THE RELATIONSHIP BETWEEN QUALITY OF SLEEP AND MOOD STATES AMONG ATHLETES

By

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DECLARATION

I, Nerine Loock, student number 196362620, hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material that to a substantial extent has been accepted for any other degree or diploma of the university or other institutes of higher learning, except where due acknowledgement has been made in the text.

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Nerine Loock **Date**

DEDICATION

I dedicate this research to my loving Ouma Rina, who inspired me to be the best I can be and to never stop chasing my dreams.

And also to my mother Amelia Loock for the sacrifices she has made to enable me to further my education, and for her constant support and encouragement.

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ABSTRACT

Sleep quality is an aspect of sleep on which there is currently a lack of research and, in particular, there is little published data related to the quality of sleep obtained by athletes. Sleep quality is difficult to define because it includes quantitative aspects of sleep such as sleep duration, sleep latency and number of arousals as well as the subjective aspects such as 'depth' and 'restfulness' of sleep. Athletes require more sleep than the non-athlete population in order to recover from their exertions and, although evidence suggests that athletes are concerned about the impact that inadequate sleep has upon performance, there is a paucity of literature examining how poor sleep patterns affect the athletes' psychological states during training and competition. Due to the scarcity of literature examining how the quality of sleep affects the psychological states of athletes, very little research has focused on athletes' sleep and mood within the South African (SA) context.

A quantitative research method with a combination of an exploratory and descriptive approach was employed. The sample of this study comprised of 87 athletes. The researcher made use of a purposive, non-randomized sampling technique. A self-report biographical questionnaire, the Profile of Mood States 2 – Adults (POMS 2), the State-Trait Anxiety Inventory-Adults (STAI-A) and the Pittsburgh Sleep Quality Index (PSQI) was administered once a week on the same day for the duration of 4 weeks.

Descriptive and inferential statistics, Pearson R correlation and One-sample t-test were used to analyse the data. The researcher obtained the necessary authorisation to conduct the study and followed the ethical rules of conduct. Results indicated that there were certain relationships between the quality of sleep and mood states among athletes such as fatigue-inertia, anxiety (state and trait), depression-dejection, anger-hostility, vigour-activity and confusion-bewilderment. There was sufficient evidence to conclude that there was a significant between-week (week 1 and 2, 2 and 3, 3 and 4) difference in fatigue-inertia and

sleep quality. Apart from differences in fatigue-inertia and sleep quality scores over the four weeks, all other results indicate a constant outcome over the four weeks for mood states and sleep quality. The results also indicated sufficient evidence to conclude that although there was evidence of a relationship between quality of sleep and mood states, it was not possible to make a definitive conclusion regarding whether sleep quality, anxiety, and depression were bi-directionally related.

Despite some of the limitations to the study, the findings were thought to contribute in a valuable way to furthering knowledge regarding the quality of sleep and mood states among athletes. The current data suggest that monitoring athletes' sleep and mood states may be a determining factor for satisfactory performance; therefore, the reasons for poor sleep quality should be identified in order to implement any coping strategies needed.

Keywords: *Sleep quality, mood states, mood and sleep, depression, anxiety*

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CHAPTER 1

INTRODUCTION AND PRIMARY AIMS

This chapter begins with a general orientation to the current study. The influence that inadequate sleep has upon performance is discussed. An outline of the aims of the current study is provided. This chapter concludes with a description of the chapter organisation in the current treatise.

1.1 IMPACT OF INADEQUATE SLEEP ON PERFORMANCE

Although sport is an extremely important part of our modern society, Pratt (2007) indicated that research has identified several implications of sleep deprivation on sport performance. Sleep is seen as a means of energy conservation – a behaviour that enhances survival. According to Rodrigues et al. (2015), sleep is identified by athletes, trainers and coaches as an important aspect of the post-exercise recovery process and is a critical factor for optimal physical and mental performance.

According to Lee and Lin (2007), maintaining and improving sleep quality is an important clinical issue in modern life and studies have reported a high prevalence of sleep problems and sleep-related disturbances among young adults. To date, sleep quality is an under-researched area of sleep (Onofrio, 2012) with little published data related to the quality of sleep obtained by athletes (Halson, 2013). Buyse, Reynolds, Monk, Berman and Kupfer (1988) indicated that sleep quality varies among individuals.

Athletes require more sleep than the non-athletic population to aid their recovery and, while a lack of sleep may be caused by stress, it is also a source of stress (McCloughan & Anderson, 2014). According to Rodrigues et al. (2015), trait anxiety is a characteristic of an individual's personality, and is an endogenous factor that may affect the temporal expression of the pattern of sleep-wake cycle. Conversely, an irregular pattern of sleep-wake cycle may

also be affected by exogenous factors, which appears to contribute to an increased state of anxiety (Rodrigues et al., 2015). Pratt (2007) further indicated that by developing a sleep debt, athletes will put themselves in a position where their circadian rhythm is disrupted. The implication of a disrupted circadian rhythm will be that athletes will not be able to perform at their optimal level due to a lack of sleep. Pratt (2007) further stated that disrupted circadian rhythms lead to increasing sleep debt or sleep loss that can cause those individuals who are sleep deprived to be fatigued. Pratt further stated that fatigue has several negative effects on performance including a decrease in motivation and impaired memory recall.

The relationship between sleep and post-exercise recovery and performance in athletes has recently become a topic of interest as the significance in the relationship between critical sleep factors and cognitive processes has increased (Samuels, 2008). Therefore, the analysis of sleep behaviour and the concomitant existence of the psychobiological aspects of anxiety, mood state and depression may provide useful information regarding the athletes' level of preparation (Rodrigues et al., 2015).

According to Chennaoui et al. (2016), sport performances have been shown to be dependent upon the quality of sleep experienced before a competition. The aim of the study done by Chennaoui, et al. (2016), was to evaluate stress markers, mood state, and sleep indicators in high-level swimmers during a major 7-day competition according to the outcomes. Their results indicated that the stress of the competition could trigger a negative mood profile and sleep disturbance which correspond with different responses of biomarkers related to the hypothalamo-pituitary-adrenal axis and the sympathetic nervous system activity.

Although evidence suggests that athletes are concerned about the impact that inadequate sleep has upon performance, there is a scarcity within the literature examining how this behaviour affects their psychological states during training and competition

(Lastella, Lovell & Sargent, 2014). According to Lee and Lin (2007), several studies have reported associations between sleep-related disturbances and poor academic performance or shuttle-run performance in adolescents. Furthermore, according to Hicks and Pellegrini (1991), these disturbances were found to be related to emotional and behavioural problems, as well as being a potential predictor of depression and stress later in life.

Sleep deprivation is a factor that is inadequately considered in literature, but one that could influence the strength of anxiety-performance relationships (Vardar et al., 2007). Gunnarsdóttir (2014) indicated that poor subjective quality of sleep resulted in increased symptoms of depression and anxiety among adolescents. Buyse, Reynolds, Monk, Berman and Kupfer (1988) indicated that sleep quality complaints are particularly relevant to psychiatry. Consistent with previous studies, Eller, Aluoja, Vasar and Veldi (2006), indicated that poor sleep quality was associated with depression, which in turn was significantly associated with sleep complaints. According to Xu, Su, Zoe, Chen and Wu (2012) a high degree of depression and anxiety were found to be the influencing factors of poor sleep among Chinese adolescents.

Wolfson (2010) stated that adolescents and young adults (ages: 12-25 years) have been identified as a population at high risk for developing sleep problems. According to Venter (2012), many athletes from the above mentioned age group compete in sport at various levels in South Africa; little sleep research has focused on athletes within the South African context. In her review article which provided insights into the role of sleep in physiological growth and repair, neuro-muscular performance, cognitive functioning and memory, emotional well-being, and immune function, Venter (2012), stated that although sleep has been identified as an important aspect of the recovery process and critical for optimal performance, most studies on sleep interventions have not focused on athletes, but non-athletes. More objective research

is needed to directly measure sleep and performance (Lee & Lin, 2007) as there is a lack of regular baseline and in-season objective sleep and performance data (Onofrio, 2012).

Galante (2011) investigated subjective and objective sleepiness, performance and mood in patients with obstructive sleep apnoea and shift-workers, and indicated that it is important to look at subjective sleepiness and mood. Galante further stated that constant sleep disruption results in wide ranging negative consequences in sleepiness and mood. According to McCloughan and Anderson (2014), despite the banning, restrictions and warnings on the use of sedatives, attention must be given to providing athletes with guidance on proper sleep hygiene as it is an important component for optimal performance. Improved sleep screening and case detection is necessary to address the concerns of athletes regarding sleep issues (Pratt, 2007; Samuels, 2008).

Sleep is identified by athletes, trainers and coaches as an important aspect of the post-exercise recovery process and is a critical factor for optimal physical and mental performance. Because of these factors, it is extremely important to assess each athlete's total sleep time requirement, the presence of disturbances/sleep fragmentation and the sleep quality (Rodrigues et al., 2015). Athletes should be educated regarding the role of sleep in performance and recovery. Venter (2012) indicated that the reasons for poor sleep quality must be identified and coping strategies must be implemented. Athletes need to be encouraged to engage with psychological services to assist in the management of anxiety and to learn to cope effectively with the stress of the competition environment (McCloughan & Anderson, 2014). According to Juliff, Halson and Peiffer (2014), there is a need for individual monitoring of athletes' sleep habits and the need for increased sleep hygiene education within both individual and team sports.

The researcher focused mainly on depression and anxiety as examples of mood states for the purpose of this study. Chapter Two provides a more detailed overview of the literature on sleep, quality of sleep and mood states, especially anxiety and depression, among athletes.

1.2 THEORETICAL FRAMEWORK

Sleep provides an opportunity for the body to physically and psychologically recover from the day's energy expenditure or activities, as well as for the mind to store memories of tasks that were learned that day (Venter, 2012). In a study conducted by Birge (2014), sleep was seen as important for organizing and implanting new memories, therefore, when the brain is able to organize newly formed memories, it makes recall and accuracy better for the next waking period, as well as improving judgment and problem solving abilities. When sleep quality and quantity are within recommended ranges this ability to process new information promotes an increase in academic performance (Birge, 2014). According to Heuchert and McNair (2012), theorists and researchers have described the construct of emotion as a hierarchical structure with trait affectivity at the top, mood in the middle and emotions at the bottom. Rottenberg (2005) indicated that emotion theorists have posited that moods facilitate emotional reactions when the mood and the emotion are similar in nature (mood-facilitation hypothesis). Three theories are proposed to discuss and to explain the reasons why we sleep, namely the associate network theory of memory and emotion, the restoration theory and the evolutionary theory. The theoretical framework is discussed in more detail in Chapter Three.

1.3 AIMS

The aim of this study was to investigate the relationship between the quality of sleep and mood states among athletes. Specific objectives of the study were to explore and describe the quality of sleep and mood states, the relationship between the quality of sleep and mood

states, and the individual differences between the quality of sleep and mood states among athletes over a period of a month of observation. To achieve these objectives, the participants were required to personally rate the Pittsburgh Sleep Quality Index (PSQI) once a week on the same day for the duration of one month. The Profile of Mood States-2 (POMS) and the State-Trait Anxiety Inventory (STAI) were administered once a week on the same day for the duration of one month. Data from the PSQI, POMS and STAI were used to explore and describe the quality of sleep and mood states, the relationship between the quality of sleep and mood states, and the individual differences between the quality of sleep and mood states among athletes over a period of one month of observation. The aims of the study and the different data analyses for each objective are discussed in more detail in Chapter Four.

1.4 RESEARCH METHODOLOGY

A quantitative research method in combination with exploratory, descriptive approaches was employed. The researcher made use of a purposive, non-random sampling technique. Self-report questionnaires were administered once a week on the same day for the duration of one month. Each objective was analysed using different data analysis techniques. Ethical rules of conduct for practitioners registered under the Health Professions Act were implemented during this study (Health Professions Act, 1974, Act no.56 of 1974). Research methodology and ethics are discussed in more detail in Chapter Four.

1.5 RESULTS AND CONCLUSIONS

The results of the statistical analyses described in Chapter Four are reported and discussed. Statistical analyses focused on information extracted from the self-report biographical questionnaire, the Profile of Mood States 2 – Adults (POMS 2), the State-Trait Anxiety Inventory-Adults (STAI-A) and the Pittsburgh Sleep Quality Index (PSQI). The three aims outlined in chapter one guide the presentation and discussion of the results. The

final chapter of the present study reviews the conclusions of the study. This is followed by a discussion of the practical implications of the current research, limitations experienced and, finally, recommendations for future research. The results of the current study and the conclusions reached, implications and limitations of the research are presented in more detail in Chapters Five and Chapter Six.

1.6 TREATISE OUTLINE

Chapter Two provides an overview of the literature on Sleep, Quality of Sleep and Mood States among athletes. The concepts of quality of sleep and mood states are defined and information relating to the physiology of sleep and mood states and sleep is presented and discussed. Chapter Three explores the theoretical framework including theories of sleep and mood states. Chapter Four delineates the methodological considerations taken to develop and conduct this research study. Chapter Five reports and discusses the results of the current study. The conclusions reached, implications and limitations of the research are then presented in Chapter Six.

CHAPTER 2

SLEEP, QUALITY OF SLEEP AND MOOD STATES AMONG ATHLETES

This chapter begins with a general overview of the literature on sleep, quality of sleep and mood states among athletes. The concepts of quality of sleep and mood states are defined. Information relating to the physiology of sleep and of mood states and sleep is presented and discussed. The researcher focuses on depression and anxiety as examples of mood states for the purpose of this study.

2.1 SLEEP

Sleep is a basic human need. According to Carskadon and Dement (2011), sleep is a reversible behavioural state of perceptual disengagement from and unresponsiveness to the environment. Venter (2012) indicated that sleep is defined as the natural and regular state of inactivity in which consciousness ceases and the bodily functions slow down. Shittu et al. (2014) suggested that sleep is a vital reparative, restorative and physiological phenomenon, and that impaired sleep has a significant negative impact on health.

According to Birge (2014), sleep is a complicated process that has been defined in many different ways. Birge, (2014) defined sleep as a dynamic behaviour that is more than "the absence of waking, sleep is a special activity of the brain, controlled by elaborate and precise mechanisms" (p.4). Therefore, according to Birge, sleep is "not simply a state of rest, sleep has its own specific, positive functions" (p.4).

Halson (2013) indicated that sleep is essential for athletes, in order for them to prepare for and recover from training and competition and that sleep disturbances in athletes can occur both during training and following competition. Ikegami et al. (2009) stated that a lack of sleep negatively affects several cognitive functions therefore the more complex the task to be performed, the greater the impact of a lack of sleep. According to Rosekind (2008) and

Van Dongen and Dinges (2005) this effect is also observed in simple and monotonous tasks involving low environmental stimulation. We can therefore hypothesise that for athletes a lack of sleep is likely to interfere with the learning of techniques, as this generally requires frequent repetition of tasks involving precise movements combined with a high attention level to stabilise them. Lack of sleep can also affect the proprioceptive capacity and thus significantly increase the risk of injuries, such as sprains (Ivins, 2006).

2.2 PHYSIOLOGY OF SLEEP

According to Davenne (2009), athletic performances are highly dependent on one of the main biological rhythms namely the sleep-wakefulness circadian cycle. Galante (2011) identified two types of sleep, namely non-rapid eye movement (NREM) sleep and rapid eye movement (REM) sleep. According to Phillips and Gelula (2006), NREM sleep is characterized by a reduction in physiological activity and, as the sleep state deepens, the brain waves become slower.

