding of the term bone mineral density by the participants revealed that 67% of the sample could give a brief explanation and 33% of the participants had no understanding until probed. Although majority of the responses included the strength of bone, the amount of minerals and nutrients that are present in the bone, participants could not identify the link between menstrual dysfunction and a decline in bone mineral density.

The understanding of the term by the participants focused more on the link between diet and a decline in bone density. Only one participant mentioned osteoporosis as a long-term effect of low bone mineral density. The long term consequences were not well understood by the athletes who participated in this study, aligning with other studies by Folscher *et al.* (2015) and Tosi *et al.* (2019) on the knowledge and understanding of the triad and its associated risks.

5.5 THEME FOUR: THE LACK OF EDUCATION SURROUNDING THE MANAGEMENT OF FAT

The data from this study revealed that there is a lack of education surrounding the management interventions of the triad. When the participants were asked if they have received any advice or education on FAT and its risk factors, seven out of the nine participants had never been educated on the triad. Swimmers, like all other athletes may benefit from education and knowledge surrounding healthy eating habits and their impact on energy availability and performance. This was highlighted by an earlier study by Hoogenboom *et al.* (2009) where the need for education and awareness on this topic was expressed to ensure young women competing in elite sports are at their optimal health, thus reducing the potential risk of developing the triad. This study is in keeping by Williams *et al.* (2019) who stated that young women of today need to be educated about the risks associated with FAT syndrome as it has a negative impact on their health status as well as their activity performance.

5.5.1 School and Parents

Two of the nine participants had received education from either a parent or a book. The participant could only express the importance of healthy eating. Other than the book, the participant had received no additional education or advice surrounding the management of a condition such as FAT.

5.5.2 Coaches and Sports Doctors

Data from this study suggested that coaches and sports doctors lack knowledge surrounding FAT. This was evident as only one participant had received education on nutrition from her coach.

A study done in 2009 by Troy *et al*. on the knowledge of the triad amongst physicians, physical therapists, athletic trainers, medical students, and coaches. 48% of physicians and only 8% of coaches could identify components of the female athlete triad. Similarly, triad knowledge was investigated amongst athletes and their coaches, revealing that although coaches had identified signs of the triad in their athletes, knowledge of its consequences was poor (Brown *et al.* 2014).

There is evidently a deficit in knowledge that coaches have on the triad and its associated long term negative health effects.

5.6 THEME FIVE: THE LACK IN CHOICE OF HEALTHCARE

The participants who took part in this study lacked good choice in health care when asked about management options, if they were experiencing the triad, or the triad risk factors. Only one participant, once probed, mentioned she would see a gynaecologist for intervention if noticeable changes in menstrual function occurred. Only one out of the nine participants stated that if problems were linked to mental health, would she approach a therapist. This was important as eating disorders are usually co-existing with other psychological disorders such as obsessive-compulsive disorder, substance use, mood disorders and schizophrenia (De Souza *et al.* 2017).

5.6.1 GPs

It is important that female athletes competing at a higher level have access to appropriate health care to ensure optimal health. Prevention, recognition, and treatment of the triad must be a priority to ensure that these athletes maximise the benefits of regular exercise and achieve optimal health as well as optimal performance (Laframboise *et al.* 2013). It was evident from the results that majority of the participants first line approach after parents and/or coaches would be a general practitioner. Athletes did not give an understanding into what management styles would be used, but instead trusted their GPs or team doctors to initiate appropriate treatment and management of this condition. These statements were of concern as the study by Troy *et al.* in 2009 which focused on exploring the knowledge surrounding FAT in different population groups revealed that only 48% of physicians knew about the triad. Due to the results directing more to the GP approach in terms of management

options, it is vital that these practitioners, who commonly act as first line contact for female athletes have knowledge and an understanding of the presentation of the triad and its associated risk factors.

5.6.2 Dieticians

Current literature expressed in **Table 2.1** evidently showed that disordered eating is a pertinent risk factor associated with development of the female athlete triad. Only four out of the nine participants mentioned that a dietician would be an option in terms of management intervention. Recovery of the athletes' lost weight is vital to ensure her menstrual cycle is relative to her weight (Nose-Ogura *et al.* 2018), thus a dietician's approach to managing the triad is necessary.

