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RATE OF PERCEIVED EXERTION AND PROFILE OF MOOD STATE (POMS) IN ELITE SPRINT KAYAKERS

by

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I declare that this thesis / dissertation is my own original work. Where secondary material is used, this has been carefully acknowledged and referenced in accordance with university requirements.

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Signature **Date**

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ABSTRACT

TITLE	Rate of Perceived exertion and Profile of Mood State (POMS) in Elite Kayakers
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Sprint kayaking is prominent in Europe with training methods devised and adopted from Eastern bloc training systems. There is a lack of published research on sprint kayaking locally and internationally. Consequently, the aims of this research directly address establishing a relationship between kayak specific training and the Profile of Mood States (POMS); monitoring training duration and intensity and establish a link with the POMS and Rating of Perceived Exertion (RPE); to monitor the general wellness of the kayakers. Seven elite sprint kayakers (two male, five female) with the following characteristics: age 26.5 (1.4) years, training experience 8.4 (3.7) years were part of the South African national sprint kayaking squad selected to participate in this study, based on their preparation for the 2008 Beijing Olympic Games (one male athlete did not qualify but continued to train). The females trained for the 500m K1, K2 and K4 events and the male for the 1000m K1. Three training camps (TC1, TC2, TC3) were held from 12 November to 09 December 2007, 25 February to 22 March 2008 and 14 July to 04 August 2008. RPE (Borg Scale) was recorded for each session. The 65-item POMS was completed twice a week, after half a days rest (Wednesday) and after a day and half rest (Sunday). Daily training load was calculated from RPE and session time; and an energy index calculated from the POMS vigour and fatigue scores. The Wisconsin Upper Respiratory Symptom Survey recorded illness and injury. Descriptive and Inferential Statistics, Friedman's rank test for k correlated samples, The Wilcoxon Signed Ranks Test, Spearman rank-order correlations were used to analyse the data. Statistical significance was calculated at 5% (p=0.05) and 10% (p=0.1). The results showed higher vigour scores associated with lower RPE and low training load; and high RPE associated with higher anger, confusion, depression, fatigue and total mood

disturbance scores. There was a relationship between increasing POMS scores and duration of the training camps. The POMS findings could not completely explain the relationship found between RPE and duration of the training camps. The energy index was higher pre-camp and the extended rest periods during the camps. The findings for the POMS and RPE suggested that a state of overreaching might have occurred during the camps. Monitoring of the kayakers for an extended period after the training camps would have been useful to determine whether any of these individuals became over-trained. In accordance with Kentta *et al* (2006), regular use of the POMS may help detect under recovery, preventing staleness and unwanted rest for extended periods. Future studies will enable a retrospective view on these results.

Key words:

Rate of Perceived Exertion; Profile of Mood State; Training Load; Energy Index; Kayak

OPSOMMING

TITEL	Tempo van Waargeneemde Inspanning en Profiel van Gemoedstoestand (*POMS*) by elite kajakers
KANDIDAAT	N.A. Burden
STUDIELEIER	Prof. P.E. Krüger
GRAAD	Magister Artium

Elite snelkajak is prominent in Europa met inoefeningsmetodes wat ontwerp en aangepas is vanuit die Oosblok afrigtingstelsels. Daar is nasionaal en internasionaal ʼn gebrek aan gepubliseerde navorsing. Gevolglik is die doelstellings van hierdie studie die daarstelling van ʼn verband tussen kajak spesifieke inoefening en die Profiel van Gemoedstoestand (*Profile of Mood State*), die monitering van oefenings tydsduur en intensiteit en die vestiging van ʻn verband tussen die POMS en die Tempo van Waargeneemde Inspanning (RPE), en die monitering van die algehele welstand van die kajakers. Sewe elite kajakers (twee mans en vyf dames) met die volgende karaktertrekke: ouderdom 26.5 (1.4) jaar, en oefenings ondervinding 8.4 (3.7) jaar was deel van die Suid Afrikaanse nasionale snelkajak oefengroep as deel van hulle voorbereiding vir die 2008 Beijing Olimpiese Spele (een man het nie gekwalifiseer nie, maar het aangehou om te oefen). Die dames het geoefen vir die 500m K1 K2 en K4 items en die mans vir die 1000m K1 item. Drie oefenkampe (TC1, TC2, TC3) was gehou vanaf 12 November tot 09 Desember 2007, 25 Februarie tot 22 Maart 2008 en 14 Julie tot 04 Augustus 2008. Die RPE was tydens elke oefensessie bepaal. Die 65-item POMS was twee keer ʻn week voltooi na ʻn halwe dag van rus (Woensdag) en na ʻn dag en ʻn half van rus (Sondag). Daaglikse inoefeningslading was bereken vanaf die RPE en die tydsduur van die oefensessie, en ʻn energie-indeks was bereken deur gebruik te maak van die POMS se Vitaliteit- en Uitsputtings tellings. Die Wisconsin se Opname van Boonste Lugwegsimptome is gebruik om siekte en besering aan te teken. Beskrywende en inferensiële statistiek, Friedman se Rangordetoets vir k-gekorreleerde steekproewe, die Wilcoxon Signed Ranks Test en Spearman se Rangordekorrelasies is gebruik om die data te ontleed. Statistiese beduidenheid was geneem by 5% (p=0.05) en 10% (p=0.1). Die resultate het aangetoon dat hoër Vitaliteits tellings word geassosieer met laer PRE tellings en lae oefenladings; en ŉ hoër RPE telling word geassosieer met hoër Woede, Verwarring, Depressie, Uitputting, en Totale Gemoedstoestandversteuring tellings. Daar was ŉ verwantskap tussen verhoogde POMS tellings en die tysduur van die oefenkampe. Die POMS tellings kon nie die verwantskap tussen die RPE en die tydsduur van die oefenkampe verklaar nie. Die energie-indeks was hoër voor die oefenkampe en die verlengde rusperiodes gedurende die kampe. Hierdie POMS en die RPE bevindinge suggereer dat ŉ toestand van ooroefening mag gedurende die kampe voorgekom het. Die monitering van die kajakers vir ŉ verlengde tydsperiode na die oefenkampe sou van waarde gewees het om te bepaal of enige van die kajakers ooroefen geraak het. In ooreenstemming met Kentta *et al*. (2006), sal die gebruik van POMS moontlik kan help met die bepaling van abnormale hersttel, die voorkoming van ooroefening en ongevraagde rusperiodes. Verdere studie sal egter ŉ retrospektiewe oorsig gee van hierdie resultate.

Sleutelwoorde:
Tempo van Waargeneemde Inspanning; Profiel van Gemoedstoestand; Energie-indeks; Kajak

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LIST OF ABBREVIATIONS

OR: Overreaching

OT: Overtraining

POMS: Profile of Mood State

RPE: Rate of Perceived Exertion

TC1: Training Camp 1

TC2: Training Camp 2

TC3: Training Camp 3

TMD: Total Mood Disturbance

URTI: Upper Respiratory Tract Infection

WURSS: Wisconsin Upper Respiratory Symptom Survey

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

The summer Olympic Games occur every four years with training cycles planned around this event. The importance of the Olympics is magnified due to the time between events (Gould & Maynard, 2009) and is usually the pinnacle of an athlete's career. To reach a peak level or medal winning potential at the Olympics can take more than six years of training and preparation. Traditional training methods for kayaking involve long periods for the development of training goals and the predominance of general over specific training such as long endurance paddles (Garcia- Pallares *et al.,* 2010).

The manipulation of training variables over time is the key concept in periodisation, which allows for the planning and the managing of training (Stebbing, 2009). Effective training programmes offer the optimal approach to athletic development and allow the athlete to peak their abilities at precisely chosen times. According to Bompa, *"...athletic performance depends on the athlete's adaptation, psychological adjustment to training and competitions, and development of skills and abilities"* (Balague, 2000: 230).

Classical periodisation involves the division of training into basic structural units, the training session, training day, micro cycle (e.g., one week), mesocycle (e.g., one month) and macrocycle (e.g., one year). Training can be further divided into phases i.e. preparation, competition, transition, and recovery. The nature of training over a specific time, moves from extensive (high volume/low intensity) to intensive (high intensity/low volume) workloads; and from general to specific tasks. This approach was used during this research in preparing the athletes for the Olympic Games. A few of the athletes had been on the programme for over four years, while others joined with less than three years to the Olympics. Kayaking is a sport, where although paddlers possess unique characteristics not commonly observed in the general population, there is no single trait that distinguishes an elite kayak paddler (Ackland *et al*., 2003).

Kayakers can tolerate different levels of physiological and psychological stress related to training and competition stress. Each kayaker's tolerance level changes through the season and during periods of intense training. During the proposed research periods, the kayakers pushed to states of exhaustion in most training periods. This makes distinguishing overtraining from over-reaching difficult. Overtraining for one may be insufficient training for another. Each kayaker is unique, and responds and adapts to the training stimulus differently and at different rates. Researchers have tried to identify strategies and markers for early detection of overtraining, as there is no diagnostic tool (Budgett, 1998, Halson & Jeukendrup, 2004). There have been a number of drawbacks associated with the traditional training methods (Issurin, 2008). These include the conflicting interactions with different motor abilities due to simultaneous development; insufficient workload specificity for the correct development of selected fitness components; the inability to provide multi-peak performances due to excessive duration of the training phases; and maintaining the residual training effects of previous developed abilities when peaking.

Elite kayakers commit themselves to training programmes that push them to the very limit of their physical capacity, frequently entering a state typically referred to as '*overreached'* (Knettä *et al.*, 2006). However, if prolonged beyond one's limitations, overreaching could lead to a more critical state of overtraining, which is associated with a host of symptoms but is most commonly, recognized by a chronic decrease in performance and severe mood disturbances (Kenttä *et al.*, 2006). The body's response to a possible injurious/stressful situation is a cognitive appraisal of the demands, resources and consequences, followed by physiologic and attention changes (Lavallee & Flint, 1996). Flat-water kayak sprinting is physiologically unique, in that it requires both high aerobic power and anaerobic capacity (Micheal *et al,* 2008). Szanto (2004) confirms that kayakers need to train strength and endurance capacities simultaneously, with a loss of strength when restricted to paddling only.

A person's mood fluctuates continuously throughout the day and is an important indicator of a general psychological well-being. The regulation of mood is essential to maintain healthy habits and lifestyle behaviours. A deduction for a kayaker competing at the highest level, and committing to strict daily training schedules, for weeks and months on end, that controlling their mood would enable efficiency in daily routine. A kayaker's mood can therefore have a strong influence on the outcome of their training and vice versa. Self-regulation of mood is important when a person is in a negative mood. This is to avoid the automatic effects of the mood, which produce mood-congruent thoughts and behaviours as well as dealing with the cyclic nature of moods (Berger & Motl, 2000). Olympic athletes need to develop a variety of coping strategies, and it is unlikely that any strategy will be successful in all circumstances (Gould & Maynard, 2009).

The affects of mood on general behaviour and health has shown much interest. Mood influences the function of the immune system by affecting both the number and activity of B and T lymphocytes, macrophages, leukocytes, antibodies, and reactivity to antigens and pathogens (Maier *et al.,* 1994). Maintaining and ensuring their heath is critical to elite kayakers. Neglecting it could lead to serious consequences for them, including overtraining and the risk of nullifying all efforts to reach a peak performance. The total amount of stress which exceeds the capacity of the organism to cope is the main reason overtraining or staleness is encountered (Kuipers, 1996)

Berger and Motl (2000) found that with or with out conscious effort, humans try to maintain good moods and to lessen the effects of negative moods. Berger and Motl (2000) stated there is a strong consensus that mood enhancement is the primary benefit of physical activity. Low to moderate intensity exercise has proven association with positive psychological benefits, such as improvement in mood and the alleviation of anxiety and depression in various populations (Mckune *et al.,* 2003).

Despite considerable research, there is no reliable and widely accepted method for accurately monitoring both training and recovery (Kenttä *et al.* 2006). Evaluation of a kayakers training status includes many ways, general guidelines and procedures that give an indication. The ability to monitor training is critical to the process of quantitating training periodization plans (Foster *et al.*, 2001). The Profile of Mood State (POMS) is a useful and practical method to monitor the response of athletes to training loads.

Robson-Ansley *et al*. (2009) noted that it is impractical to screen Olympic athletes in the laboratory to assess daily fatigue objectively, especially when these athletes may live and train long distances from specialist facilities. Therefore, subjective fatigue assessment using psychological questionnaires as a practical method of monitoring fatigue and recovery in athletes is used, and has shown to be a reliable indicator of adaptation to training load i.e. training load, perceived stress, and psychological mood states.

There is limited research on monitoring kayakers and the effects over an intensified period of training, specifically athletes that require high levels of strength and endurance (Garcia-Pallares & Izquierdo, 2011). Minimal research has been conducted on female kayak paddlers in relation to 500m performance, and specifically, to identify their physiological characteristics (Bishop, 2000).

1.1.1 Statement of the problem

There is a lack of published research on sprint kayaking locally and internationally, consequently this research directly addresses perceived efforts during training and mood affects. There are many common coaching/training systems including unique methods used among international kayakers, which bring about similar performances. The coaching system used in this research is synonymous with the eastern European way of training. With sport science being more prominent and essential in competitive sport, it is necessary to determine and quantify the effects on the kayakers, especially psychologically.

The current problem for the elite sprint kayaker has been with training and reaching a peak level for a specified event. Indicators and factors influencing the kayakers, based on their subjective feedback need to be determined, which allows for adequate recommendations and guidance for future training schedules.

1.1.2 Aim of the research

i) To establish a relationship between kayak specific training and the POMS.

ii) Monitoring training duration and intensity using RPE, and to establish a link with the POMS and RPE over intensified periods of training;

iii) To monitor the general wellness of the kayakers

1.2. OBJECTIVES

The studies objectives are:

- To establish an understanding of sprint kayak specific training, over different training phases, and in preparation for the Olympic Games;
- To look at prolonged periods of intense training spanning three to four weeks;
- To use subjective kayaker responses to exercise and establish the effects of training, through psychological and physical means;
- Establish conclusions and recommendations regarding preparation for the Olympic Games and future sprint programmes.

1.3. RESEARCH HYPOTHESIS

Thomas and Nelson (2005) stated that the hypothesis is the expected result, or anticipated outcome. The solution to the problem postulated is based on a theoretical construct, previous studies or the experimenters past experience and observation. It is expressed as a statement of a relationship between dependent and independent variables that give direction.

The following research hypothesis is formulated:

The kayakers will experience changes in the measured subjective variables in relation to their baseline values, because of the intensified training periods.

Sub-hypotheses formulated from the main hypothesis:

- **The RPE will increase over the duration of the training camps;**
- **The POMS scores will progressively decline during the training camps;**
- **The POMS scores will be statistically significant with the RPE scores**

1.4. RESEARCH APPROACH

This study used **Quantitative research** methods. Kayakers will have data recorded from training camps in a ten-month period prior to the Olympic Games of 2008. This period includes three training camps. TC1 includes endurance, cross training, and strength development. TC2 includes kayak specific endurance and threshold training. TC3 is a pre-competition/peaking period five weeks before the Olympic Games. The training camps are intense and specific in nature. The kayakers received guidelines and instructions for the data collection over the camp.

1.5. TYPE OF RESEARCH

This research used a **Quasi-Experimental** design. According to Thomas and Nelson (2005), the purpose of quasi- experimental designed research is to fit the design settings more like the real world while still having as much control of the internal validity as possible.

1.5.1 Identifying and involving participants

The population group chosen, stemmed from the researcher's interest, due to participation, current involvement and pursued interest in the sport of sprint kayaking.
The South African Sprint Kayakers qualified the largest team for the Olympic Games in 2007, and the researcher saw it as an opportunity to monitor the selected team during their preparation.

Single-subject design – these are most often used in clinical settings where participants are measured repeatedly on the task of interest. An important aspect to this type of study is to gather pre-test information, or a baseline measure. It is important to measure the dependent variable or behaviour prior to administering any treatment. Without this information, it is difficult to determine if any change has occurred. Often associated with this design are periods of measurement to determine not only a change but also the degree of change through the process of behavioural modification. The effects can be determined from the same treatment on different subjects, different treatments on different subjects, and even different treatments on the same subject (www.allpsych.com)

Correlational study – Correlational studies are used to look for relationships between variables. There are three possible results of a correlational study: a positive correlation, a negative correlation, and no correlation. The correlation coefficient is a measure of correlation strength and can range from –1.00 to +1.00 (Cherry, 2008).

While correlational studies can suggest that a relationship exists between two variables, they cannot prove that one variable causes a change in another variable. Correlation does not equal causation, which may be due to other relative factors. A naturalistic observation involves observing and recording the variables of interest in the natural environment without interference or manipulation by the experimenter. The advantages of a naturalistic observation include giving the experimenter the opportunity to view the variable of interest in a natural setting; offer further research idea's and may be the only option if lab experimentation is not available. This is a technique employed in this research. The disadvantages include time consumption and expense, not allowing for scientific control of variables and the experimenters control of extraneous variables. The subjects may also be aware of the observer and may act differently as a result (Cherry, 2008).

CHAPTER 2
LITERATURE REVIEW

2.1 KAYAKING – OLYMPIC SPORT

Flat water kayak sprinting is raced over 200m, 500m and 1000m distances on a straight course in individual lanes. The aim of the discipline is to paddle the given distance in a straight line in the fastest time. Kayaking is identified by the letter "K" and the number of people in the boat i.e. K2 – two people. The categories raced are K1, K2, and K4. A double-bladed paddle in a sitting position propels the kayak. The introduction of flat-water racing to the Olympic Programme was in 1936, and the first World Championships being held in Sweden in 1938. Canoe/Kayak racing is the fourth largest Olympic sport with sixteen events – four slalom and twelve flat-water sprints (www.canoeicf.com).

At the 2008 Beijing Olympic Games, the male kayakers competed in the 1000m K1, K2 and K4 categories as well as 500m, K1 and K2 categories. Female kayakers competed in the 500m K1, K2 and K4 categories. Recently (2009) the International Canoe Federation (ICF) and the International Olympic Committee (IOC) introduced the 200m as an Olympic event to the 2012 London Olympics. This replaces the male 500m event and a new event for the females is now open (www.canoeicf.com).

The performance of a kayaker depends on a number of physical and psychological factors that include (Szanto, 2004):

- Physical: Body Structure
- Strength: maximum, endurance and explosive
- Endurance: aerobic and anaerobic
- Technique
- Psychological: Will power, dedication, competitiveness and motivation

In a review done by Michael *et al,* (2008) they found absolute $V0_{2max}$ for elite kayakers to vary between 4.01 and 4.7 $L.min^{-1}$ and relatively between 53.8 and 58.8 $ml.kg^{-1}.min^{-1}$.

Michael *et al.* (2008) noted peak kayak paddling performance is dependant on maximal metabolic power (aerobic and anaerobic) complimented with superior locomotion economy. The anaerobic energy system seems to be an important factor for successful performance as well as great upper body muscle strength. Kayak paddlers spend the majority of their race at around peak $V0_2$ and the percentage of oxidative processes increases and anaerobic sources decrease with distance of the race. The aerobic contribution expressed as a percentage of $V0_{2max}$ was shown to be 73% for 500m lasting (1min45) and 85% for the 1000m (lasting 3min 40) (Michael *et al,* 2008). Mean lactate threshold occurred at a blood lactate concentration of 2.7mmol.L^{-1}, at a heart rate of 170 beats.min^{-1} and a $V0_2$ of 44.2 ml.kg^{-1}.min^{-1}.

Skilled kayak paddlers are able to minimise any excess body movements within the kayak to provide a more powerful and efficient stroke compared to sub-elite paddlers (Michael *et al.* 2008). High performance sprint kayaking requires a high level of relative strength, excellent local muscle endurance and the ability of muscles to perform in low pH environments (Fekete, 1998). Excellent lactic acid clearance and proton buffering capacity of the blood are also prerequisites for producing a high level of mechanical output. The ultimate goal of strength training and conditioning for sprinting is to elevate the paddlers overall capacity. Achievement of this is through properly structured and periodised strength training programmes, to a level where they can produce a consistent high power output.

The age of the kayakers and competitive time in the sport is an indicator of physical, sexual and mental maturity. The age of a kayaker does not determine the performance standard. An efficient kayaker maximises the paddle stroke to make the boat travel faster with less energy. Errors or weaknesses in paddling technique cause the boat to move less efficiently, or alternatively, place greater stress on both the muscular capabilities and the energy reserves of the paddler (Szanto, 2004). Continuous refinement and neural conditioning affects an efficient kayak technique. By dividing skills into open and closed, it is possible to compare different skills in different sports

(Beashel *et al*., 2001). The skills fall on a continuum, which considers the effects of the environment on the skills. The definitions are:

Open skills: the environment is constantly changing and movements have to be continually adapted. Therefore, skills are predominantly perceptual. The skill is mostly externally paced (Beashel *et al*., 2001).

Closed skills: These skills take place in a stable, predictable environment and the performer knows exactly what to do and when. The environment does not affect the skills and they tend to be habitual. Movements follow set patterns and have a clear beginning and end. The skills tend to be self-paced (Beashel *et al*., 2001).