Phillips and Gelula (2006) indicated that the NREM sleep phase consists of four stages namely: Stage 1 (drowsiness), Stage 2 (light sleep), Stages 3 and 4 (slow wave sleep). A short explanation of each phase according to the National Sleep Foundation (2006) follows:

- Stage 1: the transition from being awake to falling asleep;
- Stage 2: the period during which eye movements stop;
- Stages 3 and 4: sleep is deeper, with no eye movement and decreased muscle activity and it is most difficult to wake during this phase.

In contrast, the REM sleep phase is an active period of sleep marked by intense brain activity (Phillips & Gelula, 2006). Insufficient sleep quantity and poor sleep quality is defined as short sleep duration, long sleep latency and low sleep efficiency (Lemola et al., 2011). It is important to have the right balance between NREM and REM sleep, as it is

important for obtaining restful, restorative sleep and for promoting processes such as mood (National Sleep Foundation, 2006).

Birge (2014) indicated that sleep has numerous important benefits:

- sleep provides an opportunity for the body to recover physically and psychologically;
- the brain uses sleep to learn tasks that have been practiced during the day;
- sleep is important for organizing and implanting new memories; and
- increasing sleep has been shown to cause a measureable increase in performance.

Different stages of the cycle serve different restorative purposes, so the amount of time spent in each stage during each consecutive sleep cycle differs as the night progresses (table 2.1).

Table 2.1 Stages of sleep (http://sleepfoundation.org/how-sleep-works/what-happens-when-you-sleep)

Stages	When	What	Benefits
REM	After the ascension from NREM3	* Brain is active and dreams occur * Eyes dart back and forth * Body becomes immobile and relaxed, as muscles are turned off	* Provides energy to brain and body * Supports daytime performance
NREM 1	Occurs first	Light sleep	Nothing
NREM 2	Between phase of NREM 1 and 3	* Becoming disengaged from surroundings * Breathing and heart rate are regular * Body temperature drops (so sleeping in a cool room is helpful)	Nothing
NREM 3 & 4	The bottom of the sleep phase	* Deepest and most restorative stage of sleep * Blood pressure drops * Breathing becomes slower * Muscles are relaxed * Blood supply to muscles increases	* Tissue growth and repair occurs * Energy is restored * Hormones are released, such as: Growth hormone, essential for growth and development, including muscle development

2.3 QUALITY OF SLEEP

Guilleminault and Brooks (2001) indicated that sleep is a vital reparative, restorative and physiological phenomenon, and impaired sleep has a significant negative impact on health. Shittu et al. (2014) described the quality of sleep as a measure of both the quantitative and qualitative components of sleep, where the quantitative component involves the duration of sleep and the qualitative component is a subjective measure of the depth and feeling of restfulness upon awakening.

The perception of sleep quality is complex and is associated with various subjective factors such as fatigue, work stress or other emotional factors (Chien et al., 2013). Buyse, Reynolds, Monk, Berman and Kupher, (1988) stated that sleep quality is difficult to define because it includes quantitative aspects of sleep such as sleep duration, sleep latency, and number of arousals as well as the subjective aspects such as depth and restfulness of sleep. Sargent, Latsella, Halson and Roach (2014) defined the critical variables as follows:

Time in bed (h:min): The period between going to bed and getting up

Sleep onset (h:min): The time at which a participant first fell asleep after going to bed

Sleep offset (h:min): The time at which a participant last woke before getting up

Sleep period (h:min): The period between sleep onset and sleep offset

Total sleep time (h:min): The amount of sleep obtained during a sleep period

Daytime nap time (h:min): The amount of sleep obtained during a daytime nap

Cumulative sleep time (h:min): The sum of total sleep times for a single night's sleep and any naps on the following day

Sleep efficiency (%): Total sleep time expressed as a percentage of the sleep period

According to Samuels (2008), non-restorative sleep is the descriptor used to account for the fact that while some people get adequate hours of sleep, the quality of sleep is inadequate. Samuels (2008) stated that sleep quality is disturbed by sleep fragmentation as a result of

recurrent arousal throughout the sleep period without full awakening, or light sleep as a result of a hyper-aroused state with recurrent awakening throughout the sleep period.

According to Lemola et al. (2011), insufficient sleep quantity is associated with shorter sleep duration. The following variables as discussed by Onforio (2012) play an important role in sleep quantity: Sleep Onset Latency (the length of time an individual takes to fall asleep after going to bed, measured by immobility), Total Sleep Time (the amount of time spent sleeping during the sleep interval from bedtime to wake up), Wake after sleep onset (time spent awake after falling asleep until the final awakening) and Sleep Efficiency (percentage representing how well an individual slept from sleep onset until final awakening). Yarmohammadi, Amirsardari, Akbazadeh, Sepidarkish and Hashemian (2014), stated that there is a significant relationship between sleep quality and total sleep time at night.

According to Chennaoui et al. (2016), sport performances have been shown to be dependent upon both the quality and quantity of sleep taken place before a competition. Halson (2013) indicated that confusion, vigour, fatigue and total mood disturbance were all negatively affected by sleep deprivation. According to Halson (2013), mood significantly improved with increased vigour and decreased fatigue when sleep was extended. Sexton-Radek, Hernandez and Pauley (2013) indicated that the amount of sleep was found to be influential to recovery. According to Sexton-Radek, Hernandez and Pauley (2013), a substantial difference was found between the sleep efficiency scores in season and out of season.

2.4 MOOD STATES

The psychology of mood and its relationship with athletic performance has received extensive research attention over the past twenty-five years (Terry, 1995). Recall of mood is proposed to be influenced by one's mood at the time of recall (Bower, 1981) and research has found that a depressed mood is associated with a tendency to draw information from memory

that is negative, and therefore recall situations where performance was poor (Bower, 1981). Moods can greatly affect an athlete's preparation, competition, and post-contest feelings and, according to Corsini (2002), the construct of mood is broadly defined as a mild, albeit transient emotional state. Lane and Terry (2000) define mood as "a set of feelings, ephemeral in nature, varying in intensity and duration, and usually involving more than one emotion" (p. 16). Mood state refers to "a situation specific, somewhat transient, psychological response to an environmental stimulus" (Cox, 2002, p.178).

Stirling and Gretchen (2006) described mood states as illustrations of a process in which an individual attempts to adapt to environmental demands. Murray (1998) defined a mood state as a temporary emotional state that fluctuates depending upon [external] circumstances such as weather and physical activity, while others are internal, such as our appraisal of events. A growing body of medical evidence links inadequate sleep with anger, anxiety and sadness (National Sleep Foundation, 2006). Venter (2012) indicated that poor sleep quality was associated with significantly higher self-reported negative moods. It was further stated by Venter (2012) that symptoms such as increased levels of depression, stress and anxiety and diminished vigour were reported in association with poor sleep quality.

Alvaro, Roberts and Harris (2013) indicated in their study that recent studies have established high comorbidity rates between sleep disturbances, and depression and anxiety rates. Longitudinal associations have also been established between sleep disturbances, anxiety, and depression (Alvaro, Roberts & Harris, 2013). Fullagar et al. (2014) stated that when sleep is reduced, heightened levels of depression and confusion, decreases in vigour and poorer overall mood states have been reported.

Terry (1995) stated that the link between mood and sport performance has a strong intuitive appeal for both athletes and researchers. It is therefore not uncommon for athletes to attribute poor performance to their failure to "get in the right mood." Early research on mood

states among athletes has shown that athletes exhibit a mood state profile that is higher in vigour and lower in the negative mood states of tension, depression, anger, fatigue and confusion than the average individual (Morgan, 1979). Therefore a positive mood, which has states of high arousal and high pleasure, has been linked to a range of performance-related behaviours and a negative mood such as displeasure or lethargy (low arousal) has a negative association with performance and possibly inhibits full function of the athlete (Terry, 1995; Morgan, 1979).

This 'iceberg profile', as coined by Morgan (1979) is shown in figure 1. The mean of the scores showed a profile known as an iceberg. This is evidenced by the higher score on the vigour subscale in relation to the other subscales.

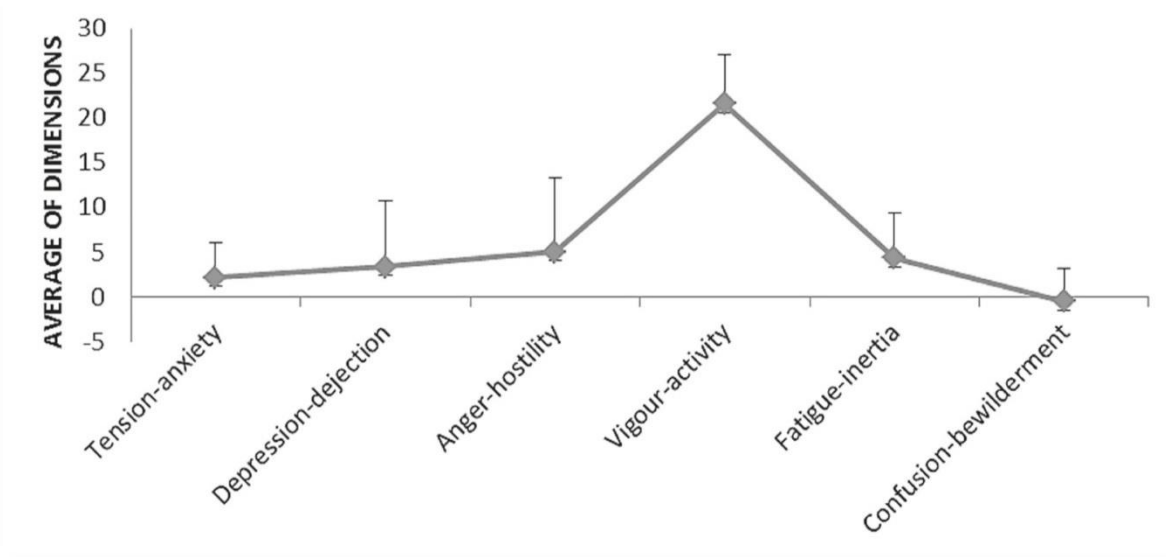

Figure 1: Iceberg profile of mood states

The Profile of Mood States (POMS), (Morgan, 1979), measures six mood states namely: anger-hostility, confusion-bewilderment, depression-dejection, fatigue-inertia, tension-anxiety and vigour-activity. Heuchert and McNair (2012) define the mood subscales as follow:

- *Anger-hostility:* A state of anger and antipathy towards others. Ruiz and Hanin (2004) defined anger as "an emotional state that consists of feelings that vary in intensity, from mild irritation or annoyance to fury and rage," hostility as "a complex set of attitudes that motivate aggressive behaviour", and aggression as "destructive behaviour directed towards other persons or objects" (p.76). Van Mechelen and Hennes (2009) found that anger was elicited in situations appraised as frustrating and that involved another person who was accountable and had a hostile intention.
- *Confusion-bewilderment*: Bewilderment and cognitive inefficiency which represents a self-report dimension of cognitive efficiency that could reflect anxiety or related states.
- *Depression-dejection*: Mood of depression accompanied by a sense of personal inadequacy.
- *Fatigue-inertia:* A mood of weariness, inertia and low energy. A wise athlete can discriminate the expected fatigue associated with the training session from the chronic fatigue that has a subtler underlying character and lingers on for longer than expected after the training session (Noakes, 2001). Changes in mood states, assessed by means of the POMS, have been shown in studies in which performance decrements occurred, supporting the use of the POMS scores as an early indicator of overtraining (Uusitalo, 2001). Filaire, Bernain, Sagnol, and Lac (2001) found that soccer players' moods improved with an increase in winning performances despite an increase in the intensity of training. Furthermore, they also observed an increase in depression and tension during a period of poor performance, where relationships between players and coach, financial and family problems, and levels of fatigue appeared to be unchanged.

- *Tension-anxiety:* Adjectives describing heightened musculoskeletal tension.
- *Vigour-activity*: Adjectives painting a mood of vigorousness and high energy.

The researcher focuses mainly on depression and anxiety as examples of mood states for the purpose of this study.

In their study with Brazilian Paralympic athletes, Rodrigues et al. (2015) indicated that the POMS results showed a lower total mood disturbance and a profile known as iceberg, where the vigour dimension appeared more evident than the other dimensions, suggesting no significant presence of mood disorders. Therefore, athletes who show positive mood states (high vigour associated with low levels of fatigue, anger, tension, depression and confusion) may have the best athletic performance.

According to Lane and Terry (1998), depression is believed to be the most important mood dimension, influencing the intensity of mood responses, the interrelationships among other mood dimensions, and moderating mood and performance relationships for anger and tension. Lane and Terry (1998) made the following conclusions with regard to the mood state effects of a depressed mood on:

- Tension: If tension increases above an optimum level for the task and/or the individual, performance-relevant cues are missed and performance declines as a result.
- Anger: Depressed mood influences the intensity of anger responses via the following process: depressed mood reduces perceived ability which in turn makes perceived goal attainment less likely. Therefore, if goal attainment is considered important the perceived inability to reach the goal leads to frustration, which leads to anger.
- Fatigue: Fatigue appears to be generally debilitative of performance regardless of the presence or absence of depressed mood.

- Confusion: Confusion is proposed to be debilitative of performance regardless of depressed mood, due primarily to attentional inefficiencies and poor information processing.
- Vigour: Although the vigour-performance relationship is not affected, depressed mood is proposed to reduce the intensity of vigour.

2.5 DEPRESSION

There are biological (e.g., genetics), psychological (e.g., cognitive deficits) and social (e.g., conflicts) influences to be assumed as factors causing the incidence of a depressive disorder (Frank, Nixdorf & Backmann, 2015). A common feature of the depressive disorders is the presence of sad, empty or irritable moods, accompanied by somatic and cognitive changes that significantly affect an individual's capacity to function (American Psychiatric Association, 2013). Sadock, Sadock and Ruiz (2015) defined depression as a mental state characterized by feelings of sadness, loneliness, despair and low self-esteem. According to the National Institute of Mental Health (NIMH), everyone occasionally feels blue or sad, but these feelings are usually short-lived and pass within a couple of days. Depression interferes with daily life and causes pain for both the sufferer and those who care about him or her. Nolen-Hoeksema (2014) indicated that sadness and a downturn in mood are symptoms that most people have experienced, and can be normal reactions to trauma or difficulties in life. The main difference between normal downturn in mood and depression is the severity of the symptoms, duration, and the gravity of impairment that depression can have on a person's daily functioning (Nolen-Hoeksema, 2014).

Wolanin, Gross and Hong (2015) stated that empirical studies indicate that athletes are just as likely to experience depression as the general population. According to Wolanin, Gross and Hong (2015), athletes may be prone to experience depressive symptoms when they face declines in their athletic performance. In a study by Hammond, Gialloreto, Kubas and

Davis (2013), the results illustrated that some high-performing athletes actually may be more susceptible to depression when faced with performance outcomes that are below expectation. According to Frank, Nixdorf and Backmann (2015), it is argued, that athletes are highly vulnerable for developing depressive symptoms due to their outstanding position in society, and the tremendous pressure and levels of stress they experience. Scott, McNaughton and Polman (2006) found that a depressed mood resulted in reduced vigour and increases in all other mood state variables such as anxiety.

2.6 ANXIETY

Fear plays an important role in human nature and according to Nolen-Hoeksema (2014), when a person faces a threat the body reacts to it with a physical and psychological response that helps the person to fight the threat or flee from it, often referred to as the fight or flight response. Normally the fear disappears as soon as the threat is gone, however, fear can turn into anxiety if the fear is unrealistic, excessive and persists long after the threat has gone (Nolen-Hoeksema, 2014). Anxiety disorders include disorders that share features of excessive fear and anxiety and related behavioural disturbances (APA, 2013). Sadock, Sadock and Ruiz (2015) defined anxiety as a feeling of apprehension caused by the anticipation of danger, which may be internal or external. According to the NIMH, anxiety is a normal reaction to stress and can actually be beneficial in some situations. For some people, however, anxiety can become excessive. While the sufferer may realize that his or her anxiety is extreme, he/she may have difficulty controlling it and it may negatively affect the day-to-day living.