5.7 CONCLUSION

Participants expressed similar levels of knowledge around the term 'Female Athlete Triad'. 78% of the participants in this study had never heard of the triad prior to the interviews that were conducted. Although the knowledge of the triad name had a major deficit, the understanding of the associated risk factors was well understood. The choice of appropriate health care was poor amongst the participants. Majority of athletes admitted to approaching parents and coaches before a healthcare practitioner, such as a dietician, sports doctor or chiropractor, thus more investigation into this population is needed to increase the knowledge amongst the female elite athlete population.

CHAPTER 6

CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS OF THIS STUDY

6.1 INTRODUCTION

This chapter addresses the research questions, the strengths and limitations of the study, the conclusions drawn from the study and recommendations based on the findings of the study.

6.2 RESEARCHER POSITIONING

This research study highlighted the knowledge and understanding of the female athlete triad and its role in female health and sport. As a female and a former athlete, the researcher was able to identify with the responses of the participants. Furthermore, the researcher is well versed in female health, nutrition, and sports participation. This enabled effective interactions with the participants and therefore influenced comprehensive interpretations of data.

6.3 SUMMARY OF THE STUDY

The aim of this study was to explore the knowledge, understanding and management of FAT and the triad risk factors among elite swimmers in KwaZulu-Natal (KZN). The responses of the participants to the interview questions were included in the findings section.

6.3.1 Research Question 1: Describe Your Understanding of the Female Athlete Triad

The participants in this study were asked to describe their understanding of the triad. From the data, it was evident that most of the participants had never heard of the name, the female athlete triad, before. There was a noticeable deficit of knowledge

amongst this population group, as coaches, parents as well as practitioners/sports doctors had never given advice or education into the triad and its associated risk factors. This gap supported the exploration into the triad aspect of this study.

6.3.2 Research Question 2: Can You Expand/Elaborate on What Makes an Individual at Risk for the Triad?

Although the name of the triad was not familiar by the participants, the understanding of the risk factors was well presented. All participants expressed the importance of a balanced diet and adequate nutrition in sport, and some were able to state the dangers of eating disorders. Most athletes could identify that menstrual dysfunction is a red flag in terms of the health status of a female athlete. The knowledge of bone mineral density was not well understood by the participants in this study.

6.3.3 Research Question 3: Describe Your Management Options You Used or Know of Someone That Has Had Fat Used

The participants of this study lacked appropriate choice in healthcare when it came to management options for the female athlete triad and its risk factors. Most participants stated that their parents would be the first line of approach, second to dieticians. Sports doctors and general practitioners were also mentioned as a management option, but not as a first line approach. None of the participants who took part in the study had ever received advice or education surrounding the female athlete triad as well as its associated risk factors.

6.4 STRENGTHS OF THE STUDY

This qualitative study contributes to the scientific literature on the knowledge and understanding of the female athlete triad, its associated risk factors as well as the management options. There was opportunity for the researcher to obtain detailed responses from the participants on the general understanding of the female athlete triad, specifically in swimming in KZN, South Africa. While the study focused on the knowledge and understanding of the triad, it also gained insight into the choice of health care the participants would choose if they suspected themselves having certain components of the triad.

6.5 LIMITATIONS OF THE STUDY

There were nine (9) female elite swimmers in KZN who agreed to participate in this study. Other athletes who fitted the criteria to partake had concerns about meeting with the researcher due to the Covid-19 pandemic, which explains the small sample size. Despite this, participants did provide the relevant and required information for this study. The researcher advises against generalizing about this study to elite female swimmers due to the small sample size. The data from this study is self-reported and is dependent on the understanding of the question and honesty of the participant. Questions surrounding disordered eating may have been underreported due to it being a sensitive topic.

There are aspects of the findings of this study that could provide useful knowledge and understanding of the triad, its risk factors as well as its management options not only to elite female swimmers, but also to coaches, parents, and other health practitioners.

6.6 RECOMMENDATIONS

It is recommended that follow-up research is done regularly to assess any changes in the knowledge that female athletes have on the triad and its associated risk factors. Similar studies should be conducted in different provinces in South Africa, amongst other lean/endurance type sporting disciplines to compare the findings.