Sprint kayaking falls near the middle of the continuum, based on the definitions of closed/open skills. There is a clear end to the race, but the actions of the opponents and environmental factors can influence the kayaker. It could be argued that it should be put nearer to the closed skill side, as the nature of racing in lanes creates an individual environment, and with the circumstances being the same for all competitors

2.1.1 Training

An increase in the contribution of sport science to the planning and guidance of training has occurred in the last decade. Kayakers are using training systems that have evolved from the trial and error days of the past and now entwined with specifically tailored scientific methods. Each training session causes a physiological stress and adaptation that result in transient physiological and metabolic changes (Lambert & Borresen, 2006). These changes include the return to pre- exercise resting levels after the exercise completion.

The accumulated acute bouts of training stimulate adaptations, transient levels of fatigue, and positive and negative effects on functional capability. Insufficient training loads will not stimulate adequate adaptation, whereas an excessive training load impairs performance and is detrimental to the health of an athlete (Hayes & Quinn, 2009).

Sprint kayaking involves a high degree of muscularity and aerobic power. However, there is conflicting evidence relating to the interaction of strength and endurance training simultaneously (Garcia-Pallares & Izquierdo, 2011). Bishop (2000) found that despite suggestions otherwise, absolute aerobic power values may be more important than relative values. With body weight supported there was a stronger correlation between 500m time and relative peak than absolute peak in women. This highlights power to weight ratio as an important factor. A larger kayaker may have a higher absolute peak VO_2, but sits deeper in the water, giving an increased wetted area, and increasing the drag co-efficient (Michael *et al*., 2008). The drag of the kayak and the efficiency determine the energy cost of kayaking, which is critical to the kayaker. Bishop (2000) explained that while a large aerobic power is very important, anthropometric characteristics could also influence performance of the sprint kayaker.

Chronic adaptations to training depend on each kayaker's current level of fitness and ability to adapt. The type of adaptation depends on the nature, intensity, duration and frequency of the training session (McArdle *et al.*, 1996). The increased stress or overload causes a disruption of homeostasis and a temporary decrease in function could arise from the training (physiological stress) (Kenntä & Hassmen, 1998). Selye's General Adaptation Syndrome (Meeusen et al., 2006) can explain psychological stress, illness (Halson & Jeukendrup, 2004) or a combination of these. The bodies stress response is tri-phasic and the ability to resist stress is finite with continual exposure.

- Alarm Stage – decline in general resistance;
- Stage of Resistance – the body's resistance to the stressor rises above normal; and
- Stage of Exhaustion – continual exposure results in drop of resistance below normal

Adaptation to training depends on the design of the programme. A good programme should focus on factors such as frequency and length of sessions and training period i.e. speed, intensity, and repetitions. The key factor in any training regime is adequate rest, which brings about the adaptations. Garcia-Pallares and Izquierdo (2011) noted the planning of the programme for elite cyclic (repetitive continuous movements) athletes is important.

In certain training period's elite athletes' can spend up to eight hours of the day training over two to four sessions. The line between sufficient and insufficient training is quite fine. The training outcomes are evident once the competition phase has begun or the required performance objectives are attained. It could also be subtleties in training that result in a positive or negative outcome (Kenttä *et al.*, 2006). Kenttä and Hassmen (1998) noted that a specific training stimulus might improve the athlete's performance at one time and maintain or cause overtraining at other times. The higher the training age of the athlete the closer they can get in judging the positive outcome of the training schedule.

John Raglin (Kenttä & Hassmen, 1998) describes three degrees of training: positive overtraining to produce optimal performance; maintenance training to remain at a certain level; under training when the stress is insufficient to maintain performance can also result in a decrease in performance. To optimise the benefits of training, the capacities of the athlete need to be accounted for (McArdle *et al.,* 1996). This applies to athletes in the same team or event, and is counterproductive and unrealistic to expect all athletes to respond to the same stimulus in a similar manner. There are general components to an athletes training, and distinguishing them is the psychological aspect. Another key area is establishing, understanding and monitoring the relationship between athlete and coach. This is crucial to assessing the progress and forward momentum of the training programme. An athlete's self-awareness is also very important. Athletes may encounter many unaccounted and unexpected extraneous variables that need to be minimised and handled efficiently. Contributing stressors include frequent competition, monotonous training, psychosocial stressors, illness and heavy travelling schedules (Halson & Jeukendrup, 2004). There has been considerable research undertaken to monitor the adaptations associated with training.

2.1.2 Overreaching

Overreaching is defined as "…*an accumulation of training and non-training stress resulting in a short-term decrement in performance capacity with or without related physiological and psychological signs and symptoms of overtraining in which restoration of performance capacity may take from several days to several weeks*" (Kreider *et al.,* 1998: viii). The non-training part of this definition could be more critical in an athlete's preparation than most research has found. Previous studies have focused more on the training load rather than the measure of fatigue or recovery. Overreaching is almost desirable in an athletes training programme (Kenttä *et al.,* (2006) and has been argued that it may be a relatively normal and harmless stage of the training process (Halson & Jeukendrup, 2004; Meeusen *et al.*, 2006). Rietjens *et al.* (2005) noted that the symptoms can be held for three to six weeks despite a reduction in training load. They noted large increases in training volume rather than intensity, results in overreaching or overtraining.

Determining factors of over training, such as changes in performance, mood state, physiology, biochemistry, glycogen depletion, immune system, hormones and autonomic balance have been investigated (Halson & Jeukendrup, 2004). These are possible factors used to indicate overreaching, with a general acceptance that it precedes the overtraining syndrome (Rietjens *et al.,* 2005). If performance is measured over a period of intensified training and remains unchanged then an athlete cannot be diagnosed as over reached. It seems that consistent underperformance is the main criteria for diagnosing overreaching, but in relation to other factors and the positive affects of training. For optimal performance a balance between training and recovery is necessary, but for well trained athletes on a demanding programme it can be difficult, especially with psychological and social factors influencing them as well (Rietjens *et al.,* 2005). Halson and Jeukendrup (2004) found studies on swimmers reporting overtraining, based on the failure to improve performance. They suggested it might be due to insufficient training volume and intensity, despite high fatigue ratings. Monotony of training due to the nature of training in the same location was another possible reason.

2.1.3 Overtraining

Overtraining has been a widely debated topic and knowledge is growing in the literature. The parameters surrounding overtraining make defining it complex, as there is no gold standard (Roose *et al.*, 2009). The terminology that describes this condition is not well defined due to the lack of understanding of the precursors that result in the chronic decrease in performance. Jones and Tenenbaum (2009) noted the lack of consensus in the terminology for description, with such terms as '*overtraining syndrome', 'staleness', 'burnout', 'chronic fatigue'* and *'sports fatigue syndrome*'. Budgett (1998) suggested redefining it as the 'unexplained underperformance syndrome' to incorporate the differing etiology in athletes. This is identified by a persistent performance deficit despite two weeks of relative rest, which cannot be explained by a major disease.

Overtraining has been described as the process while the product is '*staleness*' or '*overtraining/overreaching syndrome'* (Cockerill, 1990). Meeusen *et al.* (2006) concur, stating that '*syndrome*' emphasizes a multi-factorial etiology where exercise is not necessarily the sole causative factor for the syndrome. The commonly used term '*overtraining syndrome*' is usually associated with an imbalance between training and recovery between sessions (Lambert & Borresen, 2006). Kenttä and Hassmen (1998) found training falls on a continuum, the reason that a fine line exists between optimal training and overreaching. They stated further that overreached and staleness are on opposite ends of the overtraining-response continuum. This continuum excludes acute fatigue, under training and maintenance training. Meeusen *et al.* (2006) stated that the change along the continuum can be quantitatively measured (increase in training volume) as well as qualitatively (psychological and endocrine distress). It is generally agreed that a change in performance is the basic necessity for determining a maladaptation to training and to discriminate amongst the various definitions (Halson & Jeukendrup, 2004; Roose *et al.,* 2009).

Training can have a positive or negative effect and can be the demise or success of an athlete. The process of negative overtraining is defined as ''…*an accumulation of training and non-training stress resulting in a long-term decrement in performance* *capacity with or without related physiological and psychological signs and symptoms of overtraining in which restoration of performance capacity may take several weeks or months''* (Kreider *et al.,* 1998: viii). In other words the athlete fails to recover from training and becomes progressively fatigued and suffers from underperformance for a prolonged period (Budgett, 1998).

There is further recognition of two types of overtraining (Kuipers, 1996): a sympathetic overtraining, characterized by increased sympathetic tone at rest leading to restlessness and hyper excitability (Halson & Jeukendrup, 2004). This is usually seen in team sports and sprint events (Kuipers, 1996). Sympathetic overtraining is believed precede the parasympathetic overtraining (Conttä & Hassmen, 1998). Parasympathetic overtraining is characterized by the inhibition of the autonomic nervous system at rest and during activity. Common symptoms include hypoglycemia during exercise, decreased resting blood pressure and depression. These have been identified in endurance athletes (Kuipers, 1996; Birch & George, 1999) who are primarily affected by overtraining (Budgett, 1998). Halson and Jeukendrup (2004) suggested that the parasympathetic form may be a more advanced stage of overtraining, due to an imbalance between extended duration, high intensity endurance training and little regeneration, as well as possible other non-training stressors. Budgett (1998) believes there is evidence to suggest endurance athletes present with fatigue and underperformance, with secondary changes in mood. Sprinters and power athletes present primarily with changes in mood, with subsequent changes in performance. Halson and Jeukendrup (2004) stated it has been anecdotally suggested overtraining pertains more to endurance sports, while overreaching more in team sports and explosive/power sports, such as sprint kayaking.

A proposed '*biopsychosocial model of adjustment*' is made with factors and variables associated with previous descriptions, forming subtypes e.g. immunological suppression subtype, performance decline subtype. They redefined an athlete's overtrained state as an adjustment disorder that "...*involves a biopsychosocial response to an identifiable stressor or stressors that result in the development of clinically significant biological, emotional, cognitive and/or behavioural symptoms*" (Jones & Tenenbaum, 2009: 186).

These include any stress adjustment for the athlete. It is unethical to induce a stage of overtraining in an athlete, a reason why research is fairly limited and inconclusive.

The difference between overtraining and overreaching appears to be the time period needed for performance restoration (Halson & Jeukendrup, 2004); however there is also no evidence to suggest that the type of training, duration and degree of impairment is the same for overreached and overtrained states. According to Kenttä and Hassmen (1998), the time frame for recovery should be less than 72 hours; according to elite athletes' perspective; anything longer than this indicates working too hard. Elite athletes can not afford to miss training sessions, as they make part of a constructed training plan. Rest is entirely opposed to an athlete's instinctive response when a decline in performance occurs. Athletes' respond differently to training stimuli which explains different degrees of staleness experienced under equal training stresses. Athletes have different capacities, and the same training stimulus may improve, maintain or cause staleness. The energy expenditure to maintain a performance standard will be greater, with an accompanying increase in perception of effort (Kenttä & Hassmen, 1998).

There are indistinguishable symptoms that may appear to be normal physiological responses to a training load (Birch & George, 1999). Stress is the sum of training and non-training factors which accumulate. Stress is a specific syndrome but is not specifically induced e.g. environmental and emotional (Halson & Jeukendrup, 2004). It is unclear to what extent the non-training stress factors influence the overtraining syndrome (Kenttä & Hassmen, 1998). Many authors and sport scientists noted the origins of stress from physiological, psychological and social aspects (Jones & Tenenbaum, 2009). Occupational, educational and social stressors should not be disregarded, as well as monotony of training, personal and emotional problems and emotional demands of occupation (Meeusen *et al.*, 2006). Overtraining induces changes at the level of the central nervous system, neuro-endocrine system as well as the peripheral level (infections) (Rietjens *et al.,* 2005). Common symptoms of overtraining fall into four major categories: physiological, psychological, biochemical and immunological (Kenttä & Hassmen, 1998). These are characterized by sleep disturbance, weight loss, anxiety, raised resting pulse rate and increases sweating, and loss of competitive drive (Budgett, 1998), poor performance, reduced appetite, overuse injuries, mood disturbances, immune system deficits, concentration difficulties (Kenttä & Hassmen, 1998). Insomnia with or without nocturnal sweating, mild to severe depression and other negative mental feelings indicate the central nervous system is affected (Rietjens *et al.,* 2005). These factors can also be associated with adaptive training, which highlights the fine line with excessive training periods.

There is no diagnostic tool to identify an athlete suffering from overtraining which makes diagnosis possible by excluding all other variables (Budgett, 1998; Halson & Jeukendrup, 2004, Meeusen *et al.* 2006). Owing to human variability the physiological and psychological responses are difficult to diagnose. Exercise testing can be used to detect overtraining and include variables such as power output, blood lactate, heart rate and heart rate recovery. Psychological testing has shown to be more effective in detecting overtraining. An important pre-cursor and indicator of fatigue and overtraining is the athlete's mood state (Robson-Ansley *et al*. 2009). With early detection, the athlete can maintain a higher training volume through strategic rest intervention strategies, by identifying and altering the training programme. A useful tool in preventing overtraining in swimmers, runners and kayakers is the POMS. The psychological markers are more identifiable and monitoring the changes is more reliable. Moods fluctuate with training levels and are very replicable; some mood states are highly sensitive to increases in training load, while others are more sensitive to overtraining. Kenttä and Hassmen (1998) noted mood state variations often correlate with those of physiological markers.

Coaches and sport scientists agree that to maximize physiological adaptations and to avoid overtraining, proper handling of training programme variables, including the intensity, frequency and volume of exercise, is required (Garcia-Pallares, 2009). The fatigue associated with normal training while monitoring for the symptoms of overtraining can cause confusion. The management of an individual who has overtrained requires a holistic approach to recovery. Kenttä and Hassmen (1998) suggest looking holistically at the classification of the symptoms of overtraining, and can include behavior and perception changes of the individual. It may be difficult to put certain symptoms in one category, as they may overlap. The area in greatest need of attention during the overtrained period (physical overtraining, psychosocial stresses) should be treated primarily. Done and Hassmen (1998) identified four main categories during recovery to be attended to: hydration; sleep/rest; relaxation and emotional support; and stretching and active rest. The diagnosis of overtraining can often only be made retrospectively when the time course can be overseen. This is compounded by non-specific, anecdotal and numerous clinical features which vary from each individual (Meeusen *et al.,* 2006). Budgett *et al.* (2000) agree in most cases, when comparing performance decrement, it would be the coach and athlete who are best able to measure this. They could compare data to previous training cycles and even Olympic cycles (i.e. four years).

2.2 PERIODIZATION TRAINING FOR PEAK PERFORMANCE

The super compensation effect of training by eastern European countries for sprint kayaking is well used. The training methods stem from empirical observations of successful coaches and theoretical knowledge, dating back to and deriving from the 1950's (Garci-Pallares *et al.*, 2010). The National coach used these methods during the training camps in this research.

A training and recovery unit is the process of breakdown and recovery initiated by a single training bout. The sequence of these creates the overtraining process. The basic structural units of periodization are the training session, training day, microcycle (e.g., one week), mesocycle (e.g., one month) and macrocycle (e.g., one year). These are used in different preparation phases i.e. pre-season, base training, competition, peaking. Research into the effectiveness of periodization of physical training has however not been conclusive (Stebbing, 2009). The goal of training is to produce a winning performance or personal best time, at a specific time i.e. World Championships, Olympics. Borresen and Lambert (2009) stated that the prescription of training required to achieve this has been largely instinctive, resulting from years of personal experience in the coach and athlete. .

Periodisation is the best method for effectively structuring and manipulating strength training and conditioning in a goal-orientated manner. It allows for planned, optimal and timely conversion/translation of gains achieved in one dimension of strength into qualities and further gains in another dimension. Fekete (1998) stated that through theoretical consideration and practical experience, strength is the basic quality that provides the necessary foundation and influences the performance. The most effective strength training modality for optimal sequencing and integration of movements is free weight training.

Periodisation does not always lead to standardized, quantifiable results. Other factors, such as athletes' perceptions, non-training stressors, circadian rhythms and technical/tactical issues also have an impact on the outcome (Marshall, 2003). Training designed in a structured periodized manner allows for a progressive overload and time for recovery, (Budgett, 1998). Although the performance/competition times of the kayakers are short, the training sessions usually consist of two to three session a day, due to the high aerobic and anaerobic qualities required. The more intense the training the more benefit the athlete would get from higher quality recovery (Kenttä & Hassmen, 1998).

Häkkinen *et al.* (2003) found that endurance training interfered with strength training. The indication is that sport specific mixed training regimes, compromised performance capacity, likely inducing a state of overtraining. Leveritt *et al*. (1999) found that the interference of the concurrent variables might come from the inability of musculoskeletal tissue to adapt simultaneously. As well as the possibility that endurance training creates residual fatigue and reduces the ability of the muscles to generate force. Garcia-Pallares (2009) found in their research that it is possible to develop muscle strength and endurance in a periodised training programme.

Experienced elite athletes with a high training age may use '*unidirectional training*'. This incorporates focussing on one aspect of fitness for several weeks (e.g. strength), followed by a shorter focus on a different aspect (e.g. power) (Marshall, 2003). This approach, known as '*conjugated sequencing*', a four-week period of overreaching is followed by a two-week block with a change of emphasis to allow for super compensation. The concentrated block of training results in a 'long-term delayed training effect' of anything between four and twelve weeks, depending on the volume and intensity of the training. The two-week block should concentrate on speed and power. The advantage of this system is that the athlete does not suffer from the demands placed on their body by other training. It also offers a period of concentrated training on one aspect, allowing for overloading and a subsequently greater effect on fitness (Marshall, 2003). This allows for a lower overall work volume (not intensity) because of training one aspect at a time. Unidirectional training requires an ability to tolerate heavy training loads without breaking down, which is why athletes with an advanced training age should use it. Advanced short-term recovery methods are useful in preventing breakdown in the overreaching cycle. Short-term performance will suffer because of the overreaching part of the cycle, but the overall gains may be higher. Prevention of overtraining is more advantageous than treating it with complete rest (Kenttä & Hassmen, 1998).

2.2.1 Phases and Cycles

There is manipulation and sequencing of training variables throughout the year e.g. load, volume, intensity. Traditional phases of kayak training include a base period of establishing an aerobic capacity and conditioning, and a special preparation phase where intensity and tempo are increased, followed by a racing phase. Szanto (2004) adds a transition phase in, for physical and psychological recovery. These phases are divided into macro cycles, of three to six weeks each. Each macro cycle is broken into a micro cycle of one week, which is broken into single days of training. Traditional training development is through a pyramid structure, starting with an aerobic base to facilitate training at higher intensities. The athlete needs both aerobic base and hard intensity training to be able to maintain peak racing potential. These phases develop the following principles in the following order (Szanto, 2004):

- Basic endurance, strength development, preconditioning;
- Long, medium and short endurance capacity;
- Speed endurance; and Speed

The most important competition dates form the base of the training programme. Individual physical traits and skill determine the kayaker's distance of preference i.e. 200m, 500m and 1000m. Many kayakers are able to race competitively over the 1000m and 500m distances. The International sprint racing season peaks with the Olympic Games or World Championships, which usually take place in August, with a series of World Cups prior, through May to June. The training programme initiates in October through to April and then a focus on race preparation occurs over the competition period. Teams hold training camps throughout the year, usually to facilitate and intensify the period of training over that time. Factoring location into the training programme is essential, as it is beneficial to have warmer temperatures for training. The sprint competition period is during the Southern Hemisphere's winter; so many teams travel to and around Europe to train and race. During the base training period, the European and Northern Hemisphere countries travel to climates that are more suitable. Cross-country skiing is a very good cross training exercise used by kayakers as well during these months. Swimming is another cross training exercise used over this period.

During the base work period, the paddling intervals are longer (from four to fifty minutes or 1000m to 10,000m), at a lower intensity, and with shorter rests in-between (thirty seconds to two minutes). During the intensive phase of training, the intervals decrease in time and distance with increasing intensity e.g. thirty seconds to eight minutes or 100m to 2000m with shorter rest intervals (one to three minutes), this also includes focus on speed-work and race planning. . Training at close to anaerobic threshold increases the anaerobic capacity of the athlete over this phase. During the intensive phase, it is important to include lower intensity aerobic sessions to maintain the base. The overall volume of training decreases as the athlete gets closer to competition (race phase). These high intensity sessions are generally interspersed by recovery and technique sessions. Birch and George (1999) stated that periodization of training is important to allow for performance monitoring, training modification and to avoid training monotony.

The kayaker's progress can be monitored with the following factors:

- **Objective factors:** Time trials, resting pulse rate, recovery time, protein in the urine, bloods pH (Szanto, 2004), lactate, critical power, oxygen consumption (Borresen & Lambert, 2009); and
- **Subjective factors:** Behaviour, mood, reaction and training motivation, log books, RPE (Szanto, 2004).