Juliff, Halson and Peiffer (2014) indicated that internal factors such as nervousness about competition were the most common reasons for sleep problems among athletes. These athletes reported experiencing anxiety prior to competition. According to Lastella, Lovell and Sargent (2014), anxiety was the most common reason cited for sleep problems by athletes.

Frank, Nixdorf and Backmann (2015), stated that the tremendous psychological stress athletes are exposed to on a daily basis was frequently reported. They further indicated that different stressors range from exercise-based and competition-based stressors (e.g. loss of a competition, cost and effort of the exercise) to everyday stressors. According to Juliff, Halson and Peiffer (2014), individual sport athletes are similar to team sport athletes in their reported occurrence of sleep complaints prior to major competitions. Silva et al. (2010) indicated that an increased stress and anxiety level can trigger insomnia and reduce the total sleeping period, which adversely affects the process of recovery and recuperation for athletes. According to Fietze et al. (2009), stress was one of the factors that may significantly influence the sleep of ballet dancers.

According to McCloughan and Anderson (2014) state anxiety is a transitory condition involving feelings of fear, whereas trait anxiety is considered a personality characteristic indicative of the predisposition to respond to stressors. McCloughan and Anderson (2014) indicated that state and trait anxiety were significantly correlated with sleep onset latency and number of awakenings during the night. According to Rodrigues et al. (2015), trait anxiety is a characteristic of an individual's personality, that is, it is an endogenous factor that may affect the temporal expression of the pattern of sleep-wake cycle. Conversely, an irregular pattern of sleep-wake cycle may be affected by exogenous factors, which apparently contribute to an increased state of anxiety. According to Spielberger (1983), trait anxiety reflects the personality of the individual. People with high trait anxiety show signs of stress and anxiety in many situations, and they are more likely than people with low trait anxiety to notice information related to threats (Spielberger, 1983). State anxiety is the individual's perception of the changes in cognitive and somatic anxiety in a specific situation (Spielberger, 1983).

Kajimura et al. (1998) indicated that anxiety seems to be one of the most important factors influencing sleep parameters and causing sleep disturbances in human subjects. According to a study by Kajimura et al. (1998), there is a difference in sleep patterns between individuals with low- and high- anxiety traits.

2.7 MOOD AND SLEEP

Anxiety and depressive symptoms are often accompanied by sleep disturbances. Armitage (2007) indicated that sleep is typically disrupted in depressed subjects, with an abnormal amount and/or an abnormal distribution of rapid-eye movement (REM) sleep and non-REM sleep, with older individuals being more likely to suffer from middle or late insomnia and younger ones from hypersomnia. Research indicates that sleep serves a mood regulatory function and that mood is significantly altered after partial sleep deprivation (Galante, 2011). According to Galante - research reveals a relationship between the amount of time spent in REM sleep and the Profile of Mood States (POMS) scale of fatigue. Scott, McNaughton and Polman (2006) indicated that periods without sleep have been demonstrated to have a significant adverse effect on subjective mood. They also found significant correlations between self-reported mood and performance, suggesting that mood-state may be a useful predictor of performance.

In their study with fatigued aviators, Caldwell and LeDuc (1998) reported significant decreases in mood as measured by the Profile of Mood States (POMS) after a 48 hours' sleep deprivation. It was further found that vigour was reduced after 20 hour sleep deprivation. Galante (2011) indicated that tension, fatigue and confusion increased after 24 hours of sleep loss, thus indicating that sleep serves a mood regulatory function. In a study conducted by Scott, McNaughton and Polman (2006), tension and anger were unaffected by sleep loss, whereas vigour, fatigue and depression were more affected due to sleep deprivation.

According to Sargent, Latsella, Halson and Roach (2014), athletes report poorer mood and higher levels of fatigue when sleep is restricted. According to Lastella, Lovell and Sargent (2014), athletes who reported reduced quality of sleep the night prior to competition reported being more fatigued, more tense and less vigorous on the morning of the competition, thus, sleep would have an indirect effect on performance via mood states.

Meney, Waterhouse, Atkinson, Reilly and Davenne (1998) indicated that a lack of sleep causes bad humour, irritability, mental fatigue and loss of motivation. According to Waterhouse, Atkinson, Edwards and Reilly (2007), disturbance of the sleep cycle, triggered for example by going to bed late, leads to greater drowsiness and has effects on the emotional make-up. According to Steiger and Kimura (2010), sleep impairment has been claimed as a prodromal symptom of depression, and some sleep abnormalities are considered as specific markers for MDD, such as impairment in sleep continuity, a lack of inhibition of REM sleep, and reduction in slow-wave sleep (SWS). Athletes who lack sleep generally report a greater level of fatigue and an increased feeling of confusion, which coincides with a drop in performance (Bonnet, 1980; Reilly & Pierce, 1994) and in pain tolerance (Onen, Alloui , Gross , Eschallier & Dubray, 2001). In an investigation into the relationship between state (transitory condition involving feelings of fear) and trait (personality characteristic indicative of the response to stressors) anxiety and sleep; trait and state anxiety were significantly correlated with sleep onset latency and the number of awakenings during the night (McCloughan & Anderson, 2014). Kajimura et al. (1998) indicated that there is a difference in sleep patterns between those individuals with low and high-anxiety traits.

According to McCloughan and Anderson (2014), athletes experience worry about the effects of the loss of sleep pre-competition and consistently self-report poor pre-performance sleep, despite objective sleep measurements. Sargent, Latsella, Halson and Roach, (2014) describe anxiety as the most common reason why athletes experience disrupted sleep prior to

competition. Increased stress and anxiety can reduce the total sleeping period (Silva et al., 2010).

Athletes report lower mood status and higher levels of fatigue when sleep is restricted (Sargent et al., 2014). According to Vardar et al. (2007), sleep deprivation can result in increased anxiety, depressed mood, anger, tension, frustration and irritability. Davenne (2009) indicated that maintaining healthy sleep habits can promote optimal performance by athletes. She also stated that sleep deprivation causes a decrease in performance. Pilcher and Huffcutt (1996) indicated that when sleep quality or duration (or combinations of the two) becomes compromised, there can be a significant detrimental impact on human functioning and mood state. They further suggested that relatively short periods of intensified training, similar to a training camp, can result in significant disruptions in sleep quality and mood state.

2.8 CHAPTER SUMMARY

The chapter provided a general overview of the literature on sleep, quality of sleep and mood states among athletes. Lastella, Lovell and Sargent (2014) indicated a link between the quality of sleep and the athlete's mood on the day of competition. As discussed briefly in this chapter, previous research indicated that there is growing evidence to suggest that athletes do not obtain sufficient sleep. Samuels (2008) indicated that sleep quality is disturbed as a result of recurrent arousal throughout the sleep period, without full awakening as a result of a hyper-aroused state. Therefore, brief arousal and full awakening during the sleep period negatively impacts sleep quality.

Mood is strongly affected by sleep deprivation and poor sleep quality is associated with higher self-reported negative moods (Venter, 2012). Halson (2013) stated that the mood state, as assessed by the POMS, was negatively affected by sleep deprivation while an increase in

the amount of sleep an athlete receives may enhance performance. Chapter Three explores the theoretical frameworks relating to theories of sleep and mood states.

CHAPTER 3

THEORIES OF SLEEP AND MOOD STATES

This chapter explores the theoretical framework of sleep and mood state theories. Three theories are discussed and used to explain the reasons why we sleep and why attention to mood states is important. These theories are the associate network theory of memory and emotion, the restoration theory and the evolutionary theory.

According to Heuchert and McNair (2012), theorists and researchers have described the construct of emotion as a hierarchical structure with trait affectivity at the top, mood in the middle and emotions at the bottom. Heuchert and McNair (2012) state that affective traits are conceptualized as components of personality (predispositions to respond emotionally in a certain way), moods have effects on thoughts and behaviour and moods impact emotions (observed and can be characterised as brief and intense psychophysiological reactions to specific occurrences). Rottenberg (2005) indicated that emotion theorists have posited that moods facilitate emotional reactions when the mood and the emotion are similar in nature (mood-facilitation hypothesis). According to Rottenberg (2005), considerable evidence for mood facilitation exists, particularly for anxiety, and most characterizations of anxiety disorders refer to the prevailing anxious mood and to strong emotional reactions to mood-relevant stimuli.

3.1 ASSOCIATE NETWORK THEORY OF MEMORY AND EMOTION

According to Bower (1981), human memory can be modelled in terms of an associative network of semantic concepts and schemata that are used to describe events. Sowa (1987) defined a semantic network as a network that represents semantic relations between concepts and therefore is often used as a form of knowledge representation. Bower (1981) stated that

an event is represented in memory by a cluster of descriptive propositions. Bower (1981) proposed a theory concerned with the relationship between mood and memory.

According to Eysenck (1992), this theoretical approach states that long-term memory can be regarded as a semantic associative network in which concepts are represented as nodes. Bower's theory (1981) indicates that emotions are also represented as nodes within the semantic network, thus, the semantic network theory explains that our brain forms new memories by connecting their meaning and context with meanings already in our memory. The basic unit of thought is the proposition; the basic process of thought is activation of a proposition and its concepts (Bower, 1981). According to Bower (1981), the semantic-network approach supposes that each distinct emotion such as joy, depression or fear has a specific unit in memory that brings together many other aspects of the emotion that are connected to it by associative pointers. Therefore, collected around this emotion unit are its associated autonomic reactions and expressive behaviours. Bower (1981) further stated that some of these various linkages are innate, while others are learned and elaborated throughout acculturation; each emotion unit is linked with propositions describing events from one's life during which that emotion was aroused. These emotion units can be activated by many stimuli and when activated above a threshold, the emotion unit transmits excitation to those units that produce the pattern of autonomic arousal and expressive behaviour commonly assigned to that emotion (Bower, 1981).

Eysenck (1992) indicated that when any node, whether an emotion node or not, is activated by external or internal stimuli, activation from that node spreads to other nodes. Therefore, when an athlete is in an emotional state (anxious or depressed), the node for the particular emotion is activated and spreads to associate nodes. The associated nodes will contain information that is congruent in mood with the experienced emotion, thus concepts

such as failure, tiredness and fear would become activated when an athlete feels depressed or anxious.

According to Heuchert and McNair (2012), an individual is thus prepared through his/her experience and the formation of associative networks to manage emotions in different situations. As can be seen from figure 2, the Network theory model attempts to explain the effects of mood congruent memory and mood dependent memory in emotion and memory.

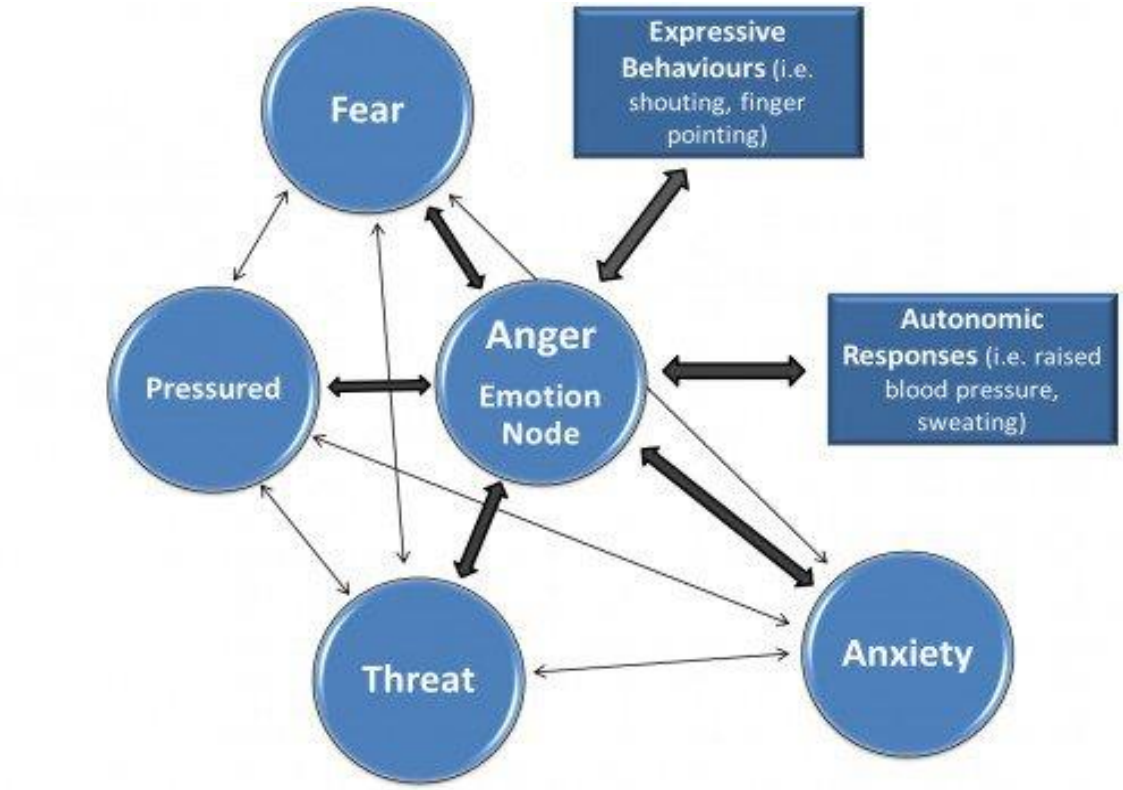

Figure 2: Explanation of Bower's network theory (Bower, 1981)

According to Bower (1981) mood congruent memory (MCM) can only occur if there is a match between the emotional stimulus being remembered and the mood state of the individual at the time of remembering, therefore there is a match between the mood state at encoding and the stimulus being encoded. Bower, (1981) further stated that mood dependent memory (MDM) is solely focused on the effect of mood on recall. It is not concerned with the material actually being recalled, therefore, there is a match between mood state at encoding and mood state at retrieval.

3.1.1 Criticisms of the associate network theory

According to Eysenck (1992) the associate network theory over-simplifies the following aspects:

- Moods or emotions and cognitive concepts are both represented as nodes in the semantic network and treated in a similar way. As stated by Eysenck (1992), moods and cognitions are very different from each other.
- Over-simplifies mood-congruent effects.
- Nodes in Bower's (1981) semantic network represent words and not schemata or larger meaningful units.

3.1.2 Evidence for the associate network theory

According to Teasdale and Barnard (1993) the following evidence supports the associate network theory as it offers the following:

- A plausible account of mood-state-dependent learning, mood-congruous retrieval, and a range of effects of mood on cognition.
- The theory has been successfully applied to understand a number of aspects of clinical depression.
- The theory has also given useful insights into cognitive vulnerability.

3.2 RESTORATION THEORY

Restoration theory suggests that the function of sleep is to repair and restore the brain and body. The functioning of the brain and body would gradually break down if this did not happen (Sammons, c2005-2009). Eysenck (2004) indicated that some of the important functions of sleep are to save energy and to permit the restoration of tissue. Virk (2010) indicated that the restorative function theory posits that sleep enables the Central Nervous System to promote development, physical growth, healing and general body restoration.

Oswald (1980) suggested that different types of sleep are necessary for restoring and replenishing our body and brain. Rapid Eye Movement (REM) sleep is necessary for brain growth, repair and reorganisation and patterns of brain activity change to allow this to happen. Slow Wave Sleep (SWS) is necessary for bodily growth and repair. During SWS, growth hormone is released, which is important for protein synthesis. Specifically, Oswald (1980) claimed that NREM sleep restores biological processes that have deteriorated during the day and REM sleep replenishes and renews brain processes through the process of protein synthesis.