6.7 CONCLUSION

This qualitative study explored the knowledge and understanding of the female athlete triad, its associated risk factors, and management amongst elite swimmers in KZN, South Africa. The findings of this study indicate that there is a gap in knowledge surrounding women's health in sports, especially pertaining to energy availability, menstrual function, and bone health. There is a lack of recognition of the triad name, however when asked about associated risk factors, there was a better understanding. Overall, the name of the female athlete triad was not well recognized, the risk factors were well understood, and the choice of health care options lacked substantial

knowledge. This is concerning and supported the reason for this study, as health practitioners are first line when it comes to treating illness and disorder. Although the findings of this study were consistent with other literature, very few studies have been done on swimmers.

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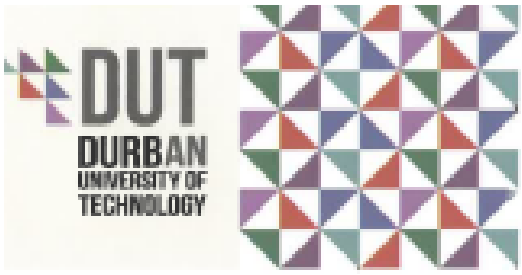
Appendices

Appendix A: DUT Ethical Clearance



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14 January 2021

Miss E L Seals
5 Assagay Downs
22 Assagay Road
Assagay
Hillcrest

Dear Miss Seals

The knowledge, understanding and management of the female athlete triad and its associated risk factors in elite swimmers in KwaZulu-Natal.
Ethical Clearance number IREC 111/20

The Institutional Research Ethics Committee acknowledges receipt of your gatekeeper permission letters.

Please note that FULL APPROVAL is granted to your research proposal. You may proceed with data collection.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC Standard Operating Procedures (SOP's).

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely

Prof J K Adam
Chairperson: IREC

DUT

2021 -01- 14

INSTITUTIONAL RESEARCH ETHICS COMMITTEE
P O BOX 1334, DURBAN 4000 SOUTH AFRICA

Appendix B: Letter of Information

LETTER OF INFORMATION

Dear participant. I wish to welcome you to my research study and thank you for your co-operation.

Title of the Research Study: An exploration into the knowledge, understanding and management of the female athlete triad and triad risk factors in elite swimmers in KZN.

Principal Investigator/s/researcher: Erin Seals (B. Tech: Chiropractic)

Co-Investigator/s/supervisor/s: Dr Ashura Abdul-Rasheed (M. Tech: Chiropractic)

Brief Introduction and Purpose of the Study: Over the past thirty years the number of women competing in organized sports has drastically increased. Female athletes experience pressure to conform to social and sporting norms concerning body weight and image in order to emphasize a lean appearance which is increasing their risk of several negative health effects. Thus, the aim of this study is to explore the knowledge and understanding of the female athlete triad (FAT) and the triad risk factors in elite swimmers in KZN.

Outline of the Procedures: You will be required to participate in an interview that is estimated to be 30 minutes. The interviews will be voice recorded. The interviews will be conducted in a private room at the Durban University of Technology (DUT) Chiropractic Day Clinic.

Risks or Discomforts to the Participant: There are no risks or discomforts involved in this study.

Benefits: There is little information on FAT in a South African context as well as other sporting disciplines, such as swimming. Knowledge is lacking on FAT but elite athletes are still getting treatment from their health practitioners. The need for education around this condition is vital to ensure optimal health of young woman who are at risk. By participating in this study, you will help medical professionals understand the knowledge and understanding of this condition more and possibly be able to treat the symptoms more effectively and efficiently.

Reason/s why the Participant May Be Withdrawn from the Study: You may withdraw from the study at any point with no adverse consequences to you.

Remuneration: There will be no remuneration for your participation in this study.

Cost of the Study: There is no cost involved to participate in the study.

Confidentiality: All the information that you supply will be kept confidential and used for research purposes only.

Research-related Injury: The research involves interviews therefore there is no possibility for injury.