2.2.2 Strength Training

Fekete (1998) proposed an annual strength training programme that incorporates four mesocycles. In this study, the participants were monitored over three out of the four mesocycles described by Fekete. The types of resistance training throughout the cycles contain variations of similar exercises performed at different speeds i.e. slow repetitions to maximal repetitions, and are essential to maximizing performance. Knowledge and understanding of the different techniques is important for coaches and athletes (Egan *et al.,* 2006)

The first mesocycle – General Anatomical Preparation - is corrective and regenerative in character and is important for athlete longevity. The training consists of three to four sessions a week of medium volume, intensity, and density and continues for about eight weeks. Extensive and proper warm ups should be done before each work out. The exercises are done in a slower, technically controlled manner with full range of motion. It is important to develop a high level of body awareness during this period. Expected results are an increased bone mass and bone mineral density, increased muscle mass, muscle balance and range of motion, increased tensile strength of tendons and ligaments, improved dynamic joint stability and improved tissue mobility (connective, muscle and nerve) (Fekete, 1998).

The second mesocycle – Maximization of strength - forms the base. Three sessions a week are characterized by medium volume, complexity and variety, and medium-to-medium-high intensity. Progression is important in this period. When more than 12 repetitions can be completed, the weight should be increased by about 5-10%. There should be sufficient rest between the sets. Szanto (2004) adds that the quicker velocity of the movement will add more strength. Targeting core muscles at the end of the session, will avoid untimely fatigue in the stabilizers. This period lasts 8-12 weeks. Results to be expected are further anatomical increases from the first mesocycle (Fekete, 1998).

The third mesocycle proposed – Specific Preparation - is characterized by constantly changing the emphasis and interrelation of the components. This is broken down into two sub phases: the first aiming to increase muscle endurance through compound sets of various exercises, and the second, at speed endurance through circuit training. Szanto (2004) agrees that endurance strength is the foundation of sprinting. The exercises become more sport specific i.e. one-arm rowing, bent-over rowing, lateral shoulder raises with an increasing intensity through out the cycle. This is due to a faster movement execution, increased number of sets and reps (four to six sets of 60 to 80 reps) and decreasing the length of rest periods. At the beginning of the work out the structural exercises performed in the first meso-cycle are repeated with medium intensity. Execution of the movement is with a fast concentric action accompanied by a total relaxation of the antagonist. There is no pause between concentric and eccentric phases. The onset of blood lactate accumulation should occur with higher loads and then continue with reduced loads as this reflects the metabolic profile of the sport (Fekete, 1998). Marshall (2003) noted the use of complex training, where near-maximal power/speed exercise follows strength exercise. This is based on the muscles ability to produce force immediately following acute resistance exercise. Proposal of this is due to an increase in reflex electrical activity in the spinal cord, which is likely to be apparent only in trained athletes. The core muscles are targeted again at the end of the work out.

Circuit training conditions the body to perform fast movements at a consistently high power output. The variable components of circuit training are the number of exercises, kind of exercise, number of repetitions at each set or working time, resting time between sets/periods, number of circuits and the load/intensity (Fekete, 1998; Szanto, 2004).

The adaptive changes that occur during this phase depend on the athlete's genetic potential and training status, reflected in (Szanto, 2004):

1. Increased oxidative enzyme levels and increased activity of local oxidative system;
2. Higher plasma lactate levels;
3. Increased proton buffering ability of the blood and muscles as well as increased ability of the muscles to function in a high proton and lactic acid environment;
4. Increased number of capillaries per fibre;
5. Conversion of fast twitch type IIb fibres to fast twitch type IIa fibres;
6. Optimization of sarcomere length for optimal force production;
7. Optimization of recruitment patterns and rate coding;
8. Increased ability of muscles to store glycogen;
9. Increased ability of the CNS to tolerate fatigue; and
10. Enhanced organization of central command for muscle action

The fourth mesocycle – The Competitive Period - It is important to maintain existing strength, power and muscle endurance well into peaking for competitions to attain a high performance capacity. The sessions consist of medium volume and low to medium intensity e.g. two to three sets of structural exercise at 60% 1-RM and three sets of 8-12 reps. Abdominal and core exercises should again be completed, and at the end of the work out (Fekete, 1998; Szanto, 2004). During the intensive phase, a kayaker should limit resistance work to one or two sessions a week (Fekete, 1998). The other form of strength training can be done off the water doing exercises using body weight or free weights.

2.2.3 Tapering and Peaking

It is important to balance training and recovery, with higher intense training usually found closer to competition, requiring longer recovery to allow for adaptation. It is important for coaches who understand the concepts involved, to supervise periodised training closely, to avert the risk of physical and mental overload leading to overtraining. A taper is the training phase characterized by a reduction of training leading up to a major competition

(Mujika, 2010). During this period, workload volume decreases, the intensity increases and adequate time for resting each day is needed as well as mental preparation. This period allows for maintenance of previously trained aerobic power and also induces high levels of fatigue on the athlete, but also allows for enhancing physiological training adaptations (i.e. lactate threshold) and performance capabilities.

For elite kayakers, personalized training methods and workloads are essential with maintaining stimulus and motivation. Kayakers have developed and practised race plans, and eliminated all variables with potential to cause a physical or mental handicap e.g. the start is an important aspect of the race especially in the 200m and 500m and a missed stroke or delayed stroke can create a big disadvantage. There is also the risk of minimizing the volume and intensity too much, which may lead to a de-training effect (Mujika, 2010). Bosquet *et al.* (2007) determined that maximal performance gains are obtained with a total reduction in training volume of 41–60% of pre-taper value, and that such a reduction should be achieved by decreasing the duration of the training sessions, rather than decreasing the frequency of training. After races, an analysis of results together with a feedback session from the coach with objective data e.g. video footage forms the base of a good performance assessment. Coaches are the most insecure about the taper period and the most suitable training strategies for each athlete (Le Meur *et al.*, 2011). Recently sports scientists have increased their understanding of the relationship between reducing training before competition for performance changes, to alleviate the trial-and-error approach.

2.3 ATHLETE AND COACH RELATIONSHIP

Coaches play an important role in developing and helping athletes to reach peak performance. They guide the practice of skills, provide instruction and feedback, and monitor performance, which helps the athlete realise their potential (Carter & Bloom, 2009). Coaches can acquire training knowledge through mediated, unmediated and internal learning situations, but the generally agreed upon source is through previous elite-level athletic experiences (Carter & Bloom, 2009). Coaches need to be open-minded, flexible and able to communicate, commonly found in elite coaches.

This study included five females available for selection for the K4. The final decision was pending the coach, with influence from the subjective feeling in the boat from the kayakers, as well as time trials. The selection method of athletes to a team can have a significant impact on the team's success. Selection is usually judged on individual's physical characteristics with minimal attention given to the psychological factors, which contribute to athletic success (Humara, 2000). Coaches are experts in identifying the physical characteristics needed for success in their field; however, there is a lack of skills necessary to asses the psychological factors proven to affect athletic performance. Coaches have relied on informal judgments of constructs, like an athlete's motivation and level of aggression to determine their potential to succeed. Athletes told they lack the physical skill to perform have overcome their physical limitations and gone on to be highly productive, due to the psychological resources of drive and determination. The identification, quantification and implementation of these psychological attributes in selection decisions can have a notable impact on a programme's success (Humara, 2000)

Many athletes' performances have suffered due to a poor relationship with a coach or team member. Athletes who possess non-conformist or non-affiliation tendencies may tend to exhibit the greatest turmoil with autocratic or inflexible coaches. The coach is an important influence on anxiety in athletes (Baker *et al.*, 2000). Athletes evaluated coaching behaviours negatively when they were more anxious and less confident (Baker *et al.*, 2000). Positive coaching behaviour stimulates the athlete and their cognitive appraisal of the situation, and the converse applying to negative coaching behaviour. An athlete likely judges a coach who improves self-esteem, efficacy, motivation and anxiety as effective (Gearity & Murray, 2011). Different athletes may interpret a coach's behaviour differently. Influential coaches develop athletes psychologically, by instilling aspects such as hard work and discipline or having fun (Gould and Maynard, 2009). They also have characteristics that facilitate athlete trust, provide encouragement and support, directly teach or foster mental skills, and understand the athletes.

The same coaching strategies are not appropriate for each athlete; different athletes require different aspects from their coaches at different career points. This emphasizes the importance of coaches reading athletes' psychological needs and using different approaches at different times and in different situations. In a study done by Gearity and Murray (2011) on the effect of poor coaching, they found that poor coaches created ego-goal climates rather than task-goal climates. The athletes' perceived greater peer conflict, less social support and positive feedback, higher anxiety and performance related worry. They perceived a poor coach as creating a maladaptive learning environment and engendering athletes' self-doubt, which lent support to an ego-goal climate rather than a task-goal climate. They deduced that athletes who reported having a coach who engendered self-doubt: would experience decreases in performance, would choose easier tasks; would not give as much effort or persist as long, attribute their performances to ability, and have a difficult time controlling emotions.

2.4 PSYCHOLOGY AND SPORT

With athletes measured across their physical, physiological and psychological components, the latter is the hardest to determine reliably. This is what makes human beings so complex. Studies done on athletes over forty years ago, showed them to be less anxious, more independent and aggressive, more extroverted, and more achievement oriented than the general population (Humara, 2000). Cockerill (1990) proposed five key factors that contribute to the success of an athlete: technique, physical condition nutrition, equipment and psychological status, with the latter playing the vital role at the highest levels of competition. Sport psychology gives the edge between being a success and a champion.

The human mind and brain makes each individual unique. It is a vast domain for differences to occur, which is the factor that creates the difference between winning and losing. Humans and the environment are both dynamic and ever changing and interacting. There is network causality with sports performance and understanding the impinging factors determining and affecting the response. It becomes easier to focus on the task by eliminating as many extraneous variables. This is possible by understanding, predicting and influencing the athlete's behaviour (Scott, 2005).

The mental techniques used by athletes are primarily learned and acquired; through training; environment and situations. This has lead to theories developed that explain why athletes behave in certain situations. Weinberg and Gould (2007) proposed different approaches to predict behaviour.

- Trait approach: Personality traits of the individual remain consistent across a range of situations which predispose the behaviour, with the role of the situation or environment being minimal;
- Situation approach: This gives evidence that regardless of personality traits, behaviour is determined and reinforced largely by the situation or environment. Each situation has a certain reaction;
- Inter-actional approach: The situation and the person are seen as co-determinants of behaviour. They interact and mesh in unique ways to influence behaviour; and
- Phenomenological approach: Individual traits and environmental factors are considered here, but the individuals own understanding, perspective and subjective experiences are taken into consideration.

It is important to distinguish between an individual's personality trait (typical style of behaving) and their state (the situations affect on behaviour (Weinberg & Gold, 2007). A person will not necessarily behave the same way every time, despite their predispositions, which is why an understanding of the traits and states is essential for determining behaviour. Athletes predisposed to higher levels of trait anxiety perceive sport competitive environments more threatening and may respond with greater state anxiety responses (Baker *et al.*, 2000). The basis of a psychological state is the individual's cognitive approach, their perceptual aspect and emotional disposition (Scott, 2005). Everyone has an innate potential, possibly stemmed from certain ancestral experiences and developed growing up. Personality is a multi-dimensional modification of response patterns in multi-dimensional situations. It is unique to the individual and an intangible phenomenon accounting for differences in response styles from different people in the same situation. It is a collection of traits that people possess to a lesser or higher degree making them unique. Individuals have varying intensities of mood fluctuations in their personal predisposition to be primarily positive or negative (Berger & Motl, 2000).

Competitiveness is the basic drive influencing all athletes and stems from two basic motives: achieving success or avoiding failure (Weinberg & Gould, 2007). It is defined as “a disposition to strive for satisfaction while making comparisons with some standard of excellence in the presence of evaluative others” (Weinberg & Gould, 2007). A competitiveness or achievement motivation can influence thoughts, feelings and emotions, including the following:

- Choice of activity;
- Effort to pursue goals;
- Intensity of effort in the pursuit of goals;
- Persistence in the face of failure or adversity.

Cockerill (1990) stated that the most important area within sport psychology is motivation and all its manifestations. Mood forms the basis of an athlete’s attitude to a situation. Their attitude is a predisposition to the response to competition and reflects direction of intensity to a task, and a critical determinant of behaviour. Mentally tough athletes have a ‘high sense of self belief and an unshakeable faith that they control their own destiny, these individuals can remain relatively unaffected by competition and adversity” (Clough *et al.,* 2002 in Crust 2005).

Situation specific achievement is important for athletes, as they must prioritise their efforts. They may be achievement orientated in one area but not necessarily in another. Cockerill (1990) found that fear of success is a phenomenon in top level sports and suggested that a low fear of success is synonymous with a tendency to want to ‘win at all costs’. Athletes lacking effort to achieve goals, lose the motivation to achieve and succeed. They may even sabotage their preparation or performance. Andre and

Metzler (2011) concluded their research stating that individuals who experience fear of success tend to report anxiety, self-doubts and problems of concentration. They give evidence of a preoccupation with rewards, and display a tendency to suffer a lack of freedom in their relations with others. They also tend to report fear concerning their capabilities to progress.

Skilled performances are the result of autonomous behaviour that has come about from many hours of conditioning. Vealey (1988) proposed three groups of psychological skills, describing them as: foundation (volition, self-awareness, self-esteem, self-confidence); performance (optimal physical arousal, optimal mental arousal, optimal attention), and facilitative (interpersonal skills, lifestyle management). Psychological skills development should take place in the same periodised manner as physiological and physical training. The integration of these creates a holistic training framework for the athlete (Stebbing, 2009). The psychological skills would progress over consecutive training cycles, from education and acquisition of basic tools and skills, through to practice, implementation, and finally performance. Using the periodised framework, education and acquisition would be the focus during recovery and preparation phases. With practice, implementation and performance strategy during the final stages of preparation and competition phases (Holliday *et al.*, 2008). This also allows for specific long term athlete development.

2.4.1 Athlete Mentality

A person's sense of self-efficacy can play a major role in approaching goals, tasks, and challenges. The concept of self-efficacy lies at the centre of Albert Bandura's social cognitive theory. It emphasizes the role of observational learning and social experience in the development of personality. According to Bandura's theory, people with high self-efficacy are likely to view themselves mastering difficult tasks rather than avoid them (Van Wagner, 2008). A positive self-image and esteem perpetuates a positive spiral of events and confidence. A person's self is formed by experience, quality of the present situation and the basis of future expectations (Scott, 2005). There are two premises that influence an individual: the way a person perceives oneself and the way they feel others perceive them. An athlete calculates physical self worth with perceptions of sports competence, bodily attractiveness, physical condition and physical strength. Individuals behave in accordance to the way they perceive themselves and this sets up a behaviour cycle. People use reflective appraisal and social comparisons as ways of creating a positive image. The expectations of others can be a big governing factor of behaviour. Van Wagner (2008) reported these criteria from Bandura:

a. People with a strong sense of self-efficacy:

- View challenging problems as tasks to be mastered;
- Develop deeper interest in the activities in which they participate;
- Form a stronger sense of commitment to their interests and activities; and
- Recover quickly from setbacks and disappointments.

b. People with a weak sense of self-efficacy:

- Avoid challenging tasks;
- Believe that difficult tasks and situations are beyond their capabilities;
- Focus on personal failings and negative outcomes; and
- Quickly lose confidence in personal abilities

Prapavessis (2000) and Robazza and Burtoli (2007) noted Yuri Hanin's proposal that individuals have a zone of optimal function (IZOF) when looking at subjective emotions. The basis is that performance efficiency can be maximised for individuals when highly emotional and others when less emotional. This confirms that what works for one athlete may not work for the other, but the key is to understand this and the pre-competitive mood state. A skilled athlete is able to account for subjective emotional responses. Hanin proposed the concept of meta-emotion, or meta-experience, to account for knowledge, attitudes, beliefs and preferences for (or rejection of) an emotion that athletes develop through a range of successful and less than successful performances (Robazza & Burtoli, 2007). An athlete competing at the highest level should maintain control of them selves in their surroundings, or at least account for as much as possible. Athletes may develop strategies to enable them to self regulate performance threatening moods (Terry & Lane, 2000). Positive expectations of achieving goals can facilitate motivation and mood states that are conducive to superior performances and vice versa.

Athletes need to develop optimal mood and emotions for successful performance and then replicate this as much as they can in training. Mood is a multi-dimensional set of temporary reversible dispositions, which vary in duration and intensity. They add a complex and dynamic variability to the individual. In order to perform great an athlete has to feel great. Linked to this is hardiness of the athlete, which incorporates the attitudes of commitment, control and challenge (Sheard & Golby, 2010). Crust (2005) maintains that through systematic training, learning mental skills is possible, the same way as physical skills are. Athletes that are not familiar with psychological training are unaware of the range of options available to help their performance. Athletes need to train their focus so that they have complete control of whatever situation they find themselves. An emphasis placed on winning can lead to a loss of emotional control. An increase in anxiety produces narrowing of attention and a misperception of situations. Clough *et al.* (2002) (cited in Crust, 2005) proposed that mental toughness consists of the following components: control (emotional and life); commitment; challenge; confidence (interpersonal and in abilities). A study by Nicholls *et al.* (2009) found no correlation between mental toughness and athletes of higher achievement compared to lower achieving athletes. However, Sheard and Golby (2010) found in their study that in addition to mental toughness, focus, optimism, and self-belief - hardiness is a psychological characteristic that distinguishes elite-level sport performers from their sub-elite counterparts. Table 2.1 shows characteristics of Olympic athletes gathered from studies over the last 20 years (Gould & Maynard, 2009).

Table 2.1: Psychological factors associated with Olympic training and success (Gould & Maynard, 2009)

Psychological/emotional state or attribute	Cognitive and behavioural strategies	Personal disposition
• Confidence/self-belief • Concentration/attentional -focus • Determination/motivation/ commitment Optimal zone of emotions/arousal/anxiety • Emotional control • Automaticity • Motivation-commitment • Body awareness • Pain management • Self-awareness	• Self-talk • Imagery • Goal-setting • Competitive simulations • Competitive plans/re-focusing plans/routines • Distraction preparation strategies • Mistake management plans • Success management strategies • Fun/enjoyment strategies • Environmental control	• Optimism • Goal orientations (task, ego) • Adaptive perfectionism • Competitiveness • Sport intelligence • Trait hope • Locus of control • Intrinsic/extrinsic motivation orientation

For an elite athlete the process of focussing internally should be autonomous. Athletes have an ideal mood state but it is possible to facilitate optimal performances across all mood states. A better understanding of the athlete allows identification of strengths and weakness. It is this dynamic that makes research on this topic so interesting. Kenttä and Hassmen (1998) define psychological stress as intra-individual arising from internal stressors. An example used, is the imbalance between athletic expectations and the performance capabilities.

Stress factors for athletes include (Kenttä & Hassmen, 1998):

Physiological:	Aerobic, anaerobic, general strength, specific strength, technique
Psychological:	Self-confidence, anxiety coping, attention capacity, motivational level, attitude control, positive mental health, visualisation capacity.
Social:	Creating, maintaining and handling relationships

Coping with acute stress is primarily a function of both personal (coping style, cognitive appraisal of stressful event) and situational characteristics (source and perceived intensity of event). Coping strategies have been found to be regulated by the degree to which the situation is perceived as controllable and the approach it necessitates (Anshel & Sutarso, 2007), as well as by the consequences and personal meaning of these consequences. Highly controllable situations draw approach-coping strategies, such as confrontation and accepting responsibility. Escape-avoiding and distancing patterns are associated with less controllable situations. This leaves the athlete feeling under prepared and ill equipped with the demands on them.

For the last decade, there has been awareness that psychological factors such as stress and anxiety contribute and influence the frequency of injury in athletes (Lavallee & Flint, 1996). The increasing pressures of competition and the desire to keep one-step ahead of the opposition can lead to acute anxiety, attention and concentration problems and aggression (Cockerill, 1990). Psychological stress can contribute to the overtraining syndrome by exacerbating negative alterations in nervous regulation. These psychological stresses may relate to training and competition but can also originate from peer pressure and unrelated life stresses (Birch & George, 1999). Adequate recovery is dependant on the specific type of stress and the athlete's capacities. The goal of monitoring training and recovery is to establish individual athlete thresholds. Every training session needs to have consistent monitoring and intelligent decision making to achieve the best results. This is achieved through a structured set up allowing all bases to be covered. Over time, the athlete and coach gather experience, which results in fine-tuning the training programme.

2.4.2 Mood and Athletes

Moods are transient subjective feelings that can last for hours and can range from minutes to weeks, involving more than one emotion. Moods are best measured by self-reports. There is no valid objective measure of any mood, or agreement on the number of moods that exist and what to name them (O'Connor 2004, 2006). Emotional responses are components of complex physiologic interactions that affect the body in maintaining health (Barak, 2006). Mood is described as reflecting changing non-specific psychological dispositions to evaluate, interpret, and act on past, current, or future concerns in certain patterned ways. Suggesting that mood has an influence on cognitions and behaviour (Lane *et al.,* 2001). Mood has been conceptualised in unipolar dimensions (tension, depression etc), bipolar opposites (happy-sad, relaxed-tense etc), broad orthogonal dimensions (negative/positive affect) and in terms of a circumplex (pleasant-unpleasant axes) (Lane *et al.,* 2001). There is the possibility of a genetic set point for emotions through which we create environments that are appropriately emotionally constructed (Barak, 2006).