According to Virk (2010), Oswald's restoration theory suggested that sleep serves the purpose of restoring and replenishing the body, therefore we sleep to recover both physically and psychologically. According to Redshaw and Redshaw (2010), the repair and restoration theory suggests that sleep is important for restoring physiological and cognitive functions and, if disrupted, the function of the brain and body will gradually break down. Horne (1988) extended Oswald's theory. According to Horne (1988), sleep is divided into core sleep (REM and SWS) and optional sleep. Horne (1988) suggested that brain restoration and repair take place during core sleep and bodily restoration occurs during optional sleep, as well as at other times (e.g. during periods of relaxed wakefulness). According to Oswald (1980), the function of sleep is to restore the body during periods of inactivity so that adequate biological functioning is ensured. The tissues of the brain and body are repaired and the chemicals needed for proper functioning are replenished.

The restoration theory makes the following predictions (Horne, 1988; Oswald, 1980):

- During periods when the brain is growing or undergoing reorganisation, there will be an increase in the amount of REM sleep a person experiences.
- Sleep will increase when the body is growing or undergoing repair.

- If a person is deprived of sleep for a significant period, he/she will attempt to catch up on the sleep he/she has lost.
- Sleep deprivation will cause deficits in psychological functioning and have a negative effect on bodily processes.

Virk (2010) indicated that an adult will spend on average of eight hours in sleep and a quarter of the eight hours are spent in Rapid Eye Movement (REM) sleep. Virk's 2010 research indicated that blood flow to the brain was shown to increase during REM sleep, thus providing extra oxygen, glucose and nutrients needed for protein synthesis (building process of proteins). Virk (2010) further indicated that REM sleep has been related to learning and memory.

3.2.1 Criticisms of the restoration theory

According to Virk (2010), sleep deprivation studies have shown that we do not require to make up for lost sleep, but we do need REM sleep. Therefore, according to Bentley (1999), the restoration theory is inconsistent with sleep deprivation studies. Bentley (1999), further stated that some recovery and manufacture of biochemicals take place during the day when an individual is relaxed.

3.2.2 Evidence for the restoration theory

The following evidence supports the restoration theory:

- According to Bentley (1999), blood flow to the brain has been shown to increase during REM sleep; therefore providing extra oxygen, glucose and nutrients for protein synthesis needed for restoration.
- Virk (2010) further indicated in his study that REM sleep has been related to learning and consolidation of memory.

3.3 EVOLUTIONARY THEORY

Evolutionary theories in general suggest that sleep evolved because it allows an organism a greater chance of survival in a hostile environment, therefore, sleep is analysed in terms of the survival advantage (Sammons, c2005-2009). Redshaw and Redshaw (2010) state that the evolutionary theory analyses sleep in terms of survival, especially with animals, where sleep forces animals to conserve energy. This leads us to believe that behaviour present in today's society must have been adapted to maximize reproductive fitness.

The Evolutionary Theory identifies the main function of sleep as that of conserving energy and that humans sleep to preserve themselves (Virk, 2010). According to Webb (1975), sleep helps to conserve energy in a number of ways. These include the fact that during sleep, behavioural activity stops, meaning that less energy is spent on movement, and body temperature and metabolic rate slow down, again, saving energy.

The hibernation theory (Webb, 1975) is one of a number of evolutionary theories of sleep. According to Webb (1975), sleep has evolved because it forces the animal to conserve energy, therefore the characteristic that helps them conserve energy is more likely to be passed on to the next generation. Webb (1975) further indicated that an animal's sleep patterns will be determined by the rate at which it loses heat, what it eats and the availability of food.

Virk (2010) indicated that throughout evolution species have developed sleep patterns that fit in with their way of life and survival. Redshaw and Redshaw (2010) further stated that all cultures and species sleep, and sleep is only influenced by the role of society and the environment in shaping human behaviour. Roeckelein (2006) stated that the evolutionary theory helps to explain differences in sleep patterns across species. According to Eysenck (2004), sleep is an adaptive behaviour favoured by evolution and therefore sleep fulfils the function of conserving energy. Meddis (1975) emphasised that the ways in which an animal's

environment exerts evolutionary pressure causes the animal to evolve in certain ways. Therefore, the animals sleep patterns will depend on factors like how much time each day it must spend looking for food and how the physical environment affects sleep opportunities.

The restoration theory makes the following predictions (Meddis, 1975; Webb, 1975):

- Small animals, which lose heat faster than large ones, will sleep more.
- Dietary factors will be related to sleep habits.
- Predators will sleep more than prey species.
- Animals will show adaptation to specific environmental challenges they face.

3.3.1 Criticisms of the evolutionary theory

The following evidence does not support the evolutionary theory:

- According to Virk (2010), not all species fit the human pattern of survival and safety.
- Bentley (1999) indicated that the evolutionary theory fails to explain why, after sleep deprivation, humans sleep longer and fall asleep during daylight (napping).

3.3.2 Evidence for the evolutionary theory

The following evidence supports the evolutionary theory:

- Sleep helps to conserve energy in a number of ways (Webb, 1975).
- Sleep is a time of inaction so prey can be safe from predators (Virk, 2010), which could explain babies sleep patterns.
- Eysenck (2004) stated that sleep is an adaptive behaviour favoured by evolution and therefore sleep also fulfils the function of conserving energy.

3.4 CHAPTER SUMMARY

Three theories were used to discuss and to explain the reasons why we sleep, namely the associate network theory of memory and emotion, the restoration theory and the evolutionary theory. Criticisms of and evidence supporting the three theories were also discussed in this chapter. The associate network theory of memory and emotion (Bower, 1981) suggests that an individual is prepared through his/her experiences and the formation of associative networks to manage emotions in different situations. In light of the significant role of memory in overall affect as well as psychological disorders such as depression, it is perhaps not surprising that alterations in sleep can be considered core features of conditions such as depression and anxiety (Assefa, Diaz-Abad, Wickwire & Scharf, 2015).

Oswald (1980) and Horne's (1988) restoration theories suggest that the function of sleep is to repair and restore the brain and body. The brain restoration and repair take place during core sleep while bodily restoration occurs during optional sleep, and also at other times (e.g. during periods of relaxed wakefulness). Webb (1975) and Meddis's (1975) evolutionary theory identifies that the main function of sleep is that of conserving energy and that humans sleep to preserve themselves. Therefore, sleep patterns will depend on factors such as how much time each day is spent looking for food and how the physical environment affects sleep opportunities.

Chapter 4 outlines the methodological considerations taken to develop and conduct this research study. The aims of the research are presented, data analysis techniques are discussed, the procedures that were followed and the ethical considerations are highlighted.

CHAPTER 4

RESEARCH METHODOLOGY

This chapter provides an overview of the research design and methodology that was utilised in the present study. It describes the research aims, design, the selection of participants and sampling procedure, measures used, data collection and analyses procedures, and ethical considerations.

4.1 AIM AND OBJECTIVES OF THE RESEARCH

The aim of this study was to investigate the relationship between the quality of sleep and mood states among athletes. In order to achieve the aim of the study, the following objectives and hypotheses were set:

- To explore and describe the quality of sleep and mood states among athletes.
- To explore and describe the relationship between the quality of sleep and mood states among athletes.
- To explore and describe the individual differences across the weeks with regard to the quality of sleep and mood states among athletes.

4.2 RESEARCH DESIGN

According to Terre Blanche and Durrheim (2002), the purpose of the research design is to provide guidelines for the researcher according to which data can be obtained, interpreted and analysed. A quantitative research method was employed. According to Gravetter and Wallnau (1995), quantitative measurement involves categorizing the size of the events by using numbers; therefore the research is based on the measurement of quantity or amount. In addition, a combination of an exploratory and descriptive approach was employed. Salkind (1997) indicated that descriptive research describes the characteristics of an existing phenomenon. The major emphasis of an exploratory approach is the discovery of ideas and

consideration of different aspects of the problem under study, while descriptive research reflects the state of affairs as it currently exists (Kothari, 2004).

Struwig and Stead (2001) stated that descriptive research attempts to provide a complete and accurate description of a situation and can be regarded as the first step in research as it provides the groundwork for future research. The current research study is descriptive in nature as it attempted to describe and explore the relationship between quality of sleep and mood states among athletes.

4.3 PARTICIPANTS AND SAMPLING TECHNIQUE

The sample of this study comprised of 87 athletes, namely triathletes, a long distance runner, cricket players and rugby players between the ages of 18 years and 49 years. According to Neuman (2006), the size of the sample depends on the kind of data analysis the researcher plans, on how accurate the sample has to be for the researcher's purposes and on population characteristics. A sample refers to the persons who are incorporated into the research study namely, the participants (Salkind, 1997).

A purposive, non-randomized sampling technique was used. Dolores and Tongco (2007) stated that the purposive sampling technique is the deliberate choice made by a researcher because of the qualities the participants possess. It is also a non-random technique. According to Blankenship (2010), in non-random sampling the probability of being selected is not the same for each individual in the population. Blankenship (2010) further states that purposive sampling allows the researcher to identify specific individuals who have information the researcher needs, related to the research question.

The participants in this study comprised 87 athletes (86 males and 1 female) from the SARU Rugby Academy, Eastern Cape Academy of Sport and the Nelson Mandela Metropolitan University High Performance Complex between the ages of 18 and 49 years. The only inclusion criteria were that athletes had to be older than 18 years and be proficient

in English (read, write and speak). The sample was made up of 64 rugby players, 15 cricket players, 7 triathletes and 1 distance runner.

Stirling and Gretchen (2006) defined an athlete as an individual who plays in a competitive sports team or individual sport, trains for the same sport at least six days a week including games and competitions, and competes for an intercollegiate team or club either nationally and/or internationally. For the purpose of this study, participants were classified as athletes as they compete at club, provincial and for national level, and 70% of the participants trained regularly for more than 5 times per week.

4.4 MEASURES

The data collection method determines the accuracy of the research findings, therefore the data collection method has to be appropriate with regard to the research questions and the research design (Struwig & Stead, 2001). A self-report biographical questionnaire was administered to obtain relevant information about the participant's medical and training background. The Profile of Mood States 2 – Adults (POMS 2) and the State-Trait Anxiety Inventory-Adults (STAI-A) was administered to the athletes to measure mood states, depression and anxiety. The Pittsburgh Sleep Quality Index (PSQI) was used for the subjective assessment of sleep quality.

A short description of the Biographical questionnaire, STAI-A, POMS and PSQI follows:

4.4.1 Biographical questionnaire

A biographical questionnaire was utilised in order to obtain essential demographic information from all of the participants. The questions in the biographical questionnaire requested the following information: the participant's name, training hours, age, gender, ethnicity and English language proficiency.

4.4.2 Profile of Mood States 2 – Adults (POMS 2)

The POMS 2 is a 65 item self-report inventory (Heuchert & McNair, 2012). According to Heuchert and McNair (2012) and as described in Chapter 2, the POMS 2 contains six subscales namely: Anger-Hostility, Confusion-Bewilderment, Depression-Dejection, Fatigue-Inertia, Tension-Anxiety, and Vigour-Activity. The authors indicated that the POMS 2 contains a summary scale, the Total Mood Disturbance scale, and a Friendliness subscale for testing positive mood. Each adjective is scored (0 = not at all, 1 = a little, 2 = moderately, 3 = quite a bit and 4 = extremely), some scored as they are on the form and some items are reverse scored. This provides a raw score for each subscale. Participants are asked to rate how they have been feeling over the past week, including the day of completion of the questionnaire.

The organization of results on each dimension of the questionnaire is provided in the form of a graph, which enables researchers to evaluate the subject's mood profile (Heuchert & McNair, 2012). If an athlete scores low on negative mood scales (tension, depression, anger, fatigue, confusion) and high on the positive vigour scale, the plotted curve resembles an iceberg. Morgan's (1979) hypothesis indicated that successful athletes possess more of an iceberg profile than less successful athletes. The sum of the scores (with vigor weighted negatively) on the six primary mood factors results a score of total mood disturbance. Higher scores for the total mood disturbance score indicate a greater degree of mood disturbance (Heuchert & McNair, 2012).

Heuchert and McNair (2012) indicated that the Profile of Mood States – Adult has very strong levels of internal consistency (internal consistency was assessed with Cronbach alpha). Cronbach's alpha is a statistic term generally used as a measure of internal consistency or reliability (Watson & Pennebaker, 1989). According to Heuchert and McNair (2012), the value for the Total Mood Disturbance scale score ranged from .94 to .97 and alpha values for

the scale scores ranged from .76 to .95. Heuchert and McNair (2012) further indicated that results from convergent validity analyses suggested that both negatively and positively valenced affects, the Profile of Mood States – Adult demonstrates convergent validity, with correlations ranging from .57 to .84 (all $p < .001$).

4.4.3 State-Trait Anxiety Inventory (STAI-A)

According to Spielberger (1983), the STAI-A is a 40 item self-report inventory which is characterized as an instrument with two parallel scales, each consisting of 20 items which measures the intensity of anxiety in adults. According to Spielberg (1983), one scale evaluates state anxiety (a temporary condition experienced in specific situations), indicating how the subject is feeling at that moment, and the other scale evaluates trait anxiety (a general tendency to perceive situations as threatening), indicating how the subject generally feels. Participants are asked to rate how they are feeling on the day of completion of the questionnaire (items 1-20) and how they are generally feeling (items 21-40). All items are rated on a 4-point scale that assesses trait anxiety and state anxiety (1 = almost never, 2 = sometimes, 3 = often and 4 = almost always). On each sub-scale some items are scored as they are on the form and some items are reverse scored. The total score ranges from 20 to 80 points for each scale, and each score indicates a level of anxiety that is low (20 to 30 points), moderate from (31 to 49 points) or high (50 or more).

Spielberg (1983) identified the range of the overall median alpha coefficients for the State anxiety dimension as 0.87 to 0.92 while the range for Trait anxiety dimension is 0.89 to 0.90. According to Spielberger (1983), state and trait are considered conceptually distinct but related constructs and correlations between state and trait scales typically fall in the range of 0.7 to 0.8. They further noted that the STAI-A covered five of eight domains for generalized anxiety disorder in the DSM-IV. These levels suggest satisfactory validity and reliability.

4.4.4 Pittsburgh Sleep Quality Index (PSQI)

According to Smyth (2012), the Pittsburgh Sleep Quality Index (PSQI) is an effective questionnaire consisting of 11 questions used to measure the quality and patterns of sleep by measuring seven domains: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The PSQI was developed with several goals in mind (Buyse, Reynolds, Monk, Berman & Kupfer, 1988):

- To provide a reliable, valid and standardized measure of sleep quality;
- To discriminate between 'good' and 'poor' sleepers; and
- To provide a brief, clinically useful assessment of sleep disturbances that might affect sleep quality.

Questions 1 to 4 are quantitative information about time going to bed, how long it takes to fall asleep, wake up time in the morning and actual number of hours sleep at night. For the purpose of scoring, the range of values for questions 5 through 10 are all measured as 0 to 3. Questions 1 through 9 may not be omitted except as noted below. If these questions are omitted, then any scores calculated using missing questions are inaccurate. Thus it was important to make sure that all questions (1 through 9) had been answered (Buyse, Reynolds, Monk, Berman & Kupfer, 1988). The score for each component ranges from 0 to 3 and the higher the global scores the poorer the sleep quality of the athlete. The scores of the seven domains are added to an overall score, which ranges from 0 to 21. Scores from 0 to 4 points indicate good quality of sleep and from 5 to 10 points poor quality. Scores above 10 to 21 points indicate that the person most likely has a sleep disorder (Buyse, Reynolds, Monk, Berman & Kupfer, 1988).

The PSQI was originally developed to measure sleep quality during the months prior to completion of the measure (Buyse, Reynolds, Monk, Berman & Kupfer, 1988), but the

researcher utilized a modified version by Sethi (2012), which asked the athletes to answer questions based on their usual sleep habits during the week prior to completion, as more recent events were considered to be easier for participants to remember. The PSQI has internal consistency and a reliability coefficient (Cronbach's alpha) of 0.83 for its seven components and numerous studies using the PSQI in a variety of older adult populations internationally have supported high validity and reliability (Buyse, Reynolds, Monk, Berman & Kupfer, 1988).