Persons to Contact in the Event of Any Problems or Queries:

Principle investigator: Erin Seals Cell: 076 419 7699

Supervisor: Dr Ashura Abdul-Rasheed Cell: 031 373 2094

Institutional Research Ethics administrator Tel: 031 373 2375

Complaints can be reported to the DVC: Research, Innovation and Engagement

Prof S Moyo on 031 373 2577 or moyos@dut.ac

Appendix C: Letter of Informed Consent

LETTER OF INFORMED CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, _____ (name of researcher), about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____.
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

_____	_____	_____	_____
Full Name of Participant	**Date**	**Time**	**Signature**
RightThumbprint			

I, _____ (name of researcher), herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

_____	_____	_____
Full Name of Researcher	**Date**	**Signature**
_____	_____	_____
Full Name of Witness	**Date**	**Signature**
(If applicable)		
_____	_____	_____
Full Name of Legal Guardian	**Date**	**Signature**
(If applicable)		

Appendix D: Advertisement

WELCOME TO MY RESEARCH STUDY

Researcher: Erin Seals
M.Tech Chiropractic student
Durban University of Technology (DUT)

You will be required to participate in an interview (estimated to be 30 minutes)

The interviews will be voice recorded and will be conducted in a private room at the DUT.

Over the past thirty years the number of women competing in organized sports has drastically increased and female athletes experience **pressure to conform to social and sporting norms concerning body weight and image** in order to emphasize a lean appearance which is increasing their risk of several negative health effects.

How much do you REALLY know??

- NO RISKS or discomforts involved
- You may withdraw at any point with NO adverse consequences to you.
- NO charge for your participation in this study.
- There is NO COST involved to participate in the study.
- All the information that you supply will be kept confidential and used for research purposes only.
- The research involves interviews therefore there is no possibility for injury.

Persons to Contact in the Event of Any Problems or Queries:

Principle Investigator: Erin Seals Cell: 076 4197699
Supervisor: Dr Ashura Abdul-Rasheed Cell: 0313732094
Institutional Research Ethics administrator Tel: 031 373 2375
Complaints can be reported to the DVC: Research, Innovation and Engagement Prof S Moyo on 031 373 2577 or moyos@dut.ac

Appendix E: Interview Guide

Demographic Data	**Participant number:_____**
Age of participant	
Race of participant	
Sports team representing	
Competitive distance (50m/100m etc.)	
Years of competitive swimming	

Research Question One

Describe your understanding (if any) of the female athlete triad?

Probing Questions:

How did you first come to know about the triad?

Do you know of anybody who has been diagnosed with FAT?

Do you consider body composition to be important to elite female swimmers and why?

Explain how you think emotions effect how a female athlete may eat or train?

Research Question Two

Can you expand/elaborate on what makes an individual at risk for the triad?

Probing Questions:

What conditions do you think are closely associated with FAT?

Explain what you consider to be an appropriate balanced nutritional diet for elite female athletes?

Does missing a period (due to overtraining) raise concerns about your health? Discuss why?

Can you tell me what you consider a regular menstrual cycle to be? What is the average age of menarche?

What is considered to be normal menstrual frequency and duration?

What is your understanding of bone mineral density?

Explain the age range that peak bone mineral density is reached in women?

Do you think there is a correlation between menstruation and bone mineral density? If yes, please elaborate how and why?

Do female swimmers lose weight to meet any specific requirements for the sport? If so, elaborate on why and what methods are commonly used?

Do you think weight directly affects performance? Discuss.

Research Question Three

Describe your management options you used or know of someone that has had FAT used?

Probing Questions:

If you suspected yourself having this condition, explain what your strategy for intervention would include?

Describe your likelihood in coordinating multi-disciplinary health practitioner involvement? If so, who would they include? Are you comfortable with discussing your menstrual irregularities with coaches and/or health practitioners?

Has a coach/ health practitioner ever given you advice and education with regards to appropriate eating habits when training?

Appendix F: Certificate of Proofreading

Helen Bond
IMPELA EDITING SERVICES
impelaediting@gmail.com
079 395 5873

22 November 2021

CERTIFICATE

Erin Seals

erinseals099@gmail.com

Dear Erin

Thank you for using my editing services to proofread your Master's dissertation entitled, *"AN EXPLORATION INTO THE KNOWLEDGE, UNDERSTANDING AND MANAGEMENT OF THE FEMALE ATHLETE TRIAD AND THE TRIAD RISK FACTORS AMONG ELITE SWIMMERS IN KWAZULU-NATAL (KZN)"*.

I have proofread for errors of grammar, punctuation, spelling, syntax and typing mistakes. I have formatted your work and checked the references (this means checking the formatting). I believe your work to be error free.

PLEASE NOTE: Impela Editing accepts no fault if an author makes changes to a document after a certificate has been issued.

Kind regards

Helen Bond (Bachelor of Arts, HDE)

Appendix G: Plagiarism Report