A common practice amongst athletes is to '*train how you race'* and simulate as much as they can with each training session they do. It is about being professional on and off the field. This means being able to produce, control and maintain appropriate emotions before competition and each practice session and block out all the distractions to optimise the performance. Dealing with extraneous variables and thoughts happens off the field of play. The relationship between sports performance and mood has anecdotal reports in the field and laboratory, and still no steadfast link between them (Beedie *et al.*, 2000).

2.4.3 Mood regulation by athletes

There is little research conducted on athletes dealing with intense mood states, which potentially impair performance (Stevens & Lane, 2001). Mood can be an important predictor of performance and provide an important psychological tool for the athlete. Research done by Marcora *et al.* (2009) found that mental fatigue affects physical performance (short-term endurance). Their subjects reached their maximum level of perceived exertion and stopped their physical task earlier than the control subjects (they did not find negative effects on cardiovascular, lactate and VO_2 max values). They stated that mental fatigue increases effort responses to a performance challenge and lowers the level of task difficulty, which subjects decide to withhold effort.

Effective coping strategies are inherent to successful sport performance and not being able to cope is detrimental to the performance and athlete's satisfaction (Anshel and Sutarso, 2007). An experienced athlete in competition has usually developed methods to manage mood and cope with stressors (Stevens & Lane, 2001), reducing the information overload (Anshel & Sutarso, 2007). Reasons given for a poor sport performance following the inability to cope with acute stresses include heightened muscular tension and narrowed attention focusing (Anshel & Sutarso, 2007). Despite strategies such as massage and relaxation/focus to relieve stress, the athlete cannot always control the extent of the stressor. Natural learning experiences are expected of elite or experienced performers where they acquire cognitive skills and strategies that enable them to attain control over the environment and self (Hanton & Jones, 1999).

A study done by Stevens and Lane (2001) on mood regulating strategies of athletes, found that the three most common strategies are to ‘change location’, ‘exercise’, and ‘listen to music’. These were common and as effective amongst all six mood dimensions in the POMS. Optimists are more likely to remain engaged in goals and experience higher short-term stress with conflicting goals, but it generally adds as a buffer against stressor related changes to the immune system. The mechanisms, which bring about mood changes associated with exercise are unclear and need to be understood further, (Stevens & Lane, 2001; Lane *et al.,* 2001), as well as the coping processes of athletes (Anshel & Surato, 2007). The type of response elicited by the athlete can give an indication into the mood state and quality of the performance. Berger and Motl (2000) proposed mode requirements of exercise, which influence mood. These include abdominal and rhythmic breathing, relative absence of interpersonal competition and closed, predictable, repetitive movements. These factors are synonymous with sprint kayaking.

2.4.4 POMS and Athletes

Assessing athlete’s mood states over a prolonged period of time, and particularly on training camps, designed to produce high work loads, have not been thoroughly researched (Kenttä *et al.,* 2006). Beedie *et al*. (2000) recommended longitudinal with-in subject approaches that seek to identify optimum pre-training or pre-performance moods on an individualised basis. Owing to human uniqueness, it is hard to standardise test procedures of personality, which decreases reliability and validity, despite general trends. Mood state assessment provides a reliable and easy sign of individual responses to a training load (Kenttä *et al.,* 2006). The terms mood and emotion reflect affective states, moods tend to be less intense, persist for longer and do not appear to have distinct or specific causes (Berger & Motl, 2000). Increased mood disturbance can distinguish between acute fatigue and decreased performance, experienced after a single intensive exercise bout or from longer term overreaching symptoms (Halson & Jeukendrup, 2004). There is no consensus whether fatigue is best conceptualised as a symptom, a mood, an aspect of quality of life or in some other way (O'Connor, 2004).

Morgan *et al.* (1987) pioneered the use of the POMS in sport and used it as an effective measure of mood states in athletes (McNair *et al.*, 1992). The POMS is a popular tool among sport psychologists using it to compare the prevailing moods of elite athletes in a variety of different sports. A primary advantage of the POMS is that it appears to be useful in detecting mood fluctuations associated with exercise, and due to its sensitive measurability can examine the effects of intensity, duration, specific participant populations and exercise modes conducive to mood alterations Berger and Motl (2000).

There are six mood states evaluated in the POMS: tension, depression, anger, vigour, fatigue and confusion. These are determined by 65, five point adjective rating scales by means of repeated factor analyses (McNair et al., 1992). A Total Mood Disturbance score is also calculated from it. Elite athletes from all different sports tend to score below average for the negative states; tension, depression, fatigue, and confusion; and score well above average on vigour (http://www.answers.com/topic/profile-of-mood-states). When presented on a graph; the POMS profile for elite athletes assumes a characteristic shape called the 'iceberg' profile; the better the athlete, the more pronounced the profile. This profile represents positive mental health (Weinburg & Gould, 2007).

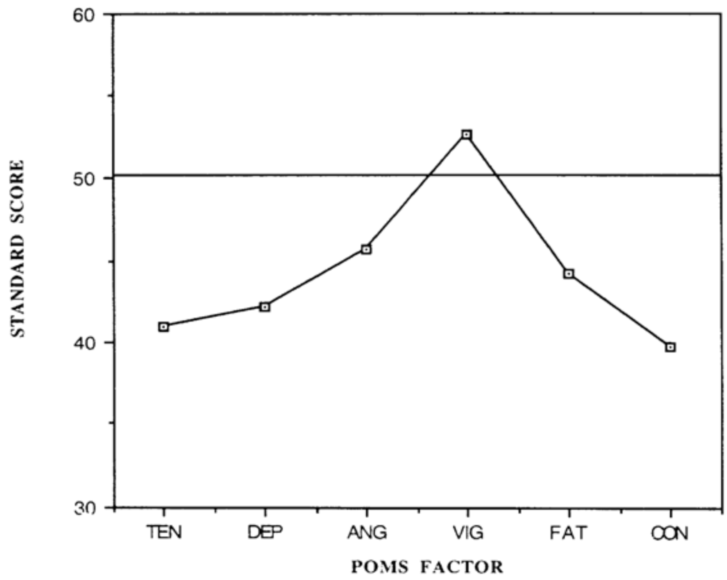

Figure 2.1: The iceberg profile showing increased vigour, with low tension, depression, anger, fatigue and confusion scores (Terry & Lane, 2000).

Копиtä *et al.* (2006) stated there is no reliable and widely accepted method for accurately monitoring both training and recovery. The POMS is a valid instrument for monitoring the dose-response relationship between observed scores and training load. In a normal response to training, athletes show reduced vigour and increased tension, depression, anger, fatigue and confusion (Budgett, 1998 Kenttä *et al*. 2006). Beedie *et al.* (2000) found the iceberg profile is 'normal' in athletes, which supports Morgan's mental health model (Terry & Lane, 2000).

There is conflicting evidence (Rowley *et al*., 1995; Prapavessis, 2000; Beedie *et al.*, 2000) distinguishing, which moods and mindset discriminate between "successful", and less "successful" athletes. The iceberg profile is not a prerequisite for successful performance, as not all the subscales directly influence the outcome of sport (Terry, 1993). A reason for the unreliability of the iceberg profile to predict performance is that it ignores individual mood state differences (Prapavessis, 2000). Athletes can still perform well despite having a negative profile, or perform poorly despite having a positive profile. Terry and Lane (2000) suggested the POMS is not able to determine profiles for athletes as they demonstrate a high variability in mood. Discrete mood states can influence performance differently (e.g. tension) which can have a motivating effect when experienced independently of depression, which collectively is termed a negative mood. It is possible to use 'negative' mood states for a positive effect (Terry & Lane, 2000). Studies have shown tension, anger and depression to facilitate performances over a variety of sports (Prapavessis, 2000; Beedie *et al.,* 2000). Anger and tension can hinder performance for an athlete in a depressed mood, and benefit them without signs of depression. Tension can be high (below the 50 percentile) and be beneficial if correctly directed. The POMS vigour scale is used as a measure of the mood of energy (O'Connor, 2006). This stemmed from nutritional related research as substances that increase feelings of energy e.g. caffeine, sugar, have been found to increase POMS vigour scores. The converse is true with foods that lower energy (tryptophan) relating to the fatigue scale.

Terry (1993) stated that 73.8% of successful performances demonstrate an iceberg profile, which means that over 25% of individuals who do not display the iceberg profile, can still perform successfully. Other studies have found the iceberg profile to be prevalent in wins, losses and draws. Rowley *et al*. (1995) found in a meta-analysis that 1% of the variance in performance outcome related to the iceberg profile. The POMS was able to identify overtrained athletes on average 81.4% of the time over a four year period in college swimmers (Halson & Jeukendrup, 2004). Rietjens *et al.* (2005) noted the POMS could be useful in the detection of overreaching on an individual basis.

A proposition by Lane and Terry in 2000 (Lane *et al.,* 2001) described a depressed mood as the inability to regulate other mood dimensions which leads to increased anger, confusion, fatigue and tension and reduced vigour. A depressed mood can act as a trigger to reveal other 'negative' mood constructs, and result in anticipated feelings of failure. It is inversely related to vigour and has a positive correlation to fatigue and confusion. Depression also causes focus on previous negative experiences, which could reduce perceptions of ability and coping. Senttä and Hassmen (1998) reported that individuals with increased anxiety perceive and rate the intensity of a given stressor as greater. Terry and Lane (2000) noted that females have reported significantly higher tension scores, although differences can be minimal between genders as well.

Beedie *et al.* (2000) performed a meta-analysis examining the mood differences between athletes of different levels of achievement, and predicting performance outcome at similar levels of achievement respectively. They also looked at the relationship between performances to each subscale of the POMS. This is more sensitive to the mood-performance relationship rather than a single overall effect. Beedie *et al.* (2000) found evidence to support higher anger scores in successful athletes.

2.4.5 POMS normative scores for athletes:

Terry and Lane (2000) monitored a group of athletes (n = 2086) from recreational level (n = 622), club level (n = 628) and international level (n = 836) over a period of five years. The participants completed the POMS in three different situations: pre-competition/exercise, post-competition/exercise or away from athletic environment.

Table 2.2: Descriptive statistics for raw scores of the POMS among an athletic sample (N = 2,086) grouped by level of achievement

	International (n = 622)			Club (n = 628)			Recreational (n = 836)		
	M	SD		M	SD		M	SD	$F_{2.2083}$
Tension	5.66	4.97		9.62	7.19		6.00	5.84	85.7*
Depression	4.38	6.43		8.67	9.49		3.11	5.39	113.8*
Anger	6.24	7.02		9.91	8.05		3.6	5.34	156.5*
Vigour	18.51	7.24		15.64	5.84		17.78	6.49	33.0*
Fatigue	5.37	5.51		8.16	5.94		6.37	5.71	38.4*
Confusion	4.00	3.79		7.38	4.96		4.84	3.94	110.2*
		Wilks' lambda 12.4156 = .81, p < .001							
*p < .001.									

Table 2.3: Descriptive statistics for raw scores of the POMS among an athletic sample (n = 2,086) grouped by situation

	Pre-competition/exercise (n = 622)			Post-competition/exercise (n = 628)			Away from athletics (n = 836)		
Mood	M	SD		M	SD		M	SD	F2.1569
Tension	8.75	7.13		3.33	3.39		7.85	6.03	104.8*
Depression	6.90	8.69		2.02	3.98		6.15	7.86	55.4*
Anger	8.29	7.92		2.63	4.62		6.82	7.05	83.9*
Vigour	16.65	6.2		19.04	6.22		15.88	6.36	28.7*
Fatigue	6.52	5.88		5.70	5.22		8.96	6.08	37.6*
Confusion	6.22	4.78		3.35	3.17		6.77	4.61	73.3*
		Wilks' lambda 12.3128 = .79, p < .001							
*p < .001.									

The athletic norms were developed to investigate whether POMS mood responses were associated with situational differences, and level of competition. Terry and Lane (2000) found international athletes reported lower scores of fatigue and confusion than recreational athletes but higher scores of depression and anger. In addition, international athletes had a more positive mood than club athletes did, possibly due to the association of higher achievement and performance; or a conditioning to the training demands, which revives the mood enhancement of exercise usually experienced by recreational athletes. It is important for athletes to recover properly, restoring mood states, especially if they are nearing competition. Terry and Lane (2000) reported that participation at international or recreational level is associated with greater mental health than at club level

2.4.6 POMS and Training

The POMS, in conjunction with other measures, has been used to determined effective training procedures and play a role in predicted success in professional and elite amateur athletes (McNair *et al.,* 1992). In six separate studies, progressive overload training decreased an athlete's performance. Mood disturbance, sleep disorder, loss of appetite and inability to concentrate (McNair *et al.*, 1992; Birch & George, 1999) increased with the training loads. Monitoring mood states can help prevent problems and identify weaknesses in an athlete's performance, and appropriate training can be applied (Weinberg & Gould, 2007).

Psychological inventories alone cannot predict athletic success, as there are limitations to their use. To determine overreaching, changes of mood state with a measure of performance was recommended (Halson and Jeukendrup, 2004), using an intra-individual approach (Weinberg & Gould, 2007). It can be beneficial to compare the result to norms, but how they feel relative to their own standards is more important. Optimal emotions vary considerably across athletes (Terry & Lane, 2000). A self-referenced performance criterion was proposed (Crust, 2005) as it would be more sensitive. It should involve a comparison of objective performance outcome with both a pre-performance goal and the result of the previous performance (as an indicator of goal difficulty) (Lane *et al.,* 2001).

Weinberg and Gould (2007) recommended using the POMS further in the following ways:

- To monitor the mood of support staff and team officials;
- To monitor training load;
- To monitor an athlete during the acclimatization process;
- To monitor an athlete during rehabilitation from overtraining ;
- To monitor emotional responses to injury;
- To predict performance (but not for team selection); and
- To individualise mental training

In a study done by Kowal *et al.* (1978), male and female recruits were tested before and after an eight-week basic training course. There were substantial improvements in male fitness, with significant drops in tension, fatigue, depression; and an increase in vigour. The females did not improve significantly in their fitness with a statistical significant drop in fatigue, and only a small increase in vigour. Henttä and Hassmen (1998) reported that fatigue and vigour are sensitive to short term conditions of overtraining, while depression is more sensitive to longer term conditions. Rietjens *et al.* (2005) found a clear trend of the TMD increasing (they used a shortened version of the POMS, and did not include confusion) over a three-week period. The first week of intensified training recorded the highest measurement, with no significant differences compared to baseline scores. Subjects showed sustained increases in mood and fatigue scores.

2.4.7 Utility of the POMS

The nature of the sport is very important, in terms of the predictive success of the POMS. There are conflicting studies supporting the POMS scores for different types of sports; from individual to team sports, and contact to skilled sports. Cockerill (1990) reported that the POMS would be an appropriate criterion for the selection of athletes when used with factors like performance history, selection trials and physiological measures. This would be subject to socially desirable answers and contriving a sought after profile. Repeated administration of the POMS can be intrusive (Berger & Motl, 2000). The effects of inadequate self-insight and dissimulation are other factors that can distort the measurement (Rowley *et al.,* 1995). Prapevesiss (2000) found recommendations by Peter Terry for utility of the POMS.

The utility of the iceberg profile increases when:

- The sample is homogenous in skill and conditioning;
- The sports selected are of short duration (less than ten min); and
- Successful vs. less successful performances are compared, rather than successful vs. less successful athletes.

Beedie *et al.* (2000) confirms the most reliable association of POMS scores being most predictive of performance, is among athletes of a relatively homogenous ability. Rowley *et al.* (1995) found a number of affecting factors, specifically: the type of skills involved; the number of co-acting performers and the measure of performance used. The interpretation of the POMS results is important to consider. An experienced successful athlete with a chance of selection to a team shows a pre-competition profile tending towards the iceberg profile, compared to an athlete on the margin who perceives more pressure. Personality, emotion, events leading up to the event, and psychological testing have an impact on observed mood states (Prapavessis, 2000). Rowley *et al.* (1995) found athletes showing successful performances had better season records, more experience, and superior training programmes with the impact of the athlete's physical skills and abilities on psychological factors overlooked.

Terry (1995) proposed that performance in closed skill sports would be more mood-dependant than performance in open-skilled sport. Sprint kayaking tends towards a closed skill sport but has an open skill side to it. There are extraneous variables that can influence the athlete's mood and possibly the resulting performance. The athletes moods in team's, such as a K4, may moderate the mood of the individuals amongst the team. Terry (1995) proposed that mood is transitory, and the longer the duration of the sport, the more mood fluctuation. Closed skill sports involve a greater degree of predictability where the pre-performance has more influence over the performance. Beedie *et al.* (2000) suggested that mood-performance relationships are specific to individual sports rather than the classification of sport. Terry and Lane (2000) found contrasting mood states across different levels of competing athletes, from recreational athletes to international competitors that incorporated a variety of sports and both genders.

An important and often neglected part of the POMS is the athlete understanding of the adjective inventory describing the mood states. Prapavessis (2000) found that cultural differences lead to confusion with certain words, and the clarity of them is misleading. The relevance of some words in relation to emotions in a sporting context is questionable. A list of positive and negative words generated by athletes differed to words found in the POMS scale. A misunderstanding on one or two POMS items, can suggest a language or intellectual problem (Albrecht & Ewing, 1989). Rowley *et al.* (1995) found that the wording in the instructions for the POMS did not direct athletes to report moods for the time in which the performance occurred.

Albrecht and Ewing (1989) reported the need for standardisation of the POMS and the way it is used to measure sports performance - "standardization implies uniformity of procedure in administering and scoring the test”. A common recommendation amongst the literature is to compare scores among different subjects with the same testing condition. The response set used in describing mood can range form “how have you felt over the past three days” to “how are you feeling right now” (Beedie *et al*., 2000) with the latter more sensitive to situational factors. These are moderating variables and mood disturbance following periods of increased training after three days (Kenttä *et al.,* 2006). Personality, training volume and situational factors affect the intensity and transience of mood. The level at which the athlete competes is important too (Terry & Lane, 2000). Using a response such as ‘*how have you been feeling over the past week*’ does not allow consideration of situational influences that occurred over the previous week or to the mood at the time of recalling it. Terry *et al.* (2005) found that the shorter the time response frame e.g. ‘*right now*’ allowed for more intense mood variations and gave a better indication of the person-environment interactions. A longer period implies assessing a trait-like construct and recalling mood over time is not as reliable and accurate. Terry *et al.* (2005) proposed using the ‘*right now*’ response period, with interest in responses over time to use multiple assessments. Incomplete coding in the brain, memory decay over time, or distorted recollections may affect accurate responses. People tend to retrieve information from memory that is consistent with their ambient mood i.e. depressed moods recall unpleasant events, and these feedback to intensify and prolong the depressed mood. Mood assessment can be influenced by mood maintenance, mood repair strategies, the athlete’s ambient mood, or a mood summary over the reference period. The time of day and level of training intensity, also influence the mood states measured by the POMS (Rowley *et al.* 1995)

A reduced time between assessment and the onset of competition prompted the development of shortened versions of the POMS. This allowed for a more reflective mood state pre-competition, which also reduced disruption to the athletes’ preparation. The higher the level of experience in the athlete the more they can get into *‘the zone’* and focus on the task (Scott, 2005). Another issue that Prapavessis (2000) proposed was whether once-off pre-competitive mood state assessment should accompany a measure of physiological arousal to predict performance. It is possible to see the effects on performance due to cognitive state and physiological arousal e.g. high mood states such as anger and tension together with high physiological arousal should be detrimental to performance. Using the POMS pre- or post event is a good indicator if not more a predictor. Past researchers may have misinterpreted the correlation between a good mood profile and good performance (Rowley et al. 1995). The athlete's successful performances and training in the past may cause a positive mood profile and a successful performance, rather than the mood that caused the good performance. According to Lane *et al.* (2001), there are factors that contribute to vague findings with the POMS and athletic performance. Namely the lack of clarity in the sport psychology literature about the nature of mood constructs; the inconsistency of the methods used; the lack of theoretical frameworks to guide research. The POMS can adequately measure the impact of training stressors failing other measures (Roose *et al.*, 2009).

2.5 Rate of Perceived Exertion (RPE)

The RPE is based on the understanding that an athlete is aware of the physiological intensity they are performing for a given exercise. Perception of effort is translated into a numerical value with the Borg scale, with '*phrase*' cues to prompt the athlete. The scale has 15 points, and graded with numbers ranging from 6 – 20. The scale corresponds closely to heart rate (RPE value x 10) and has linear correlations with intensity and heart rate over a variety of exercises and under various training conditions (O'Sullivan, 1984). RPE is usually accurate in estimating the intensity of an exercise stimulus; and athletes are capable of reproducing a certain prescribed level of RPE. It is a valid and reliable method for exercise prescription and monitoring and could be a valuable tool in the detection of overtraining (診enttä & Hassmen, 1998). The RPE scale has validity as a standard measure of physical activity intensity (Egan *et al.,* 2006). Borg (1998) suggested that the overall perception of exertion is a '*gestalt*' of many feelings and sensations related to the performance of work (O'Sullivan, 1984).