4.5 DATA COLLECTION

Participants were required to rate their PSQI and complete the POMS-2 and STAI-A once a week on the same day for four weeks (i.e. on four occasions). These questionnaires were administered during either their medical screening sessions or prior to training sessions. The procedures for the completion of the measures were explained to the participants before the first assessment session.

4.6 DATA ANALYSIS

Leedy and Ormond (2005) indicated that data analysis forms part of the analytical phase and is aimed at answering the research question, therefore, the data needs to be systematically analysed in an organised manner, which is done through statistical analysis. A statistician from the Nelson Mandela Metropolitan University (NMMU) was employed to facilitate the organisation and interpretation of the data that were collected. To determine the reliability of the participants' responses, Cronbach's alpha was the measure used to assess the reliability, or internal consistency, of a set of scale or test items (Cronbach, 1951). Different data analysis techniques were used for the different objectives. The level of significance was set at $p \leq .05$.

Objective 1 was measured using descriptive and inferential statistics. According to Howel (2010), whenever our purpose is to describe a set of data we employ descriptive statistics. Salkind (1997) described descriptive statistics as a simple measure of a distribution's central tendency (the mean, the median and the mode) and variability (the range and standard deviation). Means and standard deviations were used to describe the characteristics of the data that were collected.

Objective 2 was measured using the Pearson R correlation. The Pearson correlation measures the degree and direction of linear relations between two variables (Gravetter & Wallnau, 1995). Howel (2010) stated that the correlation reflects the direction of the relationship. The chi-square test for independence uses the frequency data from a sample to evaluate the relationship between two variables in a population (Gravetter & Wallnau 2013). Correlations, scattergrams (picture of a particular relationship, Salkind, 1997) and cross tabulations (3x3 and 2x2) were used to describe and determine the relationship between two or more variables (Salkind, 1997). The current study was aimed at determine the relationship between the quality of sleep and mood states.

Objective 3 utilised 1 sample T-test. One sample t-test is a statistical procedure used to examine the mean difference between the sample and the known value of the population means (Statistics Solutions, 2013).

A statistically significant result when a probability is less than a significance level justifies the rejection of the null hypothesis (Kumar, 2005). For the purpose of the present study the significance level was set at $p = 0.05$.

4.7 PROCEDURE

The researcher obtained authorization to conduct the study from the Faculty of Health Sciences Postgraduate Studies Committee and from the Research Ethics Committee (Human) at the Nelson Mandela Metropolitan University (NMMU). The researcher made use of a

purposive, non-random sampling technique; therefore, the managers of the various sporting codes provided the researcher with the names of athletes who met the criteria to participate in the research. A meeting with the participants was undertaken to explain the study before obtaining informed consent from the participants. Prior to the distribution of the questionnaires and measurement instruments, the participants were informed that their participation was voluntary and that all responses would be kept confidential. Before completing the questionnaires, the participants were instructed to answer all questions as honestly as possible and to ask for help if an item was unclear. An in-depth explanation of how to complete all the questionnaires was given.

Feedback of the results of the study will be given in the form of a formal presentation to the participants and their managers/coaches to emphasize the importance of sleep hygiene and the effect thereof on performance.

4.8 ETHICAL CONSIDERATIONS

Ethical rules of conduct for practitioners registered under the Health Professions Act were implemented during this study (Health Professions Act, 1974, Act no.56 of 1974). All participants were informed about the nature, goals and possible advantages of this research by means of an information session; the research had no known risks or discomfort for the participants; data was gathered under the supervision of a psychologist in training; and the data stored in a secure area at the Nelson Mandela Metropolitan University (NMMU). Facilities were put in place in order to provide counselling for participants who may have experienced any trauma (HPCSA, 1974).

Permission for the proposed research was requested from the Nelson Mandela Metropolitan University (NMMU) Faculty of Health Sciences Postgraduate Studies Committee and the NMMU Research Ethics Committee (Human). Informed consent was obtained from the participants. The participants were assured that their anonymity and

confidentiality would be maintained at all times and no individual results would be made known. General feedback was given to the participants after the data were analysed.

4.9 CONCLUSION

A quantitative research method with a combination of an exploratory and descriptive approach was employed. The sample of this study comprised of 87 athletes. The researcher made use of a purposive, non-randomized sampling technique. A self-report biographical questionnaire, the Profile of Mood States 2 – Adults (POMS 2), the State-Trait Anxiety Inventory-Adults (STAI-A) and the Pittsburgh Sleep Quality Index (PSQI) was administered once a week on the same day for the duration of 4 weeks. Descriptive and inferential statistics, Pearson R correlation and 1 sample T-test were used to analyse the data. The researcher obtained the necessary authorisation to conduct the study and followed the ethical rules of conduct.

The results of the study are presented and discussed in Chapter 5.

CHAPTER 5

RESULTS

This chapter presents and discusses the results of the statistical analyses described in Chapter Four. Statistical analyses focused on information extracted from the self-report biographical questionnaire, the Profile of Mood States 2 – Adults (POMS 2), the State-Trait Anxiety Inventory-Adults (STAI-A) and the Pittsburgh Sleep Quality Index (PSQI). The aim of this study was to investigate the relationship between quality of sleep and mood states among athletes. The three objectives outlined in chapter one guide the presentation and discussion of the results.

It is important to note that the n-value changes according to the rate of completion of the questionnaires by the participants in the study. The sample sizes varied due to the occasional non-attendance of some of the participants and to faulty questionnaires which needed to be discarded. This variation did not have any significant effect on the results of the study.

5.1 RESULTS OF OBJECTIVE ONE: TO EXPLORE AND DESCRIBE THE QUALITY OF SLEEP AND MOOD STATES AMONG ATHLETES.

5.1.1 Biographical profile of the research sample

The biographical variables presented in tables 5.1 to 5.5 summarise the information obtained from the Biographical Questionnaires that were completed by the participants (see Appendix 2). A summary of the data pertaining to sport in which athletes participated, frequency of training/competition sessions, age, gender and ethnicity follow. Table 5.1 presents an outline of the number of participants in each sports code.

Table 5.1 Frequency distribution - Sport

Cricket	15	17.25%
Ironman	2	2.29%
Rugby	64	73.56%
Running	1	1.15%
Triathlon	5	5.75%
Total	87	100%

From table 5.1 it can be seen that the majority of the participants were rugby players (74%), followed by cricket players (17%), triathletes (6%), ironman athletes (2%) and road running athletes (1%). A total of 87 athletes participated in this study. Table 5.2 presents a summary of the age categories of the participants.

Table 5.2 Frequency distribution - Age Category

18-19 years	39	44.83%
20-29 years	34	39.07%
30-39 years	7	8.05%
40-49 years	7	8.05%
Total	87	100%

Table 5.2 shows that the majority of participants were between the ages of 18-19 years (45%), with the least number of players in the age groups 30 to 39 years and 40 to 49 years (8%). Table 5.3 presents a distribution of the gender of the participants.

Table 5.3: Frequency distribution - Gender

Male	86	98.85%
Female	1	1.15%
Total	87	100%

Table 5.3 indicates that the sample consisted of a total of 87 participants. Eighty six were male participants (99%) and 1 was a female participant (1%). The one female was included in the study as the researcher could not find any studies indicating a difference in gender with regards to the relationship between sleep quality and mood states among any population group. Table 5.4 provides a frequency distribution of the ethnicity of the participants.

Table 5.4: Frequency distribution – Race

Black	21	24.13%
Coloured	13	14.94%
White	53	60.93%
Total	87	100%

Table 5.4 indicates that the majority of participants were white athletes (61%), followed by black athletes (24%) and coloured athletes (15%). The differences in the number of participants per ethnic group may be due to the sampling procedure utilized and the sporting codes selected in the current study. Thus, the sample is not an actual representation of the demographic profile in South Africa as this study contained mainly white participants. Table 5.5 presents the number of completed training sessions per week, including competitions.

Table 5.5 Frequency distribution – Number of sessions attended

<4	12	13.79%
4-5	14	16.09%
5-6	25	28.74%
>6	36	41.38%
Total	87	100%

According to table 5.5, 41 % of participants had more than 6 training sessions per week and 14 % of participants fewer than 4 training sessions a week. Forty-five % of the participants indicated that they had between 4 to 6 training sessions a week, including competition.

5.1.2 State-Trait Anxiety Inventory-Adults (STAI-A)

Table 5.6 presents an outline of the frequency distributions from week 1 to 4 on the STAI-A sub-scales.

Table 5.6: Frequency Distributions: week 1 to 4 STAI-A scores (n = 76)

	Very Positive [0 to 25)		Positive [25 to 50]		Negative (50 to 75]		Very Negative (75 to 100]	
W1-4-STAI-State anxiety	28	36%	43	57%	5	7%	0	0%
W1-4-STAI-Trait anxiety	30	39%	40	53%	6	8%	0	0%

According to table 5.6, the majority of the athletes (93%) had a positive to very positive STAI-A score over the 4 weeks for their STAI-State anxiety and only 7% had a negative score. Furthermore, 92% of the athletes indicated a positive to very positive score for their STAI-Trait anxiety over the 4 weeks, with 8% indicating a negative score.

5.1.3 Profile of Mood States 2 – Adults (POMS 2)

Table 5.7 presents the responses of the participants on the POMS-2 mood state scales.

Table 5.7: Frequency Distributions: week 1 to 4 POMS scores (n = 76)

	Very Positive [0 to 25)		Positive [25 to 50]		Negative (50 to 75]		Very Negative (75 to 100]	
W1-4-POMS:Anger-hostility	53	70%	23	30%	0	0%	0	0%
W1-4-POMS:Confusion-bewilderment	33	43%	39	51%	4	6%	0	0%
W1-4-POMS:Depression-dejection	60	79%	15	20%	1	1%	0	0%
W1-4-POMS:Fatigue-inertia	19	24%	47	62%	8	11%	2	3%
W1-4-POMS:Tension-anxiety	39	51%	34	45%	3	4%	0	0%
W1-4-POMS:Vigour-activity	1	1%	33	43%	40	53%	2	3%

Table 5.7 shows that the majority of athletes had a positive to very positive score over the 4 weeks for anger-hostility (100%), confusion-bewilderment (94%), depression-dejection (99%), fatigue-inertia (86%) and tension-anxiety (96%). Fifty six percent of the athletes had a negative to very negative score over the 4 weeks for their POMS vigour-activity score. As per discussion with the participants Fitness trainers and Biokineticists, this low result on vigour could be due to the participants' hectic training schedule of 3 weeks high intensity training and 1-week recovery. Terry (1995) and Morgan (1979) indicated that lethargy has a negative association with performance and possibly inhibits full functioning of the athlete.

5.1.4 Pittsburgh Sleep Quality Index (PSQI)

Table 5.8 presents an outline of the frequency distributions of the PSQI scores from week 1 to 4.

Table 5.8: Frequencies: week 1 to 4 PSQI score

Very Positive [0 to 25)	51	67%
Positive [25 to 50]	23	30%
Negative (50 to 75]	2	3%
Very Negative (75 to 100]	0	0%

According to table 5.8, the majority of athletes (67%) indicated a very positive sleep quality index score. Only 3% of the athletes indicted a negative sleep quality index score.

5.1.5 Reliability of the summated scores

Cronbach's alpha was utilised to establish the internal consistency and reliability of the STAI-A, POMS-A and PSQI results. These results are presented in table 5.9.

Table 5.9: Cronbach's alpha coefficients for the factors (n = 87)

	Week 1	Week 2	Week 3	Week 4
STAI-S	0.86	0.89	0.91	0.90
STAI-T	0.88	0.87	0.89	0.90
POMS-AH	0.78	0.84	0.81	0.88
POMS-CB	0.70	0.82	0.79	0.83
POMS-DD	0.84	0.86	0.88	0.93
POMS-FI	0.76	0.88	0.85	0.83
POMS-TA	0.86	0.88	0.83	0.87
POMS-VA	0.79	0.76	0.75	0.77
PSQI	0.54	0.67	0.47	0.36

Table 5.9 demonstrates that overall the internal consistency within the STAI-A state and trait could be interpreted as excellent over the four weeks, suggesting that the constructs in the scales are homogenous and relatively tapped into. Furthermore, the internal consistency within the POMS subscales ranges from good to excellent over the four weeks, also suggesting that the constructs in the scales are homogenous and relatively tapped into. Although the PSQI had the lowest but still acceptable internal consistency during weeks one and two, during weeks three and four it was poor.

A possible reason for this low internal consistency could be that some of the components that made up the sum total of sleep quality as combinations are not representative of total sleep quality. According to Alvaro, Roberts and Harris (2013), distinctions between sleep variables are obscured thus some elements of sleep do not necessarily relate to one another. Secondly, athlete's perceptions of their sleep patterns may not have been accurate and not seen as an important focus during their already busy training weeks.

5.2 RESULTS OF OBJECTIVE TWO: TO EXPLORE AND DESCRIBE THE RELATIONSHIP BETWEEN THE QUALITY OF SLEEP AND MOOD STATES AMONG ATHLETES.

The quantitative data obtained from the Profile of Mood States 2 – Adults (POMS 2), the State-Trait Anxiety Inventory-Adults (STAI-A) and the Pittsburgh Sleep Quality Index (PSQI) are presented in the following section. According to Gravetter and Wallnau (2009), correlations are statistically significant at a 0.05 level for n ranging from 81 to 70 if |r| >= rcrit ranging from 0.219 to 0.235 and practically significant if |r| >= 0.300. Thus, a significant result (both statistically and practically) is only achieved if |r| >= 0.300. For the sake of condensing the results, only results that were significant are reported upon. Table 5.10 illustrates the correlations between STAI-A, POMS-A and PSQI.

Table 5.10: Pearson Product Moment Correlations – STAI-A, POMS-A and PSQI: weeks 1 to 4

	PSQI: Week 1	PSQI: Week 2	PSQI: Week 3	PSQI: Week 4
n	70	74	59	62
rcrit;a=.05	.235	.229	.256	.250
Correlations:				
W1-STAI-S	***.390***	.219	.095	.217
W1-STAI-T	***.351***	.282	.212	***.368***
W1-POMS-AH	.287	.220	.068	.056
W1-POMS-CB	.287	***.300***	.049	.155
W1-POMS-DD	.283	***.300***	.226	.070
W1-POMS-FI	.238	.262	.146	***.347***
W1-POMS-TA	***.345***	***.346***	.131	***.302***
W1-POMS-VA	-.075	-.115	***-.307***	-.170

According to table 5.10, there are correlations with PSQI that are significant (both statistically and practically >.300) for STAI state anxiety week one, STAI trait anxiety weeks one and four, POMS confusion-bewilderment week two, POMS depression-dejection week two, POMS fatigue-inertia week four, POMS tension-anxiety weeks one, two and four and POMS vigour-activity week three.

5.2.1 Cross tabulations (3x3 and 2x2)

The chi-square test for independence uses the frequency data from a sample to evaluate the relationship between two variables in the population (Gravetter & Wallnau 2013). Scattergrams and cross tabulations (3x3 and 2x2) are used to describe and determine the relationship between two or more variables (Salkind, 1997). If p > .050 H0 would not be

rejected and if $p < 0.050$ the H0 would be rejected and the H1 would be accepted. Table 5.11 presents the relationship between PSQI and Depression-dejection sub-scale of POMS-2 during week two.