RPE proposed to detect overreaching (Lambert & Borresen, 2006) as it increases with a constant exercise load. It is a valid tool across a variety of modes of training including quantifying aerobic exercise (Egan *et al*., 2006). Subjective rating scales of perceived exertion are frequently used to regulate and monitor exercise performance intensity (Akenttä & Hassmen, 1998), as it is a determining factor in the breakdown process of training. Many factors can influence the athlete's perception (Scott, 2005). External factors include the actual task and what it entails i.e. the training session, as well as the duration, and environmental conditions, especially extreme temperatures. Internal factors can depend on the physical condition of the athlete and confidence in their ability. The athlete's personality and psychological traits as well as motivation to do well i.e. financial rewards, team selection influence the perception of effort. Past experiences, present situation and future expectations are cues to the athlete. All of these factors are integrated sub-consciously and consciously to give a holistic approach, with some more driving than others (Scott, 2005). Weinberg and Gould (2007) found the comparison of motivation to other athletes not necessarily important, but rather to their competing motivations e.g. family responsibilities, sponsors etc. Mental toughness is a personality trait that does not vary from situation to situation (Nicholls *et al.,* 2009).

Physiological factors that influence perceived exertion are divided into local (muscular, tendon, joints) and central factors (cardio-respiratory). Perception of exertion is a generalised response resulting from the summation of many different sensations. Processing of the physiological and psychological signals each having a different perceptual weighting at different stages. Central responses are associated with the heart and lungs, and the local responses more to the specific muscle groups. Central responses tend to be more associated with endurance, while higher intensity and shorter duration are associated with specific muscle groups. Kenttä *et al*. (2006) found that exertion above 16 on the RPE scale corresponds to lactate concentrations above lactate threshold A differentiation between central and local responses can occur with athletes that have a higher sense of body awareness (Scott, 2005). Exercising at a slower pace with emphasis on power output increased perceived exertion compared to higher frequencies at the same power output. During exhaustive exercise, the rise of RPE appears to follow a predictable pattern at various percentages of relative maximal effort (Egan *et al*. 2006). The introduction of heat to a test environment, caused heart rate to increase significantly but RPE remained proportional to the intensity of the exercise. This and other studies led to the support that heart rate is not a major sensory cue for perceived exertion, but is related more to cardiac output, stroke volume or blood pressure (O'Sullivan, 1984). There are strong correlations between ventilatory function and respiratory rate, especially at high exercise intensities where peak exercise intensity coincides with peak ventilation (McArdle *et al.,* 1996).

Swart *et al.* (2009) found that athletes maintain a reserve capacity, which they presumed was to prevent any catastrophic failure of homeostasis. RPE collected during exhaustive exercise acts as a protective mechanism to override the decision to increase intensity. They proposed that the brain generates an appropriate and acceptable perceived exertion strategy based on the expected duration of the exercise and on certainty of the duration. They found during maximal exercise bouts of varying duration; perceived exertion is proportional to the relative completion of the exercise and changes in relation to the certainty about the endpoint of the exercise. An increase in familiarity with a regular exercise task, the RPE strategy becomes more aggressive, presumably with less metabolic and cardio respiratory reserve. The athlete's perception of the metabolic requirements for the exercise bout and the athlete's belief that they are able to meet those requirements influence the RPE. An added benefit of using RPE stimulates a higher cognitive self-awareness for the athlete (Kenttä and Hassmen, 1998). Females rate tasks as higher with more accuracy. Inter-athlete competition occurs, which suppresses the recordings of RPE, which also occurs with males and younger individuals. Building an effort profile over time facilitates the coach and brings out the best in the athlete during practice and competition. The coach and athlete can get a measure of effort requested and effort produced.

The theoretical foundation of the construct of perceived exertion, and RPE mainly as a measure of exercise intensity, implies that high correlations are possible with simultaneous measured physiological criteria of exercise intensity (concurrent validity) and with predicted performance criteria. Perceived exertion, should allow for correlations with psychological measurements reflecting emotional and motivational aspects of performance (Borg, 1998).

2.5.1 Session RPE

A single session RPE rating can accurately reflect the intensity of an exercise session (Egan *et al*. 2006). A daily session load is calculated by multiplying the duration of the exercise (in minutes) by the session RPE, which is theoretically taken 30 minutes after exercise has stopped. The summation of these on a weekly basis is termed the total training load. Foster *et al.* (2001) used a delayed period (30 minutes) when evaluating their subjects, so they could give an overview of the session, without influence from the end of the exercise session. This is based on Bannister's method (TRIMP) (Foster *et al.*, 2001; Lambert & Borresen, 2006) where session RPE has replaced the heart rate value. Monitoring heart rate is limited by needing to wear a heart rate monitor for each session and is not as accurate in high intensity training e.g. weight training. There are conflicting studies with comparing correlations between the heart rate based and session RPE methods (Lambert & Borresen, 2006). Foster *et al.* (2001) found a high correlation between the session RPE and the summated heart rate zone methods of evaluating training sessions. Their evaluation was that athletes can be very consistent with their own pattern of reporting the session RPE method with training load and performance. Session RPE is useful over a wide variety of exercise sessions (including high intensity interval training), and represents a single global rating for the intensity of the entire session (Foster *et al.*, 2001). The major advantage of the session-RPE over other methods quantifying training load is that it is simple to measure and relatively easy to interpret. It is both a valid and reliable method for monitoring training in most sports (Coutts *et al.*, 2008). The units for session RPE are AU (arbitrary unit). Highly trained tri-athletes can tolerate a weekly load of 7200 AU (Coutts *et al.*, 2008). Robson-Ansley *et al.* (2009) recommend that athletes should maintain a weekly training load between 4000–5000 AU. The session RPE method is very useful for athletes in sports involving a variety of training modes, especially anaerobic and technical training. Athletes may have prolonged sessions with a low average heart rate; indicating light aerobic training, but the cumulative training load on the body will be significant.

Individual perceptions of a training session are influenced by many factors, including physiological variables (hormones, substrate usage, ventilation rate, and neurotransmitter levels), personality traits and environmental conditions. RPE recordings vary between muscle groups, muscle mass, fibre type, range of motion, number of joints used in the movement, the order in which exercises are performed, the number of sets and the mode of exercise. These can all play a role in limiting the reliability of quantifying the subjective response. It is suggested that the unexplained variance between perception of exertion and physiological variables can be caused by psychological variables (O'Sullivan, 1984). Anxious, depressed, or neurotic individuals consistently interpret subjective sensations of physical work inaccurately because of their altered states of autonomic arousal (O'Sullivan, 1984). Extrovert individuals also perceive the same workload as lighter than a group of introverted subjects, are more readily in exercise and have a higher pain tolerance. This does not exclude athletes that can perform based on their trait or state i.e. characteristically (trait) function in one way and in certain circumstances (extreme stress) change the way they function (O'Sullivan, 1984).

2.6 FEMALE ATHLETES

Female athletes are more integrated in previously male dominated sports. The training hours and perceived competition amongst female sport is equal to that of the males. Females have sacrificed degrees of femininity to gain as much advantage over their competitors as they can. Some female athletes (especially strength based sports) struggle with choices between performance and attractiveness at younger ages; however, older elite athletes appear to be comfortable with their bodies (Ludwig, 1996). The increasing number of women in sport facilitates a need to understand the physiological, physical and psychological aspects of them (Birch & George, 1999; Scott, 2005). Compared with female non-athletes, women athletes are independent, achievement orientated, aggressive, assertive and emotionally stable (Weinberg & Gould, 2007).

Many female Olympic athletes attempt to juggle the pressures of competition along with a career, a romantic relationship, and parenthood. They face the consequences of identity overload and struggle to determine the priorities and balance of daily life within a non-supportive environment (Ludwig, 1996). Females deal with issues such as staying confident in training, avoiding perfectionist attitudes, and minimizing the desire to over-train. Mental burnout and the subconscious denial of former achievements can erode confidence. Some athletes are too self-critical and consequently push themselves to overtraining (Ludwig, 1996). The overtraining syndrome is consistent with men and women, in terms of injury and seasonal variations (Birch & George, 1999). Women seem to have a more difficult time preparing for and coping with head-to-head competition than men. This may be due in part to differences in competitive experience. Communication factors seem to be much more of a concern for women than for men, a possible function of sociological expectations and gender role development. The inability to be assertive within socially acceptable parameters is self-destructive for some elite female athletes. This conflict has been presented not only in team relationships but also in coach-athlete relationships.

The way a women athletes menstrual cycle affects her behaviour is critical for elite athletes. Due to the pulsatile release of Gonadotropin releasing hormone (GnRH) which controls menstrual cycle disruption, there is a high prevalence of secondary athletic amenorrhea. Factors that are associated with loss of menstruation are high levels of cortisol, high levels of β-endorphins and psychological stress (Birch & George, 1999). There is growing evidence to suggest that disturbances are due to the metabolic cost of high energy expenditure without a compensatory increase in dietary intake. It has been termed “metabolic shock”. It is reversible but can cause serious long lasting health consequences. The influence of ovarian hormones on exercise metabolism appears secondary to factors such as nutritional status/energy availability, exercise intensity, and overall energy demand of exercise (Hausswirth & Le Meur, 2011). Cockerill (1990) interestingly found that words psychologically describing PMS are similar to those of the POMS and found it to be a useful method to investigate the incidence in competitive females.

The treatment of female kayakers is similar to males in training methods and training programmes. The level of intensity and structure to each training load is not reduced either. This stemmed from an assumption made before the 1980's that male and female athletes did not differ in physiological responses to exercise (where Eastern bloc training was prominent) (Hausswirth & Le Meur, 2011). Training programs and recovery strategies were generalised to female athletes as well. Absolute strength differences occur due to the cross sectional area and hormone production, and training is adjusted accordingly and made relative (McArdle *et al*., 1996). This is an important aspect as kayak sprinting requires high strength and power outputs. Female kayakers need to be aware of the changes that occur with their bodies under stressful conditions e.g. disturbances in menstruation cycles, decreased fat mass and lower oestrogen production. Women who participate in programs originally tailored for men say they are held to higher expectations than men are. Female athletes have to adapt to male-oriented coaching philosophies and tolerate the invalidation of their feelings (Ludwig, 1996).

2.7 DIETARY INTAKE

Overreaching is brought about by high intensity training with limited recovery. A postulation of the contribution to fatigue and underperformance was a decrease in muscle glycogen stores (Halson & Jeukendrup, 2004). Fatigue induced by exercise can be linked to the athlete's inability to continue supplying adenosine triphosphate (ATP) to the working muscles, due to the exhaustion of endogenous energy stores. This type of fatigue can also occur in athletes training multiple times per day, even in those not necessarily specialized in endurance activities, and can cause large quantities of energy to be expended (Hausswirth & Le Meur, 2011). The depletion of energy stores may set in progressively, when daily caloric intake does not compensate for the total energy expenditure linked to both basal metabolism and the practice of a sport. Penttä and Hassmen (1998) noted that insufficient carbohydrate digestion during heavy training periods is associated with the development signs of overtraining. This is confirmed by Robson-Ansey *et al.* (2009), noting that inadequate carbohydrate intake can lead to an earlier onset of overreaching symptoms including altered mood state, hormonal changes, and impaired performance during periods of intensified training. Hausswirth & Le Meur (2011) concluded that as females mobilize lipids to a greater extent during exercise than males. They found female lipid stores are greater and that they show a better propensity to spare glycogen and a greater ability to maintain constant energy substrate stores during exercise, as well as during the recovery period. These metabolic specificities imply the necessity for gender specific nutritional recovery strategies. In female athletes, the maintenance of energy balance is a particular focus point, because of the frequently observed concerns with physical appearance and the social pressures pushing them to maintain a low percentage of fat mass. Dietary behaviours are not always associated with weight loss (due to a decrease in resting metabolism), but rather to disturbances in the menstrual cycle (Hausswirth & Le Meur, 2011).

Disordered eating problems are especially prevalent among athletes because competitive sport reinforces characteristics often associated with eating disorders, such as perfectionism, high achievement motivation, obsessive behaviour, control of physique, and attention to detail (Ludwig, 1996). Common issues facing sport psychologists are abnormal eating patterns and/or related thought patterns, such as body dissatisfaction, distorted body image, preoccupation with food, and fear of becoming fat. Not all athletes require the same amount of food or respond to the same foods as others e.g. food allergies. The athletes taking part in this study were well informed and had experience with individual diet preferences, including replenishing for successive training periods during the day.

2.8 IMMUNE SYSTEM

There are few studies done and many anecdotal reports of increased illness and upper respiratory tract infections (URTI) which may be a trigger factor in over reached and overtrained athletes (Meeusen *et al.*, 2006). Increased upper-respiratory incidence is likely to reflect the increase in training, regardless of the response of the athlete to the increased physical stress (Halson & Jeukendrup, 2004; Meeusen *et al.,* 2006). Intense training periods may increase the risk, chances and severity of immuno-depression. It appears that the immune system is sensitive to both physiological and psychological stress.

Spence *et al.* (2007) conducted research on elite, recreational and sedentary individuals, for a five-month period from December to April. They found athletes experienced a common cold or URTI during December/January. URTI is the most common condition affecting athletes at the summer and winter Olympics. Elite athletes are affected more than recreational ones. Anecdotally there are many examples of athletes who are unable to participate at high-level competition due to a URTI. The causes for the illness are not clear but linked to viral rather than bacterial infections. Spence *et al.* (2007) found in their research a high incidence (70% in elite athletes) of unknown pathogenic related illness. The most common viral pathogen was Rhinovirus, with relatively small numbers of bacterial pathogens, including S. pyogenes (group A), H. influenzae, Staphylococcus aureus, and M. pneumoniae.

The Wisconsin Upper Respiratory Symptom Survey was an inventory used in this study and was developed as an instrument to measure patient-oriented outcomes identified as important by people with self -diagnosed common colds. The WURSS instrument is more comprehensive than existing alternatives and better reflects cold-sufferers' experiences and values. The WURSS allows a cold-sufferer to swiftly and accurately assess his or her common cold (Barrett *et al.*, *2002)*. Short-forms of the original WURSS have been developed, including WURSS-44 and WURSS-21 (Barrett *et al.*, 2009).

CHAPTER 3
METHODOLOGY

3.1 PARTICIPANTS

Seven elite sprint kayakers (two male, five female), were recruited by the researcher. Mean (SD) characteristics of the participants were as follows: age 26.5 (1.4) years, training experience 8.4 (3.7) years. The kayakers were part of the South African national sprint kayaking squad selected to participate in this study, based on their preparation for the 2008 Beijing Olympic Games (one male athlete did not qualify but continued to train). The athletes were all first time qualifiers for the Olympic Games. The selected female paddlers raced in the 500m K1, K2 and K4 boats. The male paddler raced in the 1000m K1 event. Participants were fully informed of the risks associated with the study, stated in the informed consent form, and verbally by the author. The participants could withdraw from the study at any time without consequence. The Research and Ethics Committee of the Faculty of Humanities at the University of Pretoria approved the study.

3.2 INSTRUMENTS

Each subject received a personal file prior to each training camp with instructions and data capture sheets. The file included the following: (see appendices)

1. POMS;
2. RPE training log;
3. Wellness sheet - Wisconsin Upper Respiratory Symptom Survey – 1/day;
4. Informed Consent; and
5. Borg RPE Scale (6-20).

3.3 PROCEDURES

3.3.1 Training Camps

The training camps attended by the subjects, were part of a training structure and programme implemented by the Canoeing South Africa Head Coach, in preparation for the 2008 Beijing Olympic Games. The location of TC1 and TC2 was on the Umtamvuna River in Port Edward, South Africa, a venue used for previous training camps. Accommodation was provided for the athletes. TC1 was held from the 12 November to 09 December 2007. TC2 was held from 25 February to 22 March 2008. The location of TC3 was on the Tisza River in Szolnok, Hungary, which occurred later in the year, as a pre-Olympic camp, from 14 July to 04 August. The subjects were familiar with the training venues from previous years. Data collection processes were kept consistent for each camp.

See Appendix H (Appendices) for training programmes.
Training Camp 1 – Pre-season Cross training/Base
Training Camp 2 – Kayak Specific Base Training
Training Camp 3 – Competition/Peaking

3.3.2 Training Programme

Details of the training programmes for each training camp can be seen in Appendix H (Appendices)

Table 3.1: Number of training sessions and hours per week

Training Camp 1

	Week 1	Week2	Week 3	Week 4	Average
Sessions	16	14	17	17	**16**
Hours	16:20	14:05	15:10	14:20	**14:59**

Training Camp 2

	Week 1	Week2	Week 3	Week 4	Average
Sessions	16	14	16	15	**15**
Hours	14:05	12:35	14:01	13:31	**13:33**

Training Camp 3

	Week 1	Week 2	Week 3	Average
Sessions	14	14	12	**13**
Hours	11:25	10:35	6:05	**9:22**

Indication of the different training periods is notable in the difference in total training time and average weekly training time over the training camps (Figure 3.1). TC1 fell over a base training period where emphasis was on endurance and technique in the kayak, and swimming used as cross training. TC2 incorporated more kayak specific training and a focus on threshold endurance, where as TC3 was characterised by short high intense intervals, to taper for the Olympic Games.

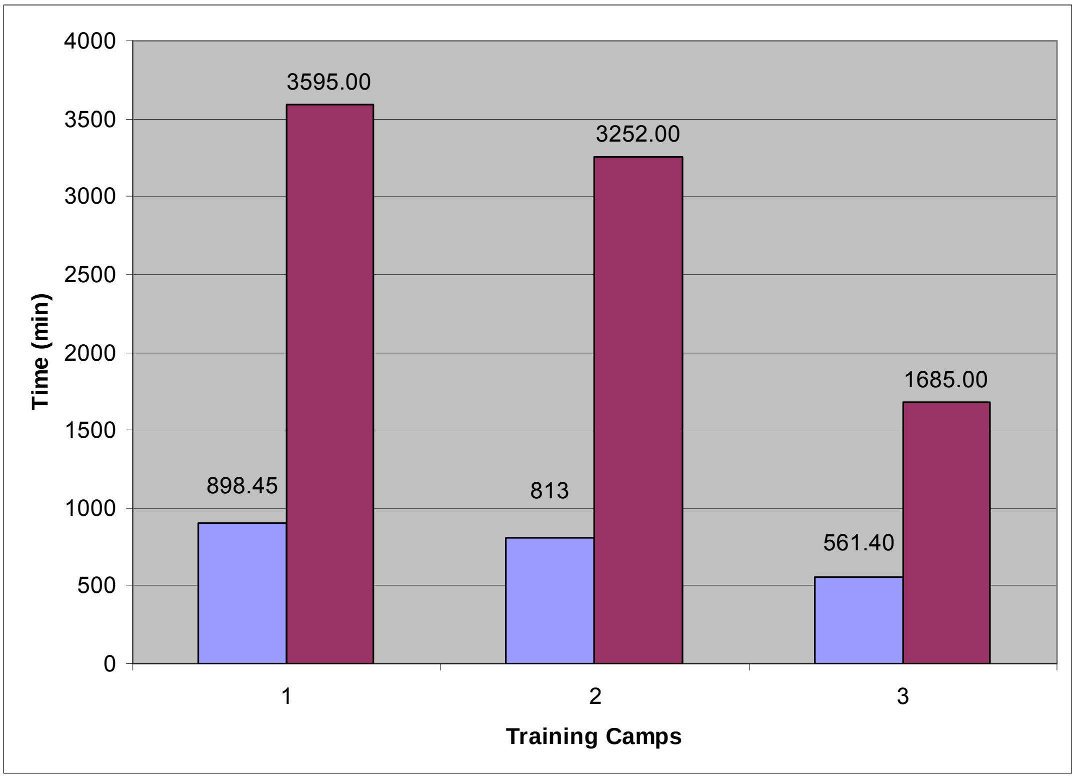

Figure 3.1: Total training time with average weekly training time

The duration of TC1 and TC2 was four weeks and the training and recovery structured the same throughout, while TC3, prior to the Olympics was three weeks with training varied to suit the athlete's feelings and individual preparation. TC3 took place in Europe, to take advantage of the summer climate. The intensity of the training camps was maximal for each training session. Recovery paddles (usually eight km after gym sessions) and technique sessions, which were between 16-20km and steady state were exceptions. Usual training times were 08:00 for the first session and then again at 16:00 for all three training camps.

A high training intensity marked the training camps, causing a state of severe fatigue. Subjects performed a normal training programme with an easier week prior to the camp. The research conformed to the training camp setup, taking place in a natural setting. The training in TC1 and TC2 was as follows: Monday – three sessions, Tuesday – three sessions, Wednesday – rest in the morning, two sessions in the afternoon, Thursday – three sessions, Friday – three sessions, Saturday – two sessions in the morning then rest in the afternoon. Sunday was a complete day of rest. At the end of the second week, Saturday and Sunday were full rest days.

Push-ups and pull-ups after most paddling sessions were mandatory, and if a gym session was not possible. Weekly time trials were set for the duration of each training camp by the coach, and routinely done in the TC1 and TC2. TC3 programme structure focused around peaking for the Olympics. The standard 2000m time trials and race pace/practice sessions were included in TC3. The venue had a measured sprint course marked out.

The time trials (5,000m and 2,000m) were maximum efforts. In the 5,000m group time trials, a mass start allowed slower kayakers to take advantage of wake riding as well as working together. The same scenario occurred for the group time trial in the 2,000m (last of the set). In TC1, the Wednesday 5,000m time trials were in a group, followed by gym training. Running time trials took place on Tuesday after the kayaking session as well as on Saturday after two 5,000m time trials in weeks one and three. In weeks two and four this took place on Friday due to the full days rest on Saturday. During TC2, there were 2 x 5,000m time trials (individual and group) on Wednesdays. In weeks one and three, 6 x 2,000m with 4 min rest were on Saturdays and in weeks two and four on Fridays. The running time trials were done on the same course as TC1 on Tuesday afternoon after the kayak session, and then after the 6 x 2,000m respectively. In TC3, the 2,000m time trials were set for Tuesday (four in week one, three in week two, two in week three) and 3 x 2,000m on Friday week one.

3.3.3 POMS Test

This study aimed to compare results found byIenttä *et al*. (2006) and their efforts to determine the magnitude of changes in the POMS scores in response to training and recovery during intense training camps. This allows monitoring athletes in a natural but controlled environment. The athletes completed the 65-item POMS inventory (McNair *et al*., 1992) used to monitor mood states during the training camps. Instructions on how to complete the POMS test were given prior to the training camp. The format and scoring of the test had no language limitations in understanding each mood adjective and was familiar to the athletes. Responses were provided on a five-point scale ranging from zero to four (Not at all – Extremely) for the six subscales: tension, depression, anger, vigour, fatigue and confusion. The athletes' instructions were to respond to, "How have you felt during the past week including today?" This is appropriate for establishing a longitudinal profile of the athlete, as well as being sensitive to acute stressors that may influence the response. The POMS usually takes less than ten min to complete.

The POMS was completed on the specified rest days of the week (Wednesdays – half day; and Sundays – full day which includes half day of rest on Saturday), for the duration of the camp. There was no specification of exact time and data collection on the day, so the athletes had the full mid-week rest day to report their mood, as well as the second rest day. The subjects completed the POMS three days prior to each camp, as a baseline value. A post-POMS evaluation was done three days after the camp except TC3. The POMS were analysed using the instructions from the EdITS manual (McNair *et al.* 1992). A TMD score was calculated by subtracting the vigour score from the other subscales. To prevent a negative score, a constant of 100 was added to the TMD. An energy index was calculated by subtracting the fatigue score from the vigour score (Kenttä *et al,* 2006).

3.3.4 RPE

Subjective perceived exertion was determined using the Borg RPE scale. The 15-point scale (6 – 20, with verbal cues) determined exertion level. This was done independently so as not to be influenced by the other athletes and based on the athletes' honest appraisal of the training session. There were usually two training blocks each day, in the morning and afternoon. The subjects filled in exertion rates on the daily training log after each training session. The training sessions involving two modes of exercise i.e. kayak and run, had a daily average taken, and a weekly average calculated from these. For the majority of training sessions the athletes had to maintain the same exertion so that the session started and finished at the same intensity. The Borg scale has a high linear correlation with physiological variables e.g. HR, VO_2 which gives an accurate reflection of the intensity that an athlete is working at.

3.3.5 Training Load

Calculation of the session RPE was done using the actual training time, which was recorded (excluding warm up and rest between intervals) for each training session and then multiplied by the RPE value given for that training session. Where there were two training modes completed in the session, the times were added together, as the RPE was indicative of both. The summation of these is the total training load.

Training Load = Duration (min) x session RPE (Foster *et al,* 2001).

The Borg 6 -20 scale was converted to the Borg CR-10 scale using the conversion scale below (Robertson, 2004), for calculation of the training load.

Table 3.2: Borg conversion scale

RPE Conversion	
Borg 6-20	**Borg CR-10**
6	0
7	1
8/9	2
10	3
11	4
12/13	5
14	6
15/16	7
17	8
18	9
19/20	10

3.3.6 Wisconsin Upper Respiratory Symptom Survey

The Wisconsin Upper Respiratory Symptom Survey – 21 provided a daily symptom report for the subjects. When the subjects felt sick, they would complete the form. If the forms were not completed it was assumed that the subjects were healthy and continued with the training programme. The WURSS allows a cold-sufferer to swiftly and accurately assess his or her common cold and was developed as an instrument that measures patient-oriented outcomes identified as important by people with self-diagnosed common colds (Barrett *et al.*, 2002).

3.3.7 Training log

A booklet issued to the athletes contained all the documents needed to record data. This included the weekly Training Log, used to record the daily RPE after each session; the POMS questionnaires for the duration of the camp; the Wisconsin Upper Respiratory Symptom Survey – 21 Daily Symptom reports.

3.4 DESIGN AND ANALYSIS

The sample consisted of seven elite Sprint Kayakers who took part in three camps over a one year period. TC1 and TC2 consisted of four weeks training activities and TC3 consisted of three weeks' prior to the 2008 Olympic Games. During these weeks, several measurements were recorded. The administration of the POMS tests occurred on Wednesday and Sunday of every week. At TC1 and TC2, pre-test and post-test POMS measurements were recorded. There were no post-test measurements taken after TC3. The RPE scores were recorded daily. The training load and energy index scores were calculated from these measurements.

3.5 STATISTICAL ANALYSIS

The collected measurements were captured on a computer and analysed by means of the SPSS package (Statistical Product and Service Solutions). The following statistical techniques were used to do the analysis.

3.5.1 Descriptive statistics

"Descriptive statistics is a medium for describing data in manageable forms" (Babbie, 1992: 430). Descriptive statistics presented within this study included the number of participants, minimum and maximum values, mean scores and standard deviations for each measurement. These descriptive statistics gives the reader an indication of the nature of the data on all variables measured, for reference purposes.

Mean score: The mean score is used to describe central tendency. It is calculated by adding up all the applicable values and dividing it by the number of cases (Research methods, Knowledge base; http://www.socialresearchmethods.net/kb /statdesc.php). The mean scores on all measurements were calculated in order to be able to compare changes in performance over time.

Standard Deviation: The Standard Deviation shows the relation a set of scores has to the mean of the sample (Research methods, Knowledge base; http://www.socialresearchmethods.net/kb/statdesc.php). It gives an indication of the distribution of data around the mean on all variables measured. The higher the standard deviation, the more the data is dispersed.

3.5.2 Inferential statistics

"Inferential statistics assists you in drawing conclusions from your observations; typically, that involves drawing conclusions about a population from the study of a sample drawn from it "(Babbie, 1992: 430). Since the sample was relatively small and consisted of only seven subjects, use was made of non-parametric statistics to analyse the data. Non-parametric tests, also known as distribution-free tests, are a class of tests that does not rely on a parameter estimation and/or distribution assumptions (Howell, 1992). The major advantage attributed to these tests is that they do not rely on any seriously restrictive assumptions concerning the shape of the sampled populations and thus accommodates small samples as in the case of this study. The inferential statistics determined whether statistically significant differences existed between measurements taken at different time intervals. The following techniques were used:

3.5.2.1 Friedman's rank test for k correlated samples

This test is the distribution free analogue of the one-way repeated measures analysis of variance. "*It is a test on the null hypothesis that the scores of each treatment were drawn from identical populations, and it is especially sensitive to population differences in central tendency*" (Howell, 1992: 624). This test determined whether statistically significant differences existed between the pre- mid- and post-test measurements within each camp, and when comparing the same measurements across the three camps.

3.5.2.2 The Wilcoxon Signed Ranks Test

The **Wilcoxon signed-rank test** is a non-parametric test that used to test two related samples or repeated measurements on a single sample. The Wilcoxon test involves comparisons of differences between measurements. It is used to test the difference between scores of data collected before and after an experimental manipulation. (Wikipedia, http://en.wikipedia.org/wiki/Wilcoxon_signed-rank_test). This test is the distribution-free analogue of the t-test for related samples. According to Howell (1999), it tests the null hypothesis that two related (matched) samples are from identical populations or from symmetric populations with the same mean. This test determined whether statistically significant differences existed between the Wednesday and Sunday POMS measurements within each camp, and when comparing week four measurements across camps (since TC3 only had three weeks' measurements).

3.5.2.3 Spearman rank-order correlations.

Use was also made of Spearman's rho to determine the correlations between the POMS, RPE and training load Scores. Spearman's rho is a non-parametric version of the Pearson correlation coefficient, based on the ranks of the data rather than the actual values. It is appropriate for ordinal data, or for interval data that do not satisfy the normality assumption. Values of the coefficient range from -1 to +1. The sign of the coefficient indicates the direction of the relationship, and its absolute value indicates the strength, with larger absolute values indicating stronger relationships (SPSS Manual).

CHAPTER 4
RESULTS AND DISCUSSION

4.1 RESULTS

The results of this study will be presented in the following order.

- Descriptive statistics of all measurements taken per camp;
- Results of the analysis of POMS measurements over time;
- Results of the analysis of RPE measurements over time;
- Results of the analysis of Training Load over time;
- Results of the analysis of the energy index measurements; and
- Results of the correlations of POMS, RPE and Training Load scores.

4.1.1 Descriptive statistics of all measurements taken per camp.

Descriptive statistics are provided in Appendix A (on CD) for POMS, RPE, training load and energy index scores. The minimum, maximum, mean and standard deviation for every measurement is reflected for reference purposes.

4.1.2 Results of the analysis of POMS measurements over time

The analysis in this section focused on examining POMS results in four different ways namely:

- An analysis of POMS results per sub-scale as well as the total mood disturbance score within each camp, by comparing all 10 measurements with one another. This implies that the results of the pre-tests, mid-tests and post-test were compared to see whether statistically significant differences existed. This analysis was done within each camp (See Appendix B – on CD).
- The second set of analysis compared the results across weeks for the same day within the weeks within each camp (e.g. Wednesday results for weeks one to four were compared within each camp). (See Appendix B – on CD)
- The third analysis compared the POMS results of Wednesdays and Sundays within the same week with one another. This allows the exploration of statistically

significant differences between measurements taken after one and a half day rest versus a half day rest. (See Appendix B – on CD)

- The last set of analysis compared results of similar weeks across training camps (e.g. week one, TC1 Wednesday results were compared to week one Wednesday results of the other two camps). See Appendix C – on CD.

The results of the analysis per sub-scale of the POMS as well as the TMD scores are presented in Figures 4.2 to 4.8. All statistical output is presented in Appendices B and C for reference purposes. Specifically in Figures 4.9, 4.10 and 4.11 the Wednesday scores (Wed) refer to half a day rest, while Sunday (Sun) refers to a full day and half rest. Comparison is made to normative values in section 2.4.5 and Tables 2.2 and 2.3

4.1.2.1 Tension scores

TC1 tension scores showed no statistically significant differences in scores when comparing the results of the pre-test with the mid-tests to post-test (see Figure 4.2). Tension scores were higher at the pre-test, and tapered off towards week three with increased scores around Sunday week three and Wednesday week four. Tension levels were lower towards the end of the camp. The fluctuations in scores were not statistically significant. Tension scores during TC2 showed random up and down movements with an increase towards the end of the camp, but were not statistically significant. TC3 tension scores tended to be higher towards weeks two and three of the camp, but were not statistically significant.

Table 4.1: TC1 tension scores

	Mean	Std. Deviation	N	Minimum	Maximum
Tension Camp 1 Pre-test	5.17	4.021	6	0	11
Tension Camp 1 week 1 Wed	2.57	5.682	7	-3	10
Tension Camp 1 week 1 Sun	3.86	6.842	7	-2	14
Tension Camp 1 week 2 Wed	3.43	5.381	7	-2	13
Tension Camp 1 week 2 Sun	1.33	4.412	6	-3	7
Tension Camp 1 week 3 Wed	1.71	3.450	7	-2	8
Tension Camp 1 week 3 Sun	5.71	10.781	7	-3	29
Tension Camp 1 week 4 Wed	5.00	6.137	7	-2	15
Tension Camp 1 week 4 Sun	1.20	2.168	5	0	5
Tension Camp 1 Post-test	1.00	2.160	4	-2	3

Tension scores were generally lower and inline with international level athlete norms (5.66). The lowest levels of depression occurred in the second week Sunday where the last training session occurred on Friday, giving two full days of rest. The low scores were generally indicative of a post-exercise situation (3.33), where the athletes were more relaxed.

Table 4.2: TC2 tension scores

	Mean	Std. Deviation	N	Minimum	Maximum
Tension Camp2 Pre-test	4.43	4.791	7	-1	12
Tension Camp2 week1 Wed	5.57	7.413	7	-2	16
Tension Camp2 week1 Sun	2.29	5.314	7	-3	13
Tension Camp2 week2 Wed	7.00	8.832	7	1	26
Tension Camp2 week2 Sun	3.50	7.007	6	-3	16
Tension Camp2 week3 Wed	6.57	7.185	7	-3	20
Tension Camp2 week3 Sun	2.43	6.630	7	-3	16
Tension Camp2 week4 Wed	6.29	9.517	7	-2	22
Tension Camp2 week4 Sun	4.29	7.135	7	-2	15
Tension Camp2 Post-test	8.50	12.534	6	-3	28

Mean tension scores fluctuated substantially between international (5.66) and club level athlete scores (9.62)

Table 4.3: TC3 tension scores

	Mean	Std. Deviation	N	Minimum	Maximum
Tension Camp3 Pre-test	4.50	7.714	6	-2	19
Tension Camp3 week1 Wed	3.57	5.127	7	-4	13
Tension Camp3 week1 Sun	4.14	8.630	7	-4	22
Tension Camp3 week2 Wed	8.50	9.915	6	1	28
Tension Camp3 week2 Sun	4.43	9.744	7	-3	26
Tension Camp3 week3 Wed	7.57	10.998	7	-4	30
Tension Camp3 week3 Sun	5.14	9.616	7	-3	26

The mean appears to be more stable around the international athlete scores (5.66)

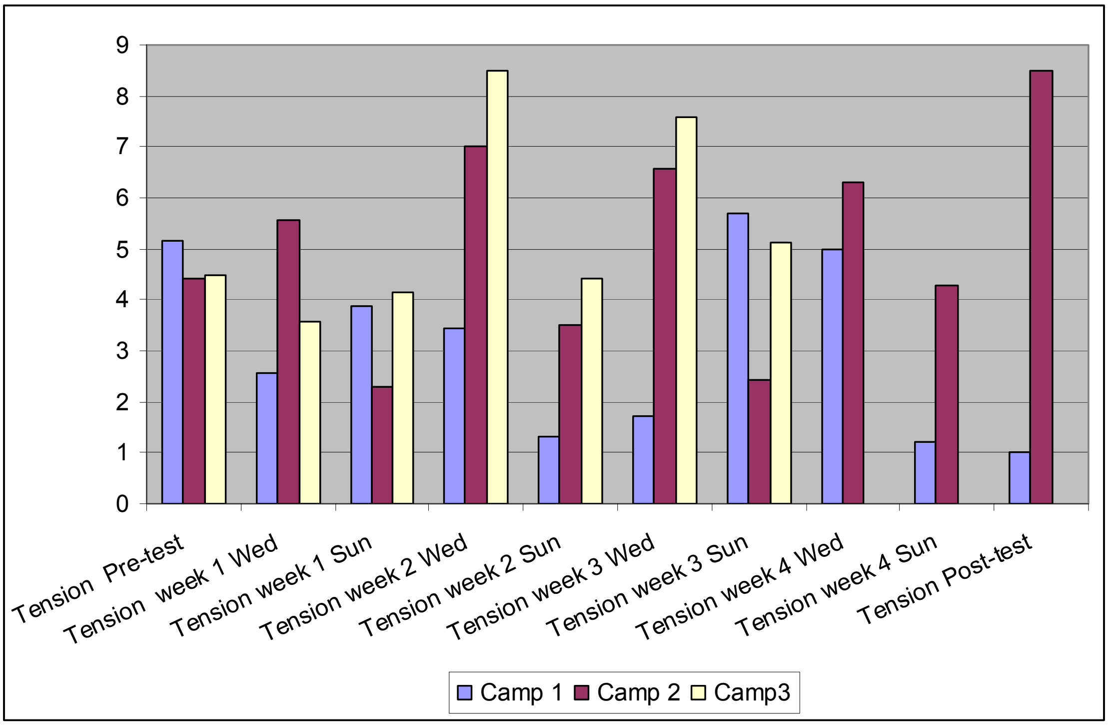

Figure 4.1: Mean tension scores for measurements across camps

The comparison of similar days within each week within camps produced the following results. Wednesday measurements across the four weeks of TC1 showed no statistically significant difference. In all cases, Wednesday measurements were low. Sunday measurements had the same trend with a higher score in week three. TC2 and TC3 had the same trend even though tension scores were higher.

The comparison of Wednesday and Sunday results within the same week produced the following results. Week three of TC1 had a statistically significant difference between the Wednesday and Sunday tension measurements. In five of the seven cases, the Sunday tension scores were higher than Wednesday scores. This difference was significant at the 10% level of significance (Z=-1.807; p=0.071). TC2 week one had a statistically significant difference between Sunday and Wednesday measurements with five of the seven cases having lower Sunday tension scores than Wednesday scores. This difference was significant at the 10% level of significance (Z=-1.802; p=0.072). The same trend was found in week two though this difference was significant at the 5% level of significance (Z=-1.997, p=0.046). TC3 showed similar results to TC2 with Sunday tension scores in weeks two and three being lower than Wednesday scores. These differences were significant at the 10% level (Z=-1.897, p=0.058) and 5% levels respectively (Z=-1.997, p=0.046). A comparison of similar weeks across camps showed no statistically significant differences between the measurements between the camps. Tension levels were higher during TC2 and TC3 than in TC1, but were not statistically significant.

4.1.2.2 Depression scores

Depression scores in TC1 fluctuated randomly; with lower scores recorded towards week four and in the post-test (see Figure 4.2). These fluctuations in scores were not statistically significant. Depression scores during TC2 were lower at the pre-test with higher scores during the camp. These scores fluctuated randomly and were not statistically significant. TC3 depression scores tended to be higher towards weeks two and three of the camp, but did not differ statistically significantly. TC3 showed random depression scores with no statistically significant movement.

The comparison of similar days within each week within camps produced the following results. Both Wednesday and Sunday measurements, across the four weeks of TC1, showed no statistically significant differences. In all cases, measurements were moderately low. TC2 Wednesdays were generally higher but did not differ significantly from Wednesday to Wednesday. Sunday measurements had the same trend. TC3 showed the same trends with no significant differences. With reference to Table 2.2, the depression scores fluctuate around the club athlete level (8.67) with the lowest measurements occurring at the first week Wednesday, fourth week Sunday, and during the post-test. These all occur at periods, initially when the athletes have been or returned from a ‘homely’ environment. Week four Sunday score and post-test compare well with Table 2.3 and the post exercise scores (2.02).

Table 4.4: TC1 depression scores

	Mean	Std. Deviation	N	Minimum	Maximum
Depression Camp 1 Pre-test	6.17	4.119	6	1	11
Depression Camp 1 week 1 Wed	4.43	7.435	7	0	20
Depression Camp 1 week 1 Sun	8.86	11.510	7	0	28
Depression Camp 1 week 2 Wed	6.29	8.789	7	0	19
Depression Camp 1 week 2 Sun	5.17	8.841	6	0	23
Depression Camp 1 week 3 Wed	6.43	12.713	7	0	35
Depression Camp 1 week 3 Sun	8.00	14.526	7	0	40
Depression Camp 1 week 4 Wed	7.86	9.582	7	0	26
Depression Camp 1 week 4 Sun	2.40	2.510	5	0	6
Depression Camp 1 Post-test	1.25	1.258	4	0	3

Table 4.5: TC2 depression scores

	Mean	Std. Deviation	N	Minimum	Maximum
Depression Camp2 Pre-test	3.86	3.338	7	0	9
Depression Camp2 week1 Wed	10.43	12.259	7	0	30
Depression Camp2 week1 Sun	6.43	7.613	7	1	23
Depression Camp2 week2 Wed	8.43	11.385	7	1	33
Depression Camp2 week2 Sun	9.50	13.323	6	0	35
Depression Camp2 week3 Wed	10.86	10.367	7	1	32
Depression Camp2 week3 Sun	5.71	7.566	7	0	20
Depression Camp2 week4 Wed	8.43	12.934	7	0	31
Depression Camp2 week4 Sun	6.57	9.693	7	0	26
Depression Camp2 Post-test	10.67	14.292	6	0	30

There were notably high scores during TC2, with scores predominantly around the club level athlete (8.67). It is interesting to note the high score for the post-test.

Table 4.6: TC3 depression scores

	Mean	Std. Deviation	N	Minimum	Maximum
Depression Camp3 Pre-test	5.67	8.383	6	0	22
Depression Camp3 week1 Wed	7.29	9.995	7	0	29
Depression Camp3 week1 Sun	6.43	7.231	7	0	21
Depression Camp3 week2 Wed	11.67	9.180	6	2	28
Depression Camp3 week2 Sun	4.14	8.335	7	0	23
Depression Camp3 week3 Wed	6.14	5.490	7	0	15
Depression Camp3 week3 Sun	3.86	3.024	7	0	9

With reference to Table 2.2 the scores occur between the international (4.38) and club level scores (8.67). Interestingly the highest mean score (11.67) occurs on week two Wednesday). This score was also the highest across all three training camps.