Table 5.11: Contingency Table – Week 2 PSQI and Week 2-POMS Depression-dejection

Week 2: PSQI	Week 2: POMS Depression-dejection							
	[0.00 to 7.21)		[7.21 to 25.00)		[25.00 to 00.00]		Total	
[0.00 to 14.29)	10	48%	9	43%	2	10%	21	100%
[14.29 to 28.57)	4	15%	17	63%	6	22%	27	100%
[28.57 to 100.00]	4	15%	11	42%	11	42%	26	100%
Total	18	24%	37	50%	19	26%	74	100%
Chi^2(d.f. = 4, n = 74) = 13.03; p = .011; V = 0.30 Medium								

As seen in table 5.11, the following hypotheses were tested:

- H0: There is no relationship between quality of sleep and POMS depression-dejection.
- H1: There is a relationship between quality of sleep and POMS depression-dejection.

There was sufficient evidence to conclude that there is a significant relationship between quality of sleep and POMS depression-dejection during week two. This was also confirmed by the results of the Pearson Product Moment Correlations (table 5.10). Table 5.12 presents the relationship between PSQI and Fatigue-inertia sub-scale of POMS-2 during week three.

Table 5.12: Contingency Table – Week 3.PSQI and Week 3 POMS fatigue-inertia

Week 3: PSQI	Week 3: POMS Fatigue-inertia							
	[0.00 to 20.83)		[20.83 to 45.83]		(45.83 to 00.00]		Total	
[0.00 to 19.05)	10	42%	8	33%	6	25%	24	100%
[19.05 to 25.83)	2	10%	10	50%	8	40%	20	100%
[25.83 to 100.00]	0	0%	11	73%	4	27%	15	100%
Total	12	20%	29	49%	18	31%	59	100%
Chi^2(d.f. = 4, n = 59) = 10.67; p = .030; V = 0.30 Medium (1 added to each cell to meet minimum expected frequency requirements)								

As seen in table 5.12 the following hypotheses were tested:

- H0: There is no relationship between quality of sleep and POMS fatigue-inertia.
- H1: There is a relationship between quality of sleep and POMS fatigue-inertia.

There was sufficient evidence to conclude that there is a significant relationship between quality of sleep and POMS fatigue-inertia during week three. Table 5.13 presents the relationship between PSQI and Fatigue-inertia sub-scale of POMS-2 during week four.

Table 5.13: Contingency Table – Week 4.PSQI and Week 4 POMS fatigue-inertia

Week 4: PSQI	Week 4: POMS Fatigue-inertia							
	[0.00 to 13.54)		[13.54 to 45.83]		(45.83 to 00.00]		Total	
[0.00 to 14.29)	8	40%	9	45%	3	15%	20	100%
[14.29 to 24.70)	7	27%	13	50%	6	23%	26	100%
[24.70 to 100.00]	1	6%	5	31%	10	63%	16	100%
Total	16	26%	27	44%	19	31%	62	100%
Chi^2(d.f. = 4, n = 62) = 10.21; p = .037; V = 0.29 Medium (1 added to each cell to meet minimum expected frequency requirements)								

As seen in table 5.13 the following hypotheses were tested:

- H0: There is no relationship between the quality of sleep and POMS fatigue-inertia.
- H1: There is a relationship between the quality of sleep and POMS fatigue-inertia.

There was sufficient evidence to conclude that there is a significant relationship between quality of sleep and POMS fatigue-inertia during week four. This was also confirmed by the results of Pearson Product Moment Correlations (table 5.10). Table 5.14 presents the relationship between PSQI and Vigor-activity sub-scale of POMS-2 during week four.

Table 5.14: Contingency Table – Week 4.PSQI and Week 4 POMS vigour-activity

Week 4: PSQI	Week 4: POMS vigour-activity							
	[0.00 to 41.67]		(41.67 to 61.11]		(61.11 to 100.00]		Total	
[0.00 to 14.29)	5	25%	3	15%	12	60%	20	100%
[14.29 to 24.70)	8	31%	14	54%	4	15%	26	100%
[24.70 to 100.00]	6	38%	7	44%	3	19%	16	100%
Total	19	31%	24	39%	19	31%	62	100%
Chi^2(d.f. = 4, n = 62) = 11.69; p = .020; V = 0.31 Medium (1 added to each cell to meet minimum expected frequency requirements)								

As seen in table 5.14 the following hypotheses were tested:

- H0: There is no relationship between quality of sleep and POMS vigour-activity.
- H1: There is a relationship between quality of sleep and POMS vigour-activity.

There was sufficient evidence to conclude that there is a significant relationship between quality of sleep and POMS vigour-activity during week four. Table 5.15 presents the relationship between PSQI and STAI- State anxiety during week one.

Table 5.15: Contingency Table – Week 1.PSQI and Week 1 STAI-S

Week 1.PSQI	Week 1 STAI-S					
	[0.00 to 41.67]		(41.67 to 100.00]		Total	
[0.00 to 28.57)	43	84%	8	16%	51	100%
[28.57 to 100.00]	10	53%	9	47%	19	100%
Total	53	76%	17	24%	70	100%
Chi^2(d.f. = 1, n = 70) = 7.40; p = .007; V = 0.33 Medium (1 added to each cell to meet minimum expected frequency requirements)						

As seen in table 5.15 the following hypotheses were tested:

- H0: There is no relationship between quality of sleep and STAI-S.
- H1: There is a relationship between quality of sleep and STAI-S.

There was sufficient evidence to conclude that there is a significant relationship between quality of sleep and STAI-State anxiety during week one. This was also confirmed by the results of Pearson Product Moment Correlations (table 5.10). Table 5.16 presents the relationship between PSQI and Depression-dejection subscale of POMS-2 during week two (Cross tabulations 2 x 2).

Table 5.16: Contingency Table – Week 2.PSQI and Week 2 POMS Depression-dejection

Week 2.PSQI	Week 2 POMS-DD					
	[0.00 to 25.00)		[25.00 to 100.00]		Total	
[0.00 to 28.57)	40	83%	8	17%	48	100%
[28.57 to 100.00]	15	58%	11	42%	26	100%
Total	55	74%	19	26%	74	100%
Chi^2(d.f. = 1, n = 74) = 5.81; p = .016; V = 0.28 Small						

As seen in table 5.16 the following hypotheses were tested:

- H0: There is no relationship between quality of sleep and POMS depression-dejection.
- H1: There is a relationship between quality of sleep and POMS depression-dejection.

There was sufficient evidence to conclude that there is a significant relationship between quality of sleep and POMS depression-dejection during week two. This was also confirmed by the results of Pearson Product Moment Correlations (table 5.10) and Cross tabulations (3 x 3) table 5.11. Table 5.17 presents the relationship between PSQI and Fatigue-inertia subscale of POMS-2 during week two (Cross tabulations 2 x 2).

Table 5.17: Contingency Table - W2.PSQI and W2-POMS-FI

Week 2 PSQI	Week 2 POMS-FI					
	[0.00 to 50.00]		(50.00 to 100.00]		Total	
[0.00 to 28.57)	40	83%	8	17%	48	100%
[28.57 to 100.00]	16	62%	10	38%	26	100%
Total	56	76%	18	24%	74	100%
Chi^2(d.f. = 1, n = 74) = 4.35; p = .037; V = 0.24 Small						

As seen in table 5.17 the following hypotheses were tested:

- H0: There is no relationship between quality of sleep and POMS fatigue-inertia.
- H1: There is a relationship between quality of sleep and POMS fatigue-inertia.

There was sufficient evidence to conclude that there is a significant relationship between quality of sleep and POMS fatigue-inertia during week two.

Table 5.18 presents the relationship between PSQI and STAI- State anxiety during week three (Cross tabulations 2 x 2).

Table 5.18: Contingency Table – Week 3.PSQI and Week 3 STAI-S

Week 3.PSQI	Week 3 STAI-S					
	[0.00 to 43.33]		(43.33 to 100.00]		Total	
[0.00 to 25.83)	35	80%	9	20%	44	100%
[25.83 to 100.00]	8	53%	7	47%	15	100%
Total	43	73%	16	27%	59	100%
Chi^2(d.f. = 1, n = 59) = 3.89; p = .049; V = 0.26 Small (2 added to each cell to meet minimum expected frequency requirements)						

As seen in table 5.18 the following hypothesis was tested:

- H0: There is no relationship between quality of sleep and STAI-S.
- H1: There is a relationship between quality of sleep and STAI-S.

There was sufficient evidence to conclude that there was a significant relationship between quality of sleep and STAI-State anxiety during week three. Table 5.17 presents the relationship between PSQI and Anger-hostility subscale of POMS-2 during week three (Cross tabulations 2 x 2).

Table 5.19: Contingency Table – Week 3.PSQI and Week 3 POMS Anger-hostility

Week 3.PSQI	Week 3 POMS-AH					
	[0.00 to 25.00)		[25.00 to 100.00]		Total	
[0.00 to 25.83)	34	77%	10	23%	44	100%
[25.83 to 100.00]	7	47%	8	53%	15	100%
Total	41	69%	18	31%	59	100%
Chi^2(d.f. = 1, n = 59) = 4.83; p = .028; V = 0.29 Small (1 added to each cell to meet minimum expected frequency requirements)						

As seen from table 5.19 the following hypotheses were tested:

- H0: There is no relationship between quality of sleep and POMS anger-hostility.
- H1: There is a relationship between quality of sleep and POMS anger-hostility.

There was sufficient evidence to conclude that there was a significant relationship between quality of sleep and POMS anger-hostility during week three. Table 5.20 presents the relationship between PSQI and Depression-dejection subscale of POMS-2 during week three (Cross tabulations 2 x 2).

Table 5.20: Contingency Table – Week 3.PSQI and Week 3 POMS DD

Week 3.PSQI	Week 3 POMS-DD					
	[0.00 to 23.08)		[23.08 to 100.00]		Total	
[0.00 to 25.83)	38	86%	6	14%	44	100%
[25.83 to 100.00]	9	60%	6	40%	15	100%
Total	47	80%	12	20%	59	100%
Chi^2(d.f. = 1, n = 59) = 4.83; p = .028; V = 0.29 Small (3 added to each cell to meet minimum expected frequency requirements)						

As seen from table 5.20 the following hypotheses were tested:

- H0: There is no relationship between quality of sleep and POMS depression-dejection.
- H1: There is a relationship between quality of sleep and POMS depression-dejection.

There was sufficient evidence to conclude that there is a significant relationship between quality of sleep and POMS depression-dejection during week three. Table 5.21 presents the relationship between PSQI and Confusion-bewilderment subscale of POMS-2 during week four (Cross tabulations 2 x 2).

Table 5.21: Contingency Table – Week 4.PSQI and Week 4 POMS Confusion-bewilderment

Week 4.PSQI	Week 4 POMS-CB					
	[0.00 to 35.00]		(35.00 to 100.00]		Total	
[0.00 to 24.70)	38	83%	8	17%	46	100%
[24.70 to 100.00]	9	56%	7	44%	16	100%
Total	47	76%	15	24%	62	100%
Chi^2(d.f. = 1, n = 62) = 4.51; p = .034; V = 0.27 Small (2 added to each cell to meet minimum expected frequency requirements)						

As seen from table 5.21 the following hypotheses were tested:

- H0: There is no relationship between quality of sleep and POMS confusion-bewilderment.
- H1: There is a relationship between quality of sleep and POMS confusion-bewilderment.

There was sufficient evidence to conclude that there is a significant relationship between quality of sleep and POMS confusion-bewilderment during week four. Table 5.22 presents the relationship between PSQI and Fatigue-inertia subscale of POMS-2 during week four (Cross tabulations 2 x 2).

Table 5.22: Contingency Table – Week 4.PSQI and Week 4 POMS Fatigue-inertia

Week 4.PSQI	Week 4 POMS-FI					
	[0.00 to 45.83]		(45.83 to 100.00]		Total	
[0.00 to 24.70)	37	80%	9	20%	46	100%
[24.70 to 100.00]	6	38%	10	63%	16	100%
Total	43	69%	19	31%	62	100%
Chi^2(d.f. = 1, n = 62) = 9.79; p = .002; V = 0.40 Medium (1 added to each cell to meet minimum expected frequency requirements)						

As seen from table 5.22 the following hypotheses were tested:

- H0: There is no relationship between quality of sleep and POMS fatigue-inertia.
- H1: There is a relationship between quality of sleep and POMS fatigue-inertia.

There was sufficient evidence to conclude that there is a significant relationship between quality of sleep and POMS fatigue-inertia during week four. This was also confirmed by the results of Pearson Product Moment Correlations (table 5.10) as well as Cross tabulations (3 x 3) table 5.13.

5.3 RESULTS OF OBJECTIVE THREE: TO EXPLORE AND DESCRIBE THE INDIVIDUAL DIFFERENCES ACROSS THE WEEKS WITH REGARD TO THE QUALITY OF SLEEP AND MOOD STATES AMONG ATHLETES.

One sample t-test is a statistical procedure used to examine the mean difference between the sample and the known value of the population means (Statistics Solutions, 2013). A statistically significant result when a probability is less than a significance level justifies the rejection of the null hypothesis (Kumar, 2005). For the purpose of the current study the significance level was set at p = 0.050. Table 5.23 presents the individual

differences between week one and two with regard to the quality of sleep and mood states among participants.

Table 5.23: One-sample t-Tests: Between weeks differences in STAI, POMS and PSQI scores

Difference	Variable	n	Mean	S.D.	T	d.f.	p (μ=0.00)	Cohen's d
Week 2 - 1	STAI-S	72	0.77	12.50	0.52	71	.603	n/a
	STAI-T	72	-0.95	10.40	-0.77	71	.442	n/a
	POMS-AH	72	-0.59	10.61	-0.47	71	.640	n/a
	POMS-CB	72	-0.52	10.96	-0.40	71	.690	n/a
	POMS-DD	72	-0.05	10.52	-0.04	71	.966	n/a
	POMS-FI	72	-5.61	23.00	-2.07	71	.042	0.24
	POMS-TA	72	1.18	12.63	0.79	71	.430	n/a
	POMS-VA	72	1.65	12.81	1.10	71	.277	n/a
	PSQI	60	-0.06	9.04	-0.05	59	.959	n/a

Table 5.23 indicates that there was sufficient evidence to conclude that there was a significant difference between weeks one and two for the POMS Fatigue-inertia scale. The athletes suffered more from low energy and inertia in week one than they did in week two. Table 5.24 presents the individual differences between week three and four with regard to the quality of sleep and mood states among participants.

Table 5.24 One-sample t-Tests: Between weeks′ differences in STAI, POMS and PSQI scores

Difference	Variable	n	Mean	S.D.	t	d.f.	p (μ=0.00)	Cohen's d
Week 4 - 3	STAI-S	57	1.89	12.54	1.14	56	.260	n/a
	STAI-T	58	-2.09	9.38	-1.70	57	.095	n/a
	POMS-AH	58	-0.16	9.73	-0.12	57	.903	n/a
	POMS-CB	58	-1.99	11.51	-1.32	57	.193	n/a
	POMS-DD	58	-0.94	11.62	-0.62	57	.539	n/a
	POMS-FI	58	-2.87	22.02	-0.99	57	.325	n/a
	POMS-TA	58	1.94	12.13	1.22	57	.228	n/a
	POMS-VA	58	0.13	12.02	0.08	57	.934	n/a
	PSQI	51	-2.79	9.45	-2.10	50	.040	0.29

Table 5.24 indicates that there was sufficient evidence to conclude that there was a significant difference between weeks three and four for the PSQI. The athletes' sleep quality was lower in week three than in week four. Table 5.25 presents the individual differences over the four weeks with regard to the quality of sleep and mood states among participants.