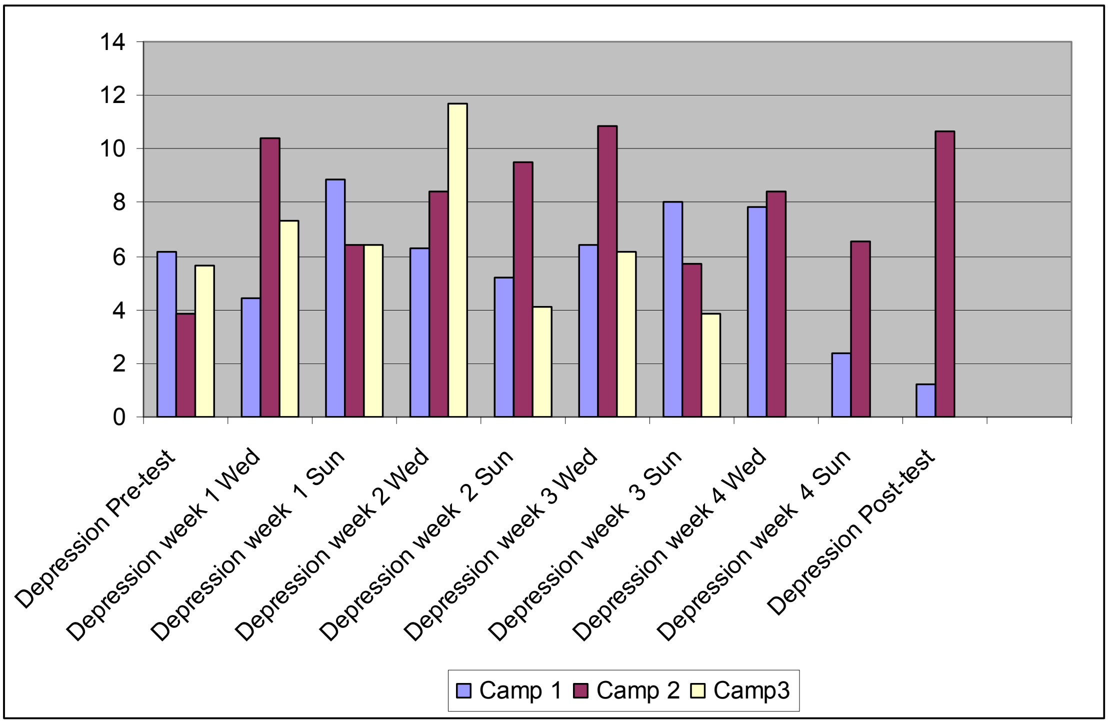

Figure 4.2: Mean depression scores for measurements across camps

The comparison of Wednesday and Sunday results within the same week produced the following results. Week one of TC1 had a statistically significant difference between the Wednesday and Sunday depression measurements. Five of the Sunday depression scores were higher than Wednesday scores. This difference was significant at the 5% level of significance (Z=-2.032; p=0.042). TC2 had no statistically significant differences between Wednesday and Sunday depression scores. TC3 results indicated a significant difference between scores of week two. In all six cases (who completed the POMS) the Sunday depression scores were lower than Wednesday scores of the same week. This difference was significant at the 5% level (Z=-2.201, p=0.028). A comparison of similar weeks across camps showed two statistically significant differences at the 10% level of significance. Week one Wednesday depression scores were significantly lower during TC1 than TC2 and TC3 (Chi-square=4.9692, p=0.096). Week two Wednesday depression scores were much higher during TC3 when compared to TC1 and TC2.

4.1.2.3 Anger scores

Table 4.7: TC1 anger scores

	Mean	Std. Deviation	N	Minimum	Maximum
Anger Camp1 Pre-test	6.67	3.559	6	2	12
Anger Camp1 week1 Wed	5.00	8.165	7	0	23
Anger Camp1 week1 Sun	10.57	12.634	7	0	33
Anger Camp1 week2 Wed	9.43	10.502	7	0	29
Anger Camp1 week2Sun	3.17	4.579	6	0	10
Anger Camp1 week3 Wed	5.00	8.246	7	0	23
Anger Camp1 week3 Sun	7.00	10.263	7	0	29
Anger Camp1 week4 Wed	4.86	6.040	7	0	17
Anger Camp1 week4 Sun	5.80	6.496	5	0	16
Anger Camp1 Post-test	4.75	5.500	4	0	12

The scores in Table 4.8 vary quite considerably but compare well with the International level athlete scores in Table 2.2 (6.24). It is interesting to note that the lowest score of TC1 occurs immediately after the two highest scores (week two Sunday, 3.17). The scores compare surprisingly well with athlete scores in Table 2.3 '*away from athletics'* (6.84).

Table 4.8: TC2 anger scores

	Mean	Std. Deviation	N	Minimum	Maximum
Anger Camp2 Pre-test	7.14	7.946	7	1	23
Anger Camp2 week1 Wed	10.00	10.646	7	0	29
Anger Camp2 week1 Sun	7.29	8.789	7	0	26
Anger Camp2 week2 Wed	9.43	12.109	7	0	34
Anger Camp2 week2 Sun	7.00	7.510	6	0	19
Anger Camp2 week3 Wed	14.00	13.102	7	0	33
Anger Camp2 week3 Sun	5.14	8.454	7	0	22
Anger Camp2 week4 Wed	10.57	14.864	7	0	35
Anger Camp2 week4 Sun	8.86	11.582	7	0	27
Anger Camp2 Post-test	11.33	15.227	6	0	39

Anger scores comparing to the club athlete (9.91). The highest anger occurs in the middle of the camp (14.00). Interestingly the lowest score (5.14) of the camp follows the highest score.

Table 4.9: TC3 anger scores

	Mean	Std. Deviation	N	Minimum	Maximum
Anger Camp3 Pre-test	6.17	5.345	6	0	14
Anger Camp3 week1 Wed	5.14	5.490	7	0	16
Anger Camp3 week1 Sun	8.71	11.672	7	0	34
Anger Camp3 week2 Wed	12.17	11.618	6	0	32
Anger Camp3 week2 Sun	5.57	9.607	7	0	27
Anger Camp3 week3 Wed	9.86	10.319	7	0	28
Anger Camp3 week3 Sun	4.86	8.572	7	0	24

Anger scores compare well with the international athlete scores (6.24). The highest score in the camp, week two Wednesday (12.17), correlates with the high depression score over the same period.

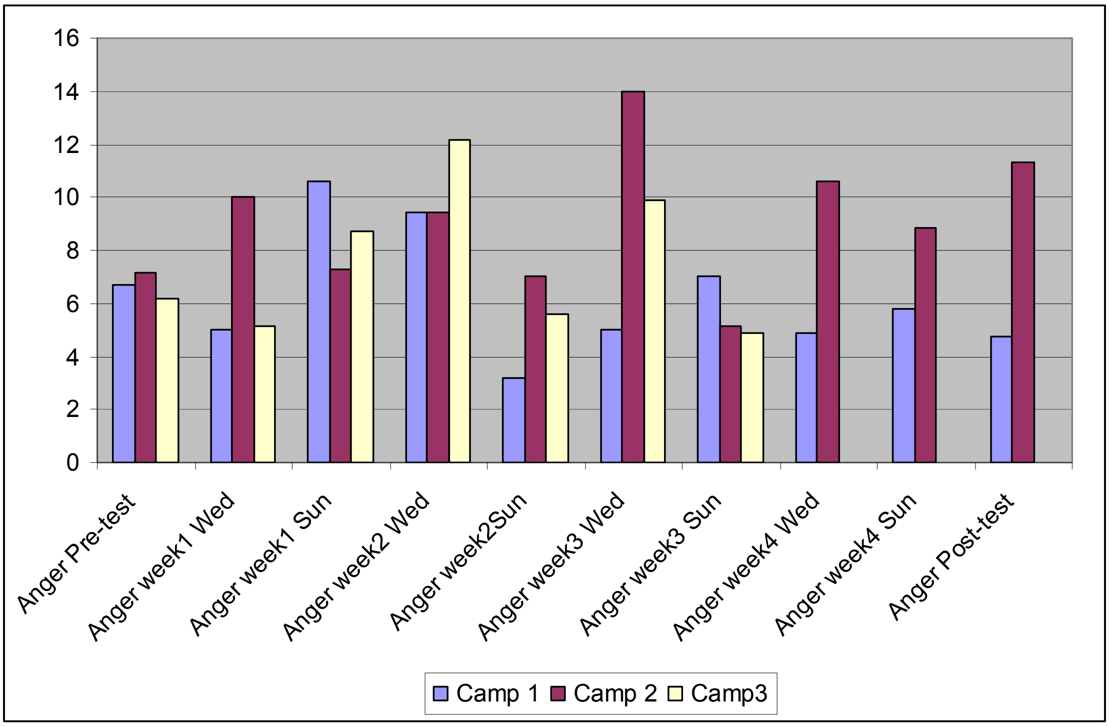

Figure 4.3: Mean anger scores for measurements across camps

Anger scores in TC1 showed no statistically significant differences in scores when comparing the results of the pre-test with the mid-tests to post-test (see Figure 4.3). Anger scores were higher during the first two weeks and decreased towards the end of the camp. The fluctuations in scores were not statistically significant. Anger scores during TC2 showed random up and down movements with the highest score on the Wednesday of week three, but were not statistically significant. TC3 anger scores fluctuated randomly and were not statistically significant.

The comparison of similar days within each week within camps produced the following results. Wednesday measurements across the four weeks of TC1 showed no statistically significant difference. The same trend was found for Sundays even though anger levels were higher in week one. TC2 showed no significant differences when comparing Wednesday measurements with the same trend for Sunday measurements. TC3 results indicate no significant differences when comparing Wednesday measurements, but Sunday measurements did show a statistically significant difference. Anger scores during week one were significantly higher than weeks two and three. This difference was significant at the 5% level (Chi-square=9.333, p=0.009).

The comparison of Wednesday and Sunday results within the same week produced the following results. No statistically significant differences occurred between Wednesday and Sunday Scores of the same week for both TC1 and TC2. TC3 Wednesday and Sunday scores differed significantly from one another during all three weeks. Week one Sunday anger scores were higher than Wednesday scores in five of the seven cases (Z=-2.060, p=0.039). Weeks two, three and four had lower Sunday anger scores than Wednesday scores. Both differences were significant at the 10% level (Z=-1.753, p=0.080 and Z=-1.761, p=0.078 respectively).

A comparison of similar weeks across camps showed no statistically significant differences between the measurements between the camps. Anger levels were higher in some weeks on TC2 but were not statistically significant.

4.1.2.4 Vigour scores

TC1 and TC3 vigour scores showed no statistically significant differences when comparing the results of the pre-test with the mid-tests to post-test (see Figure 4.5). Vigour scores appeared to decline steadily from the pre-test to the post-test during these camps but were not statistically significant. TC2 vigour scores showed a statistically significant difference when comparing scores across the ten measurements. The Wednesday scores of weeks one, two and at the post-test were significantly lower than the rest of the camp. These differences were significant at the 10% level (Chi-square=14.963, p=0.092).

Table 4.10: TC1 vigour scores

	Mean	Std. Deviation	N	Minimum	Maximum
Vigour Camp1 Pre-test	16.67	6.250	6	7	23
Vigour Camp1 week1 Wed	15.29	6.317	7	4	24
Vigour Camp1 week1 Sun	13.00	6.083	7	5	21
Vigour Camp1 week2 Wed	16.29	4.855	7	9	24
Vigour Camp1 week2 Sun	13.50	5.788	6	4	19
Vigour Camp1 week3 Wed	12.14	5.757	7	3	18
Vigour Camp1 week3 Sun	11.29	6.651	7	1	19
Vigour Camp1 week4 Wed	11.43	4.685	7	3	18
Vigour Camp1 week4 Sun	12.40	3.912	5	10	19
Vigour Camp1 Post-test	12.00	3.742	4	7	16

It is evident to see the steady decline in mean scores for TC1. The scores do not reach the international athlete scores (18.51).

Table 4.11: TC2 vigour scores

	Mean	Std. Deviation	N	Minimum	Maximum
Vigour Camp2 Pre-test	14.29	6.626	7	1	20
Vigour Camp2 week1 Wed	12.57	5.968	7	1	19
Vigour Camp2 week1 Sun	11.57	3.457	7	7	16
Vigour Camp2 week2 Wed	10.29	5.765	7	1	18
Vigour Camp2 week2 Sun	12.67	6.186	6	5	20
Vigour Camp2 week3 Wed	12.29	5.407	7	4	19
Vigour Camp2 week3 Sun	12.00	5.416	7	5	19
Vigour Camp2 week4 Wed	12.29	4.716	7	4	18
Vigour Camp2 week4 Sun	9.86	4.706	7	2	15
Vigour Camp2 Post-test	9.33	4.761	6	3	15

The notable differences in pre-test and post-test scores are seen in Table 4.11. The scores here indicate that the athletes are “away from athletics” (15.88).

Table 4.12: TC3 vigour scores

	Mean	Std. Deviation	N	Minimum	Maximum
Vigour Camp3 Pre-test	18.67	5.989	6	11	24
Vigour Camp3 week1 Wed	14.57	6.079	7	4	21
Vigour Camp3 week1 Sun	14.57	9.016	7	0	25
Vigour Camp3 week2 Wed	9.67	6.055	6	4	19
Vigour Camp3 week2 Sun	12.43	4.721	7	6	19
Vigour Camp3 week3 Wed	14.14	2.610	7	11	19
Vigour Camp3 week3 Sun	12.71	3.988	7	8	20

The highest mean vigour score was in the pre-test (18.67), and during the middle of the camp (Wednesday week two) one of the lowest scores for all camps was recorded (9.67), which correlated with the elevations in the negative mood states. This is a normal response to training according to Budgett (1998). The female scores represent five of the seven measurements with a strong possibility that a common factor influenced them. A steady decline of scores is evident from pre-camp measurement.

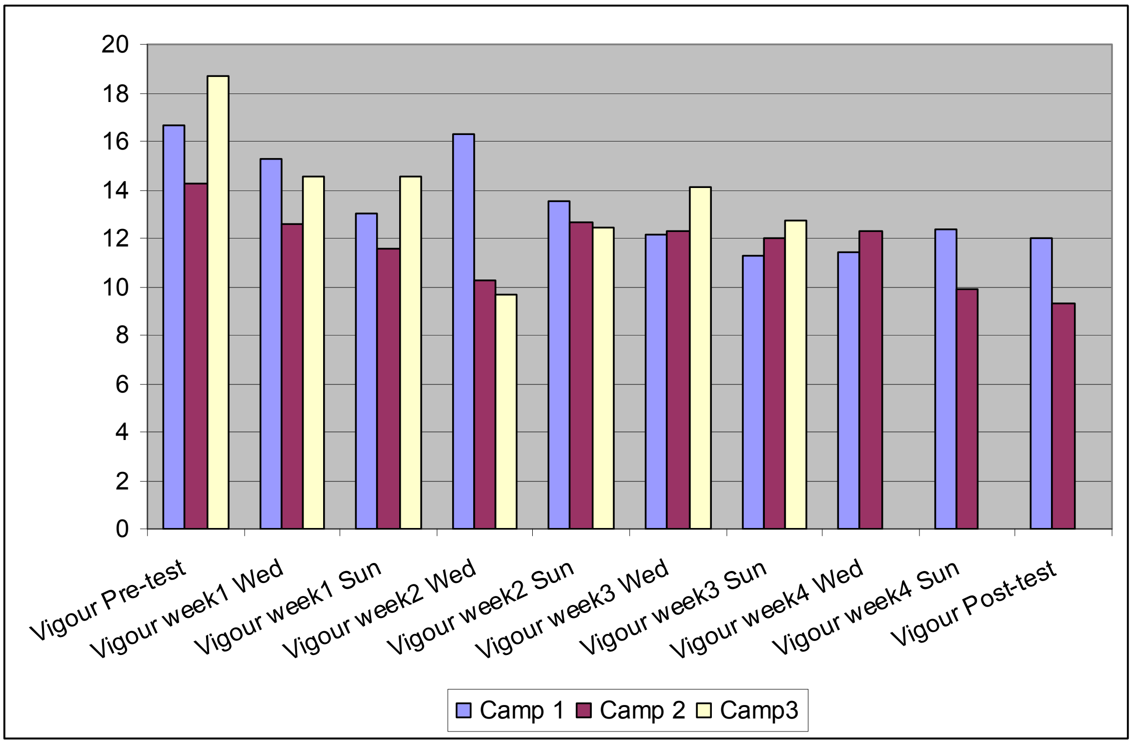

Figure 4.4: Mean vigour scores for all measurements across camps

The comparison of similar days within each week within camps produced the following results. Wednesday measurements during TC1 and TC3 showed significant differences. During TC1 the week four Wednesday vigour scores were significantly lower than during the rest of the camp (Chi-square=7.087, p=0.069). During TC3, week two Wednesday vigour scores were significantly lower than the rest of the camp (Chi-square=4.727, p=0.094. These scores reflect the effect that the training camps had on the athletes and the aim of the coach. Sunday scores at all three camps did not differ significantly from one another.

The comparison of Wednesday and Sunday results within the same week produced the following results. TC2 and TC3 showed no significant difference between Wednesday and Sunday scores in any of the weeks. TC1 week TC2 Sunday scores were lower than Wednesday scores in five of the cases (Z=-1.802, p=0.072).

A comparison of similar weeks across camps indicated that vigour scores differed significantly at the pre-tests (Chi-square=6.421, p=0.040). TC2 vigour scores were considerably lower than TC1 and TC3. Wednesday scores at week two also differed significantly with TC1 having the highest scores (Chi-square=6.333, p=0.042).

4.1.2.4 Fatigue scores

Table 4.13: TC1 fatigue scores

	Mean	Std. Deviation	N	Minimum	Maximum
Fatigue Camp1 Pre-test	7.67	3.077	6	4	13
Fatigue Camp1 week1 Wed	10.86	10.007	7	2	26
Fatigue Camp1 week1 Sun	9.71	10.657	7	1	25
Fatigue Camp1 week2 Wed	10.00	8.718	7	3	24
Fatigue Camp1 week2 Sun	9.67	10.405	6	0	26
Fatigue Camp1 week3 Wed	11.14	10.090	7	3	28
Fatigue Camp1 week3 Sun	10.86	10.605	7	0	27
Fatigue Camp1 week4 Wed	12.29	10.797	7	1	28
Fatigue Camp1 week4 Sun	13.60	7.470	5	5	23
Fatigue Camp1 Post-test	10.50	9.256	4	4	24

Table 4.13 shows elevated fatigue scores when compared to Tables 2.2 and 2.3. There is a general trend of increasing fatigue as the camp progresses.

Table 4.14: TC2 fatigue scores

	Mean	Std. Deviation	N	Minimum	Maximum
Fatigue Camp2 Pre-test	5.00	5.000	7	0	15
Fatigue Camp2 week1 Wed	6.86	6.517	7	0	18
Fatigue Camp2 week1 Sun	7.71	8.077	7	1	25
Fatigue Camp2 week2 Wed	9.71	9.142	7	0	25
Fatigue Camp2 week2 Sun	5.33	6.121	6	0	16
Fatigue Camp2 week3 Wed	10.00	9.292	7	2	25
Fatigue Camp2 week3 Sun	6.57	8.182	7	0	23
Fatigue Camp2 week4 Wed	12.14	9.634	7	2	25
Fatigue Camp2 week4 Sun	10.43	10.081	7	1	26
Fatigue Camp2 Post-test	10.83	12.766	6	0	28

There is an increasing trend with the mean fatigue scores. The scores at the pre-test are reflective of international standard athletes (5.22) and then show a steady fluctuating increase to club level and above (8.16).

Table 4.15: TC3 fatigue scores

	Mean	Std. Deviation	N	Minimum	Maximum
Fatigue Camp3 Pre-test	2.83	2.639	6	0	7
Fatigue Camp3 week1 Wed	7.57	6.680	7	0	20
Fatigue Camp3 week1 Sun	8.29	6.945	7	0	21
Fatigue Camp3 week2 Wed	11.33	8.042	6	4	26
Fatigue Camp3 week2 Sun	7.71	6.726	7	2	21
Fatigue Camp3 week3 Wed	8.71	7.889	7	1	23
Fatigue Camp3 week3 Sun	6.86	7.819	7	0	23

Within a few days of the training camp, the fatigue scores increased from the pre-test measurement. The high fatigue score prior to a training camp could show a lack of rest from training before the onset of the camp.