Table 5.25: One-sample t-Tests: Between weeks differences in STAI, POMS and PSQI scores

Difference	Variable	n	Mean	S.D.	t	d.f.	p (μ=0.00)	Cohen's d
Week 4 - 1	STAI-S	60	1.46	12.70	0.89	59	.378	n/a
	STAI-T	60	-2.09	10.89	-1.49	59	.142	n/a
	POMS-AH	60	-1.78	11.84	-1.16	59	.250	n/a
	POMS-CB	60	-1.80	11.19	-1.25	59	.217	n/a
	POMS-DD	60	-0.22	13.78	-0.12	59	.901	n/a
	POMS-FI	60	-10.90	20.88	-4.04	59	<.0005	0.52
	POMS-TA	60	0.46	14.55	0.24	59	.808	n/a
	POMS-VA	60	-0.98	15.98	-0.48	59	.635	n/a
	PSQI	50	-1.63	8.99	-1.28	49	.207	n/a

Table 5.25 indicates that there was sufficient evidence to conclude that the athletes were more fatigued and had lower energy levels in week one than in week four. This could be due to a recovery week every four weeks as indicated by the participants Fitness trainers and Biokineticists.

5.4 ADDITIONAL QUANTITATIVE INFORMATION

Additional quantitative information gathered that fell within the scope of the current study is discussed using descriptive and inferential statistics. Table 5.26 outlines the frequency distribution of anxiety and depression scores over one month.

Table 5.26: Frequency Distributions: Week 1-4 POMS Depression-dejection and Tension-Anxiety Scores (n=76)

	Very Positive [0 to 25)		Positive [25 to 50]		Negative (50 to 75]		Very Negative (75 to 100]	
W1-4-POMS-DD	60	79%	15	20%	1	1%	0	0%
W1-4-POMS-TA	39	51%	34	45%	3	4%	0	0%

Table 5.26 shows the frequency data of anxiety and depression in athletes over the period of one month. A small minority of athletes experienced negative scores for the depression-dejection and tension-anxiety scale, indicating that 1% - 4% of the athletes struggle with feelings of worthlessness or inability to cope. This was confirmed by similar results on the STAI-S (Table 5.27) which indicated that 7% of the athlete' experience feelings of fear and worry. Table 5.27 outlines the frequency distribution of state and trait anxiety scores over one-month period.

Table 5.27: Frequency Distributions: Week 1-4 STAI Scores (n = 76)

	Very Positive [0 to 25)		Positive [25 to 50]		Negative (50 to 75]		Very Negative (75 to 100]	
W1-4-STAI-S	28	36%	43	57%	5	7%	0	0%
W1-4-STAI-T	30	39%	40	53%	6	8%	0	0%

Table 5.28 presents the frequency distribution of the calculated amount of hours slept by the participants over one month.

Table 5.28: Frequency Distributions: Week 1-4.PSQI - Hours of sleep (calculated)

	< 4 hours		[4 to 5 hours)		[5 to 6 hours)		[6 to 7 hours)		[7 to 8 hours)		8+ hours	
Week 1-4 Sleep quality: Day 1-4	0	0%	0	0%	2	3%	12	16%	31	42%	28	38%
Week 1-4 Sleep quality: Day 5	0	0%	1	1%	3	4%	13	19%	36	52%	16	23%

As can be seen from table 5.28, athletes sleep less on day five (which was Friday night). This could be due to the competition on Saturday as most athletes indicated that they competed on Saturdays or had time trials and or games on Saturdays. Table 5.29 outlines the frequency distribution of participants with good or poor sleep quality, sleep latency and efficiency.

Table 5.29: Frequency of athletes with good or poor sleep quality, sleep latency and efficiency.

Sleep quality	Good quality	61 athletes (81%)
	Poor quality	14 athletes (19%)
Sleep latency	< 20min	53 athletes (82%)
	> 20min	12 athletes (18%)
Sleep efficiency	< 85%	0 athletes (0%)
	>85%	66 athletes (100%)

The results in table 5.29 indicate that the majority of athletes reported a good sleep quality with 82% of the athletes indicating that it took them less than 20 minutes to fall asleep after going to bed. All the athletes had a sleep efficiency or total sleep time, expressed as a percentage, of more than 85%, which confirmed their perception of their good quality of

sleep. Table 5.30 presents the primarily reported factors contributing to the disruption of athletes' sleep during week one.

Table 5.30: Frequency Distributions: Week 1 Events affecting sleep (n = 30)

	No		Yes	
Game/race day	15	50%	15	50%
Relationship issues	17	57%	13	43%
Health issues	23	77%	7	23%
Family issues	29	97%	1	3%
Any trauma	28	93%	2	7%

As can be seen from table 5.30, 50% of the athletes had their sleep affected by their upcoming game or race, 43% were affected by relationship issues and 23% affected by health issues which included influenza, injuries or pain during week one. Table 5.31 presents the primarily reported factors contributing to the disruption of athletes' sleep during week two.

Table 5.31: Frequency Distributions: Week 2 Events affecting sleep (n = 23)

	No		Yes	
Game/race day	10	43%	13	57%
Relationship issues	18	78%	5	22%
Health issues	18	78%	5	22%
Family issues	22	96%	1	4%
Any trauma	22	96%	1	4%

The most common reasons cited in table 5.31, that affected sleep during week two were: game or race day (57%), relationship issues (22%) and health issues (22%). Table 5.32

presents the primarily reported factors contributing to the disruption of athletes' sleep during week three.

Table 5.32: Frequency Distributions: Week 3 Events affecting sleep (n = 15)

	No		Yes	
Game/race day	9	60%	6	40%
Relationship issues	8	53%	7	47%
Health issues	9	60%	6	40%
Family issues	14	93%	1	7%
Any trauma	15	100%	0	0%

The results in table 5.32 indicate that 47% of the participants were affected by relationship issues, 40% of athletes had their sleep affected by their game or race day, and 40% were affected by health issues during week three. Table 5.33 presents the primarily reported factors contributing to the disruption of athletes' sleep during week four.

Table 5.33: Frequency Distributions: Week 4 Events affecting sleep (n = 20)

	No		Yes	
Game/race day	10	50%	10	50%
Relationship issues	18	90%	2	10%
Health issues	18	90%	2	10%
Family issues	19	95%	1	5%
Any trauma	20	100%	0	0%

During week four, which was generally a recovery week, athletes' sleep was affected by: game or race day (50%), relationship issues (10%) and health issues (10%). The most

common reason cited for disrupted sleep was game or race day followed by relationship and health issues.

5.5 CONCLUSION

The internal consistency within the STAI-A and POMS-A could be interpreted as satisfactory. Although the PSQI showed satisfactory internal consistency, poor internal consistency during the last two weeks was noted. Results indicated that there were certain relationships between the quality of sleep and mood states among athletes such as fatigue-inertia, anxiety (state and trait), depression-dejection, anger-hostility, vigour-activity and confusion-bewilderment.

There was sufficient evidence to conclude that there was a significant between-week (week 1 and 2, 2 and 3, 3 and 4) difference in fatigue-inertia and sleep quality. Apart from differences in fatigue-inertia and sleep quality scores over the four weeks, all other results indicate a constant outcome over the four weeks for mood states and sleep quality. The results also indicated sufficient evidence to conclude that although there was evidence of a relationship between quality of sleep and mood states, it was not possible to make a definitive conclusion regarding whether sleep quality, anxiety, and depression were bi-directionally related.

The conclusions based on the results of the study, limitations of the study and recommendations for future research are considered in the following chapter.

CHAPTER 6

DISCUSSION, CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

This chapter provides a summary of the main findings and presents a discussion of the conclusions reached regarding the present study. This is followed by possible limitations of the research. Chapter 6 concludes with a brief list of recommendations for future research.

6.1 AIM AND OBJECTIVES OF THE STUDY REVISITED

The primary aim of the study was to investigate the relationship between quality of sleep and mood states among athletes. In order to investigate this aim, the following objectives were set:

- To explore and describe the quality of sleep and mood states among athletes.
- To explore and describe the relationship between the quality of sleep and mood states among athletes.
- To explore and describe the individual differences across the weeks with regard to the quality of sleep and mood states among athletes.

A quantitative research method with a combination of an exploratory and descriptive approach was employed in order to achieve the above objectives. The findings and conclusions that were drawn from the present study are addressed according to these three objectives.

6.2 QUALITY OF SLEEP AND MOOD STATES

Venter (2012) indicated that mood was strongly affected by sleep deprivation, and poor sleep quality was associated with significantly higher self-reported negative moods in a sample of male and female students. Sleep-deprived individuals consistently showed increased levels of depression, stress, anxiety, worry, frustration, irritability, diminished vigour, lower confidence and difficulty in coping with new environmental stressors (Venter,

2012). In her review article Venter (2012) indicated that students who reported earlier bedtimes were in a healthier psychological state, which strengthens the notion that earlier onset of sleep is associated with a better mood.

The restoration theory (Horne, 1988; Oswald, 1980) and the associate network theory of memory and emotion (Bower, 1981) supported Venter's (2012) notion that sleep is not only about resting the body, but it also has important implications for brain functioning. In the current study it was not possible to make a definitive conclusion regarding whether sleep quality, anxiety and depression were bi-directionally related. The restoration theory (Horne, 1988; Oswald, 1980) and the associate network theory of memory and emotion (Bower, 1981) could explain why we sleep and why attention to mood states is important.

The first aim and objective of the study was to explore and describe the quality of sleep and mood states among athletes. This was done by administering the Profile of Mood States 2 – Adults (POMS 2), the State-Trait Anxiety Inventory-Adults (STAI-A) and the Pittsburgh Sleep Quality Index (PSQI). The current study's results show similarities with those of Rodrigues et al. (2015) who assessed psychobiological aspects, such as anxiety, mood state, depression and sleep quality of Brazilian Paralympic athletes prior to the London Paralympic Games.

The present study showed that most athletes had low-level anxiety and/or a positive mood state, which supports results by Rodrigues et al. (2015) in their study. Regarding sleep quality, most participants showed good sleep quality in both aspects evaluated (sleep latency and sleep efficiency). The STAI-A revealed that the majority of athletes had a positive to very positive score over the 4 weeks for their state anxiety (a temporary condition experienced in specific situations) and trait anxiety (a general tendency to perceive situations as threatening).

In order to better understand the participants' sleep quality and correlations between PSQI and mood states, the following results were of interest. In the present study the majority of athletes had a positive to very positive score over the 4 weeks on five of the six subscales of the POMS-2, namely anger-hostility, confusion-bewilderment, depression-dejection, fatigue-inertia and tension-anxiety. Furthermore, the majority of athletes indicated a very positive sleep quality index score. Results indicated that there were certain positive relationships between the quality of sleep and mood states among athletes such as fatigue-inertia, anxiety (state and trait), depression-dejection, anger-hostility, vigour-activity and confusion-bewilderment. Similar results were obtained by Onforio (2012), who found a correlation between fatigue and the PSQI, the STAI-T and the STAI-S of football players.

Scott, McNaughton and Polman (2006), investigated the effects of moderate exercise and sleep deprivation on students. Results from their study showed an interaction effect for the fatigue and depression subscales and non-significant findings for the tension and anger subscales. The results of the current study support Scott et al. (2006), findings in those relationships between quality of sleep and fatigue-inertia and depression-dejection were found. However, unlike in the current study, Scott et al. (2006) did not find a relationship between quality of sleep and anxiety and anger-hostility.

6.3 THE RELATIONSHIP BETWEEN THE QUALITY OF SLEEP AND MOOD STATES AMONG ATHLETES

A number of significant correlations were found between sleep quality and mood states of the participants. There were correlations with PSQI that were significant (both statistically and practically >.300) for STAI state anxiety, STAI trait anxiety, POMS confusion-bewilderment, POMS depression-dejection, POMS fatigue-inertia, POMS tension-anxiety and POMS vigour-activity. Results also indicated that there was sufficient evidence to conclude that there was a significant relationship between quality of sleep and POMS

depression-dejection, POMS fatigue-inertia, POMS vigour-activity, POMS anger-hostility, POMS confusion-bewilderment and STAI-state anxiety.

The results of the current study are consistent with the findings of Alvaro, Roberts and Harris (2013), which indicated that the statistical significance and magnitude of the relationship between sleep disturbances, anxiety and depression differs across sleep and mental health variables (anxiety and depression). The positive correlations between mood states and sleep in this study also support those of Chennaoui et al. (2016) who found that confusion-bewilderment and depression-despair were negatively correlated with sleep quality among swimmers during a major competition. However, according to Chennaoui et al. (2016), the stress of the competition could have triggered a negative mood profile and sleep disturbance.

A small minority of athletes experienced negative scores for the depression-dejection and tension-anxiety scales, indicating that some athletes might struggle with feelings of worthlessness or inability to cope. This finding was confirmed by similar results on the STAI-S (Table 5.27), which indicated that some of the athletes might experience feelings of fear and worry. Another interesting result was that athletes sleep less on day five (which was, for most, the night before their competition, game or time trials).

Onforio (2012) examined objective sleep and performance measures in football players over two seasons. Results indicated that football players' total sleep time ranged from 6h15 ($\pm$ 1h10) during the off-season to 6h49 ($\pm$1h12) during the in-season. Onforio (2012) further indicated that results on day five (day before competition) during in-season indicated football players' total sleep time ranging from 5h53 to 8h03. Similarly, results of the current study indicate that most participants' slept for seven to eight hours during the in-season (days one to four) and that 52% of the participants' total sleep time on day five ranged between 7 to 8 hours.

The sleep efficiency of the participants in the current study was above 85%, which falls within the same range as that of Onforio (2012) which ranged from 72% to 89% during the in-season. While Samuels' (2008) assessment of the sleep quality of competitive athletes indicated a substantial prevalence of poor sleep quality, the current study indicated that only 19% of the athletes had poor sleep quality. Furthermore, results in the current study indicated that most athletes (82%) took less than 20 minutes to fall asleep at night. These findings are in contrast to findings of Silva et al. (2010) that sleep latency was higher (more than 20 minutes to fall asleep) in a group of paralympic athletes with poor sleep quality in the period leading up to the Beijing Paralympic Games in 2008.

In their investigation of the sleep-wake rhythm and sleep quality during rehearsal phases prior to a ballet premiere, Fietze et al. (2009) found that the ballet dancers' total sleep time ranged from 6h16 to 7h41. These results concur with the 7 to 8 hour range found in the current study. The dancers' sleep efficiency scores ranged from 74% to 83%, which were slightly lower than those found in the current study (>85%).

Kajimura et al. (1998) examined the relationship between anxiety-related personality traits and sleep patterns. Their results showed that the participants who experienced low anxiety scores showed longer sleep latency than the participants who experienced high anxiety scores. This result is in contrast with the current study, which found that although the majority of participants scored low on both trait (92%) and state (93%) anxiety, sleep latency was shorter (< 20 minutes) in 82% of the participants. A possible explanation could be that there had not been fixed times for participants to go to bed.

According to Harvey (2001), patients suffering from depression had complaints related to changes in sleep patterns, primarily insomnia. As 82% of the athletes in the current study had a sleep latency of less than 20 minutes, it was presumed that they had no complaints of

insomnia and thus slept better and had no propensity for depression related to sleep quality (Harvey, 2001).

Silva et al. (2010) evaluated the sleep quality, sleepiness, chronotype and the anxiety level of Brazilian Paralympic athletes. They found that athletes with greater sleep latency presented lower sleep efficiency. The current study confirmed this finding with 82% of participants' sleep latency being less than 20 minutes, all participants achieved above 85% sleep efficiency and 81% fell in the good sleep quality range. Most participants also experienced low anxiety scores on both the POMS-2 and the STAI-A.

6.4 INDIVIDUAL DIFFERENCES ACROSS THE WEEKS WITH REGARD TO THE QUALITY OF SLEEP AND MOOD STATES AMONG ATHLETES.

There was sufficient evidence to conclude that there was a significant between-week difference in the POMS Fatigue-inertia and PSQI scales. Apart from differences in fatigue-inertia and sleep quality scores over the four weeks, all other results indicate a constant outcome over the four weeks for mood states and sleep quality. The most common reason cited for disrupted sleep was game or race day followed by relationship and health issues.

All the participants' (100%) sleep efficiency was considered optimal (> 85%) for recovering the biological functions performed during the preceding period of wakefulness (Rodrigues et al., 2015). The difference in sleep efficiency (>85%) compared with data from the 2008 Beijing Paralympics (Silva et al., 2010), where 27 track-and-field Paralympic athletes showed a sleep efficiency of 78.5%, was noteworthy. A possible explanation for this difference in sleep efficiency could be the level of demand involved in the competitive situation (e.g. club vs provincial vs paralympic), including the demand from the self, coaching staff, family, and fans, and, particularly, the fear of failure experienced by the athlete (Rodrigues et al., 2015).

The current study supported the need to assess each individual athlete's total sleep time requirement, the presence of disturbances/sleep fragmentation and the sleep quality. However, apart from significant differences in fatigue-inertia and sleep quality scores over the four weeks, there was insufficient evidence to conclude that there was a significant between-week (week 1 and 2, 2 and 3, 3 and 4) difference in other POMS-2 subscales, STAI-A scores and quality of sleep. The constant results found over the four week period indicated that weekly monitoring of sleep quality may not be necessary, and that sleep quality could be assessed once a month.

Results revealed three major reasons for disruptions to athletes' sleep, namely game or race day, relationship issues and health issues. The most common reason cited was game or race day followed by relationship issues and health issues. These could be used to explain why athletes may experience disrupted sleep.

The question then still remains: how many hours does an athlete need to sleep in order to perform at an optimal level? Venter (2012) indicated in her review article about the role of sleep in performance and recovery of athletes, that because of individual variations with regard to the optimal amount of sleep required, the best way to achieve sleep requirements is to experiment with going to bed when tired and sleepy and getting up in the morning feeling refreshed, without the use of an alarm clock for a few days.

6.5 PRACTICAL IMPLICATIONS OF THE CURRENT RESEARCH

The analyses of sleep indicators such as sleep efficiency, total sleep time, sleep latency and sleep quality and psychological assessment such as mood states of athletes can provide an opportunity to identify how an athlete copes with stress induced by a competition. Also, results of the current study found that weekly monitoring of sleep quality may not be necessary, and that sleep quality could be assessed once a month. Results pertaining to sleep quality may be utilised in order to emphasize the importance of sleep hygiene and the effect

thereof on performance. Guidelines and practical recommendations for athletes, coaches and managers with regard to sleep intervention to enhance the psychological well-being of the athlete could be provided.

According to Fullagar et al. (2014), the following strategies could be followed:

- Identify whether sleep problems exist within an athletic population and, if issues are present, identify poor practice such as how, when, and why these issues occur.
- Treat issues in conjunction with a trained professional to improve the quantity and quality of sleep.

6.6 LIMITATIONS OF THE PRESENT RESEARCH

The limitations of the current research study are discussed in order to suggest improvements for future research.

- A purposive non-randomised sampling technique was used. A random sampling technique would have provided an unbiased representation of a particular group (Dolores & Tongco, 2007).
- A larger homogeneous sample could have been a more representative sample. The current research presents limitations including the heterogeneity of the sample recruited, sample size and gender difference. The sample size comprised mainly white participants (61%) and males (99%), making it difficult to generalise the results of the study to the broader South African population.
- The data were collected from questionnaires and despite the fact that all measures were valid and reliable, there may have been inherent limitations to the method such as understanding the questions or statements, as these items may have different meanings or interpretation for participants. PSQI, POMS-2 and STAI-A are subjective measures. Self-reporting by participants though

empowering, may reflect inaccurate information if the participant has difficulty understanding what is written, especially if their first language was not English.

- Very little research has been conducted with regard to the relationship between the quality of sleep and mood states of athletes, especially in South Africa. As a result, it was difficult to make comparisons in relation to the South African context.
- Participants' lack of motivation especially on the PSQI during weeks three and four may have influenced the results.

6.7 RECOMMENDATIONS FOR FUTURE RESEARCH

The researcher proposes the following ideas for future research:

- A large-scale study to clarify the importance of sleep for athletes and the effects of sleep loss on performance, along with physiological and cognitive responses to exercise.
- Apart from sleep factors that can influence mood states, other factors such as coping skills, relationship issues and health issues, should be taken into consideration.
- A comparison of sleep quality and mood states between individual and team sport participants, and among individuals from diverse cultural backgrounds.
- A longitudinal study to measure the quality of sleep and mood states over time, e.g. off-season, pre-season and in-season (Alvaro, Roberts & Harris, 2013).
- A mixed methods study design could be considered in order to evaluate the qualitative results with regard to the quality of sleep and mood states.

6.8 CONCLUSION

This study provided new insights into anxiety, mood states and quality of sleep on a sample of South African athletes. Despite some of the limitations of the study, the findings were thought to contribute in a valuable way to furthering knowledge regarding the quality of sleep and mood states among athletes. The current data suggest that monitoring athletes' sleep and mood states may be a determining factor for satisfactory performance.

As the Researcher is a qualified Biokineticist, Intern Psychologist and competitive athlete herself; she understands the value of sleep and the effects it has on mood states, which are underestimated. The Researcher has seen and experienced the lack of sport coaches' understanding (ignorance regarding complaints about continuous sleep disturbances) with regard to sleep and mood states. An understanding of the relationship between these two variables (sleep and mood states) should not be ignored as it could have an impact on the performance of the athlete. In the words of Joseph E. Crossman: "The best bridge between despair and hope is a good night's sleep."

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APPENDIX 1 CONSENT FORM

NELSON MANDELA METROPOLITAN UNIVERSITY

INFORMATION AND INFORMED CONSENT FORM

RESEARCHER′S DETAILS		
Title of the research project	The relationship between quality of sleep and mood states among athletes.	
Reference number		
Principal investigator	Nerine Loock	
Address	NMMU Psychology Clinic, Building 7, Lower ground	
Postal Code	6000	
Contact telephone number	0845156878	
DECLARATION BY OR ON BEHALF OF PARTICIPANT		Initial
I, the participant and the undersigned	(full names)	
ID number		
OR		
I, in my capacity as	(parent or guardian)	
of the participant	(full names)	
ID number		
Address (of participant)		
A.1 HEREBY CONFIRM AS FOLLOWS:		Initial

I, the participant, was invited to participate in the above-mentioned research project		
that is being undertaken by	Nerine Loock	
From	Psychology Department	
of the Nelson Mandela Metropolitan University.		

THE FOLLOWING ASPECTS HAVE BEEN EXPLAINED TO ME, THE PARTICIPANT:			Initial
2.1	Aim:	The investigators are studying the relationship between the quality of sleep and mood states among athletes. The information will be used to publish a research treatise as well as research articles that will be submitted to research journals.	
2.2	Procedures:	I understand that I will be required to complete 3 questionnaires every Monday for a period of 1 month.	
2.3	Risks:	I realise that I will need to disclose medical and emotional information as well as usage of supplements and daily habits.	
2.4	Possible benefits:	As a result of my participation in this study knowledge will be generated on my sleeping habits and emotional well-being.	
2.5	Confidentiality:	My identity will not be revealed by the investigators in any discussion, description or scientific publications.	

2.6	Access to findings:	Any new information or benefit that develops during the course of the study will be shared as follows: Feedback of the findings will be emailed to me after the research has been finalized. A copy of the treatise will also be available in the NMMU library.			
2.7	Voluntary participation / refusal / discontinuation:	My participation is voluntary	YES	NO	
		My decision whether or not to participate will in no way affect my present or future care/employment/lifestyle	TRUE	FALSE	

3. THE INFORMATION ABOVE WAS EXPLAINED TO ME, THE PARTICIPANT BY:							Initial
Nerine Loock							
in	Afrikaans		English				
I was given the opportunity to ask questions and all these questions were answered satisfactorily.							
4.	No pressure was exerted on me to consent to participation and I understand that I may withdraw at any stage without penalisation.						
5.	Participation in this study will not result in any additional cost to myself.						

A.2 I HEREBY VOLUNTARILY CONSENT TO PARTICIPATE IN THE ABOVE-MENTIONED PROJECT:
Signed/confirmed PORT ELIZABETH On 20....

Signature of witness:	
Full name of witness:	

STATEMENT BY OR ON BEHALF OF INVESTIGATOR(S)						
I,	Nerine Loock			declare that:		
	I have explained the information given in this document to					
	And/or his representative					
2.	He/she was encouraged and given ample time to ask me any questions;					
3.	This conversation was conducted in	Afrikaans		English		
4.	I have detached Section C and handed it to the participant				YES	NO
Signed/confirmed at				on		20
Signature of interviewer				Signature of witness:		
				Full name of witness:		

IMPORTANT MESSAGE TO PATIENT/REPRESENTATIVE OF PARTICIPANT

Dear participant/representative of the participant

Thank you for your/the participant′s participation in this study. Should, at any time during the study:

- an emergency arises as a result of the research, or
- you require any further information with regard to the study, or
- the following occur

(indicate any circumstances that should be reported to the investigator)

Kindly contact	Nerine Loock
at telephone number	0845156878

APPENDIX 2 BIOGRAPHICAL QUESTIONNAIRE

Administrator's code for confidentiality	

Biographical questionnaire

Name and Surname: _____

Sport: _____

Date of birth				
Age				
Gender	Female		Male	
Race (for statistical purposes)	Asian	Black	Coloured	White
Nr of sessions of training on average per week (include game/race day)				
Proficiency in English	Good	Average	Bad	

APPENDIX 3 EXAMPLES OF POMS, STAI AND PSQI

POMS

Below is a list of words that describe people′s feelings. Please read each word carefully, then blacken in the square that best describes how you have been feeling during the past week, including today:

	Not at all	A little	Moderately	Quite a bit	Extremely
Friendly					
Sad					
Restless					
Lonely					
Nervous					

STAI

Form Y-1 (S-Anxiety)

A number of statements which people have used to describe themselves are given below. Read each statement and then blacken the appropriate square to the right of the statement to indicate how you feel at this moment.

	Not at all	Somewhat	Moderately	Very much so
I feel calm				
I feel upset				
I am worried				

Form Y-2 (T-Anxiety)

A number of statements which people have used to describe themselves are given below. Read each statement and then blacken the appropriate square to the right of the statement to indicate how you generally feel.

	Almost never	Sometimes	Often	Almost always
I feel nervous and restless				
I feel rested				
I feel secure				

PSQI

The following questions relate to your usual sleep habits during the past 7 days only. Your answers should indicate the most accurate replay for the majority of days and nights in the past 7 days.

- When have you usually gone to bed at night?
- How often have you had trouble sleeping because you:
    - Have to get up to use the bathroom
    - Have pain
- How would you rate your sleep overall?

    Very Good/Fairly Good/Fairly bad/Very bad

APPENDIX 4: PERMISSION TO USE THE PSQI

Sent on behalf of Dr. Buysse

Dear Nerine,

You have my permission to use the PSQI for your research study. Please ensure that the PSQI is accurately reproduced in any on-line version (including copyright information).

Good luck with your research.

Sincerely,

Daniel J. Buysse, M.D.

Professor of Psychiatry and Clinical and Translational Science

University of Pittsburgh School of Medicine

APPENDIX 5: COVER LETTER

Dear Participant

My name is Nerine Loock and I am a postgraduate student registered at the Nelson Mandela Metropolitan University. I am currently studying towards a Master′s degree in Counselling Psychology and I am required to conduct a research study. I have chosen to research the relationship between quality of sleep and mood states among athletes.

Managers from the SARU Rugby Academy, EC Sport Academy and NMMU High Performance Complex have granted permission for the study to be conducted and I would like to ask you to participate in my study.

I am seeking participation for this study in order to describe the main objective of this study, which is to explore and describe the relationship between the quality of sleep and mood states among athletes. The information for this study will be gathered through a biographical questionnaire and three Psychological assessments to measure your mood state, the level of anxiety you might experience and your quality of sleep. The assessment process should take approximately 30 minutes. Assessment will take place once a week on the same day for one month. It is important that you answer as honestly as possible.

The assessment process will be confidential and participation in this study is completely voluntary. Your identity will remain completely anonymous.

A summary report of the findings will be made available to SARU Rugby Academy, EC Sport Academy and the NMMU High Performance Complex. The findings will be written up in the form of a dissertation for degree purposes and will also be presented at a scientific conference.

If you decide to participate in the study, you will be asked to give written informed consent. Please sign your initials against each section to indicate that you understand and agree to the conditions of the research study.

If you require the assistance of a psychologist after the study, you will be referred to UCLIN, the psychology clinic at Nelson Mandela Metropolitan University. Please indicate this need on the biographical questionnaire.

Please feel free to ask any questions that may not have been answered.

Your assistance in this study is greatly appreciated. Please do not hesitate to contact me on 041-504 2330 if you require any information regarding the study.

Thanking you

Nerine Loock Researcher	Lisa Currin Supervisor	Prof Louise Stroud Co-Supervisor	Dr Lynn Slogrove Co-Supervisor

APPENDIX 6: INFORMATION LETTER TO SARU RUGBY ACADEMY, EC ACADEMY OF SPORT AND NMMU HIGH PERFORMANCE COMPLEX

The relationship between quality of sleep and mood states among athletes.

Information letter to the Managers of SA Rugby Academy, EC Academy of Sport and NMMU High Performance Complex

To whom it may concern

I am currently conducting research on the relationship between the quality of sleep and mood states among athletes. This study is being conducted under the supervision of Mrs Lisa Currin, Prof Louise Stroud and Dr Lynn Slogrove. I hereby request permission to allow me to conduct this research at your Academy and High Performance Complex. This study has been approved by the Faculty Post Graduate Studies Committee and the Research Ethics Committee (Human) of Nelson Mandela Metropolitan University (Ethics approval number: H15-HEA-PSY-020).

Aim of the Research

The aim of this study is to investigate the relationship between the quality of sleep and the mood states among athletes. Specific objectives of the study are to explore and describe the quality of sleep and mood states, the relationship between the quality of sleep and mood states among athletes, and the individual differences between the quality of sleep and mood states over a period of one month of observation. This information will be gathered through the completion of 3 assessment measures and a biographical questionnaire. The information will be recorded and confidentiality will be ensured.

Benefits of the Research to the Organisation

- A summary of the findings of the study will be disseminated to each Manager.

- Results may be utilized in order to emphasize the importance of sleep hygiene and the effect thereof on performance.
- Guidance with regards to sleep intervention to enhance the psychological well-being of the athlete.

Research process

Once consent has been received from NMMU, I will:

- Arrange a suitable time where I will discuss the research process and give the necessary information for the participants to make an informed decision.
- Arrange for informed consent to be obtained.
- Arrange a suitable time for the assessment to take place.
- This research will not disrupt training.

If you are willing for your athletes to participate in this research, please complete and return the attached form. Thank you for taking the time to read this information.

Kind Regards,

Nerine Loock Researcher	Lisa Currin Supervisor	Prof Louise Stroud Co-Supervisor	Dr Lynn Slogrove Co-Supervisor

APPENDIX 7: INFORMED CONSENT FROM MANAGERS

The relationship between quality of sleep and mood states among athletes.

I give consent for you to approach the nominated athletes to participate in the above mentioned research study.

I have read the information letter explaining the purpose of the research and understand that:

- The participation of the athletes is voluntary.
- Only athletes who consent will participate in this research.
- All information obtained through psychological testing will be strictly confidential.
- Participants may withdraw from the study without penalty.
- Information obtained will be written in the form of a dissertation and will be made available in the library of NMMU.
- Information may be presented at scientific conferences and if the opportunity arises it may be used to write scientific articles.

_____	_____	_____
Manager′s Name	Signature	Date

APPENDIX 8: SCATTER PLOT MATRIX - STAI, POMS AND PSQI