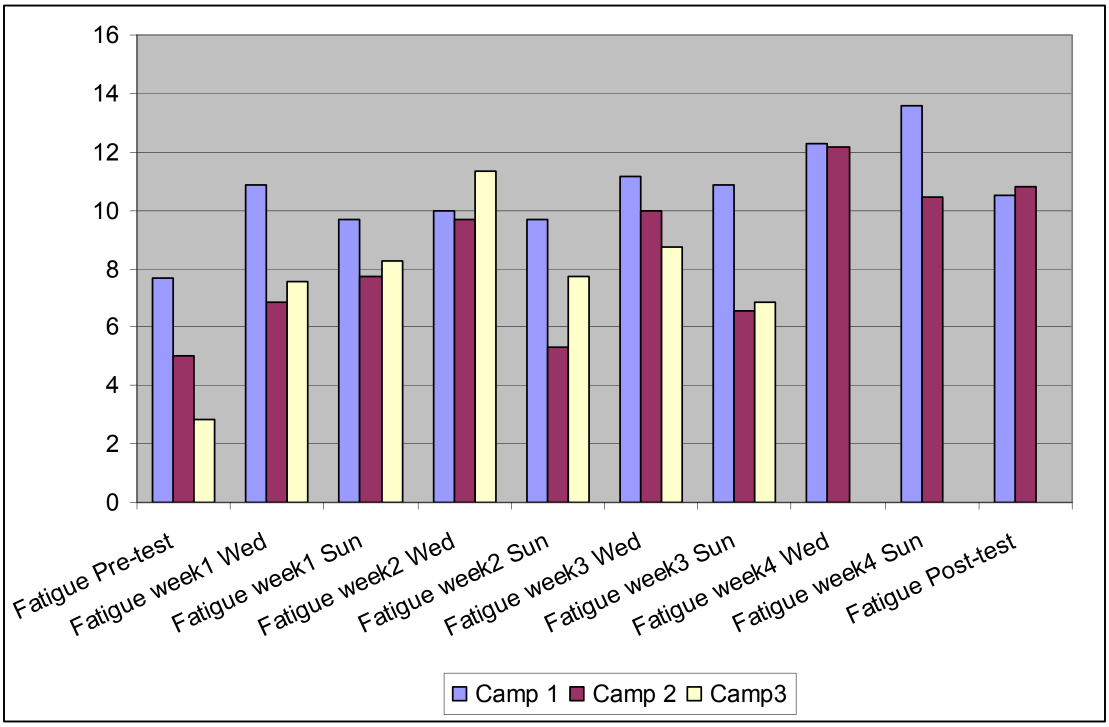

Figure 4.5: Mean fatigue scores for all measurements across camps

TC1 and TC3 had no statistically significant differences between the ten measurements from pre- to post-test (see Figure 4.5). TC1 fatigue scores increased over time, although this increase was not statistically significant. TC3 scores increased up until the Wednesday of week two but then steadily declined. TC2 showed statistically significant differences at the 5% level of significance (Chi-square=17,742, p=0.038).

The comparison of similar days within each week within camps produced the following results. TC1 and TC3 had no significant differences in Wednesday scores. TC2 had a statistically significant difference in Wednesday scores across the weeks (Chi-square=8.952, p=0.030). Fatigue scores were lowest during week one with the highest scores during week four. TC1 and TC3 also showed no statistically significant difference in Sunday scores. Significant differences were found during TC2 at the 10% level of significance (Chi-square=7.789, p=0.051). Considerably lower scores were recorded during week two.

The comparison of Wednesday and Sunday results within the same week during TC1 indicated that there were no statistically significant differences in any of the weeks. Both TC2 and TC3 showed significant differences between Wednesday and Sunday scores of week two. During both camps, the majority of cases had lower Sunday fatigue scores than Wednesday scores. These differences were significant at the 5% and 10% level respectively (Z=-2.226, p=0.026 and Z=-1.687, p=0.092). When comparing camps at the same measurement interval no statistically significant differences were found.

4.1.2.6 Confusion scores

Confusion scores had no statistically significant differences across all ten measurements in any of the three camps (see Figure 4.6). These scores showed random trends across the measurements**.** The comparison of similar days within each week within camps indicated no statistically significant differences when comparing Wednesdays as well as Sundays within each camp. The comparison of Wednesday and Sunday results within the same week indicated no statistically significant differences in any of the weeks during TC1 and TC2. TC3 week three had a statistically significant difference between Wednesday and Sunday scores. In five of the cases Sunday scores were lower than Wednesday scores (Z=-2.032, p=0.042).

Table 4.16: TC1 confusion scores

	Mean	Std. Deviation	N	Minimum	Maximum
Confusion Camp1 Pre-test	3.67	2.875	6	0	8
Confusion Camp1 week1 Wed	2.71	4.821	7	-3	10
Confusion Camp1 week1 Sun	2.14	4.100	7	-2	10
Confusion Camp1 week2 Wed	1.71	3.402	7	-2	8
Confusion Camp1 week2 Sun	1.83	5.811	6	-3	13
Confusion Camp1 week3 Wed	1.57	3.359	7	-2	7
Confusion Camp1 week3 Sun	3.14	4.598	7	-3	11
Confusion Camp1 week4 Wed	2.00	4.761	7	-3	11
Confusion Camp1 week4 Sun	2.20	3.114	5	-1	6
Confusion Camp1 Post-test	2.00	3.742	4	-2	7

In all three camps, with reference to Tables 2.2 and 2.3, the confusion scores are significantly lower than the norms of any level of achievement and situation.

Table 4.17: TC2 confusion scores

	Mean	Std. Deviation	N	Minimum	Maximum
Confusion Camp2 Pre-test	1.43	2.699	7	-3	5
Confusion Camp2 week1 Wed	3.57	5.287	7	-1	13
Confusion Camp2 week1 Sun	2.14	2.968	7	-2	6
Confusion Camp2 week2 Wed	3.57	3.599	7	-2	10
Confusion Camp2 week2 Sun	2.50	3.507	6	-3	6
Confusion Camp2 week3 Wed	2.71	4.192	7	-1	9
Confusion Camp2 week3 Sun	1.00	4.243	7	-2	10
Confusion Camp2 week4 Wed	2.57	7.138	7	-3	18
Confusion Camp2 week4 Sun	2.29	4.536	7	-2	12
Confusion Camp2 Post-test	1.83	5.845	6	-4	11

Table 4.18: TC3 confusion scores

	Mean	Std. Deviation	N	Minimum	Maximum
Confusion Camp3 Pre-test	2.00	2.530	6	-1	5
Confusion Camp3 week1 Wed	0.29	1.496	7	-2	2
Confusion Camp3 week1 Sun	0.71	2.360	7	-3	4
Confusion Camp3 week2 Wed	2.67	3.882	6	-2	8
Confusion Camp3 week2 Sun	0.86	2.545	7	-2	5
Confusion Camp3 week3 Wed	3.29	3.450	7	-1	9
Confusion Camp3 week3 Sun	1.43	3.409	7	-3	7

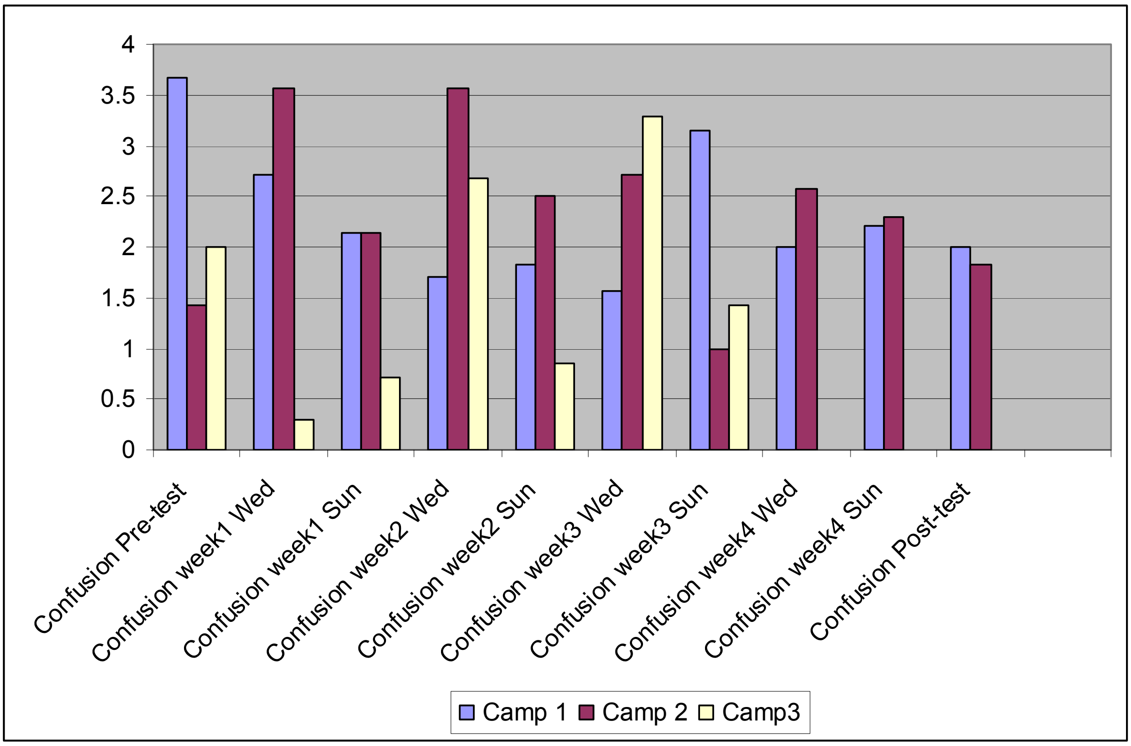

Figure 4.6: Mean confusion scores for measurements across camps

When comparing camps at the same measurement interval, confusion scores on Wednesday week three differed significantly at the 10% level of significance (Chi-square=4.727, p=0.094). Confusion scores on the Wednesday of TC1 were significantly lower than TC2 and TC3.

4.1.2.7 Total Mood disturbance scores

Figure 4.7 reflects the results of TMD scores. TC1 and TC3 showed no statistically significant differences across the measurements from the pre-test to the last test. TC2 scores showed a statistically significant difference at the 10% level (Chi-square=14.883, p=0.094). Scores were considerably lower on Sundays in weeks two and three.

Table 4.19: TC1 TMD scores

	Mean	Std. Deviation	N	Minimum	Maximum
TMD Camp1 Pre-test	112.67	15.782	6	89	138
TMD Camp1 week1 Wed	110.29	38.806	7	74	183
TMD Camp1 week1 Sun	122.14	47.439	7	76	197
TMD Camp1 week2 Wed	114.57	33.540	7	78	168
TMD Camp1 week2 Sun	107.67	33.980	6	76	168
TMD Camp1 week3 Wed	113.71	38.815	7	84	194
TMD Camp1 week3 Sun	123.43	53.307	7	76	235
TMD Camp1 week4 Wed	120.57	38.034	7	82	179
TMD Camp1 week4 Sun	112.80	13.646	5	95	127
TMD Camp1 Post-test	107.50	14.799	4	89	124

Table 4.20: TC2 TMD scores

	Mean	Std. Deviation	N	Minimum	Maximum
TMD Camp2 Pre-test	107.57	23.316	7	81	152
TMD Camp2 week1 Wed	123.86	42.932	7	86	185
TMD Camp2 week1 Sun	114.29	29.084	7	82	175
TMD Camp2 week2 Wed	127.86	43.793	7	86	214
TMD Camp2 week2 Sun	115.17	31.006	6	76	165
TMD Camp2 week3 Wed	131.86	36.685	7	83	195
TMD Camp2 week3 Sun	108.86	36.237	7	83	186
TMD Camp2 week4 Wed	127.71	54.920	7	84	221
TMD Camp2 week4 Sun	122.57	43.813	7	86	201
TMD Camp2 Post-test	133.83	60.181	6	79	217

The comparison of similar days within each week within camps indicated no statistically significant differences when comparing Wednesdays as well as Sundays within each camp.

Table 4.21: TC3 TMD scores

	Mean	Std. Deviation	N	Minimum	Maximum
TMD Camp3 Pre-test	102.50	19.222	6	85	135
TMD Camp3 week1 Wed	109.71	28.430	7	80	167
TMD Camp3 week1 Sun	113.71	38.686	7	74	188
TMD Camp3 week2 Wed	131.33	44.617	6	87	208
TMD Camp3 week2 Sun	110.14	35.765	7	85	189
TMD Camp3 week3 Wed	115.00	34.171	7	84	179
TMD Camp3 week3 Sun	108.57	31.469	7	80	175

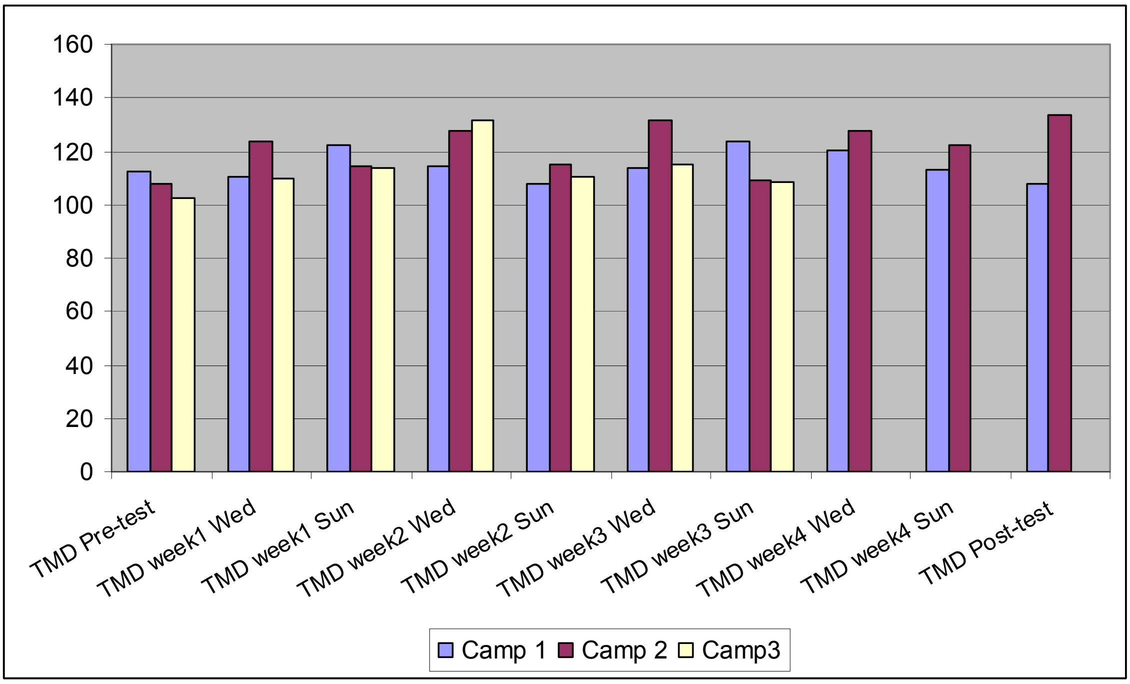

Figure 4.7: Mean TMD for measurements across camps

The comparison of Wednesday and Sunday results within the same week indicated no statistically significant differences in any of the weeks during TC2. TC1 showed a statistically significant difference between Wednesday and Sunday scores in week one (Z=-2.032, p=0.042). In six of the cases the TMD score was higher on Sundays than on

Wednesdays. In TC3 week three, these scores also differed significantly at the 10% level (Z=-1.703, p=0.089). In five cases Sunday scores were lower than Wednesday scores.

When comparing camps at the same measurement interval the TMD scores only differed significantly from one another between camps on the Wednesdays of week three. TMD scores were significantly higher during camp two (Chi-square=5.556, p=0.062).

Table 4.22: P1 TMD scores per subject across training camps

	TC1	TC2	TC 3
Subject 1	115	152	104
Subject 2	138	107	109*
Subject 3	183*	122	135
Subject 4	115	95	91
Subject 5	107	94	87
Subject 6	89	81	85
Subject 7	112	102	113
Average	122.71	107.57	103.43

- * P1 not recorded, P2 used.
- +100 was added to the score to avoid negative numbers

It is evident the athletes were more prepared for the training camps from the pre-test TMD scores, with a decrease from TC1 to TC3. From Figure 4.7, the P1 scores are also lower than the rest of the camp, showing the effect the training camps had on the athletes. The following Tables 4.23, 4.24 and 4.25 show this effect:

4.1.3 POMS comparisons per camp

Tables 4.23, 4.2.4, 4.25 show the mean scores and standard deviation for each POMS measurement in TC1, TC2 and TC3. TC1 and TC2 had eleven measurements over the four weeks of training, while TC3 had eight measurements over three weeks. Kentta *et al,* (2006) recorded 19 measurements over their three week camp.

Table 4.23: POMS results for TC1

	Tension		Depression		Anger		Vigour		Fatigue		Confusion		TMD	
POMS	M	s	M	s	M	s	M	s	M	s	M	s	M	s
Pre	5.17	4.02	6.17	4.12	6.67	3.56	16.67	6.25	7.67	3.08	3.67	2.88	112.67	15.78
Wed	2.57	5.68	4.43	7.44	5.00	8.16	15.29	6.32	10.86	10.01	2.71	4.82	110.29	38.81
Sun	3.86	6.84	8.86	11.51	10.57	12.63	13.00	6.08	9.71	10.66	2.14	4.10	122.14	47.44
Wed	3.43	5.38	6.29	8.79	9.43	10.50	16.29	4.86	10.00	8.72	1.71	3.40	114.57	33.54
Sun	1.33	4.41	5.17	8.84	3.17	4.58	13.50	5.79	9.67	10.41	1.83	5.81	107.67	33.98
Wed	1.71	3.45	6.43	12.71	5.00	8.25	12.14	5.76	11.14	10.09	1.57	3.36	113.71	38.81
Sun	5.71	10.78	8.00	14.53	7.00	10.26	11.29	6.65	10.86	10.61	3.14	4.60	123.43	53.31
Wed	5.00	6.14	7.86	9.58	4.86	6.04	11.43	4.69	12.29	10.80	2.00	4.76	120.57	38.03
Sun	1.20	2.17	2.40	2.51	5.80	6.50	12.40	3.91	13.60	7.47	2.20	3.11	112.80	13.65
Post	1.00	2.16	1.25	1.26	4.75	5.50	12.00	3.74	10.50	9.26	2.00	3.74	106.00	13.25

Table 4.24: POMS results for TC2

	Tension		Depression		Anger		Vigour		Fatigue		Confusion		TMD	
POMS	M	s	M	s	M	s	M	s	M	s	M	s	M	s
Pre	4.43	4.79	3.86	3.34	7.14	7.95	14.29	6.63	5.00	5.00	1.43	2.70	107.57	23.32
Wed	5.57	7.41	10.43	12.26	10.00	10.65	12.57	5.97	6.86	6.52	3.57	5.29	123.86	42.93
Sun	2.29	5.31	6.43	7.61	7.29	8.79	11.57	3.46	7.71	8.08	2.14	2.97	114.29	29.08
Wed	7.00	8.83	8.43	11.39	9.43	12.11	10.29	5.77	9.71	9.14	3.57	3.60	127.86	43.79
Sun	3.50	7.01	9.50	13.32	7.00	7.51	12.67	6.19	5.33	6.12	2.50	3.51	115.17	31.01
Wed	6.57	7.18	10.86	10.37	14.00	13.10	12.29	5.41	10.00	9.29	2.71	4.19	131.86	36.69
Sun	2.43	6.63	5.71	7.57	5.14	8.45	12.00	5.42	6.57	8.18	1.00	4.24	108.86	36.24
Wed	6.29	9.52	8.43	12.93	10.57	14.86	12.29	4.72	12.14	9.63	2.57	7.14	127.71	54.92
Sun	4.29	7.13	6.57	9.69	8.86	11.58	9.86	4.71	10.43	10.08	2.29	4.54	122.57	43.81
Post	8.50	12.53	10.67	14.29	11.33	15.23	9.33	4.76	10.83	12.77	1.83	5.85	133.83	60.18

Table 4.25: POMS results for TC3

	Tension		Depression		Anger		Vigour		Fatigue		Confusion		TMD	
POMS	M	s	M	s	M	s	M	s	M	s	M	s	M	s
Pre	4.50	7.71	5.67	8.38	6.17	5.34	18.67	5.99	2.83	2.64	2.00	2.53	102.50	19.22
Wed	3.57	5.13	7.29	10.00	5.14	5.49	14.57	6.08	7.57	6.68	0.29	1.50	109.71	28.43
Sun	4.14	8.63	6.43	7.23	8.71	11.67	14.57	9.02	8.29	6.95	0.71	2.36	113.71	38.69
Wed	8.50	9.91	11.67	9.18	12.17	11.62	9.67	6.06	11.33	8.04	2.67	3.88	131.33	44.62
Sun	4.43	9.74	4.14	8.34	5.57	9.61	12.43	4.72	7.71	6.73	0.86	2.54	110.14	35.77
Wed	7.57	11.00	6.14	5.49	9.86	10.32	14.14	2.61	8.71	7.89	3.29	3.45	115.00	34.17
Sun	5.14	9.62	3.86	3.02	4.86	8.57	12.71	3.99	6.86	7.82	1.43	3.41	108.57	31.47

Tables 4.26, 4.27 and 4.28 show the comparison of the POMS sub-scales for each training camp respectively in comparison to pre-camp measures. The camp scores did

not include the pre- and post-POMS values. Figures 4.8, 4.9 and 4.10 reflect this and the iceberg profiles of each training camp.

Table 4.26: TC1 - Data values for pre vs. inter camp POMS scores

TC1 - Pre vs Avg of Camp 1- showing change						
	Tension	**Depression**	**Anger**	**Vigour**	**Fatigue**	**Confusion**
Pre	5.17	6.17	6.67	16.67	7.67	3.67
Camp Avg (not inc. pre or post)	3.21	6.34	6.43	13.19	10.94	2.17
	TMD					
Pre	112.67					
Camp Avg (not inc. pre or post)	115.91					

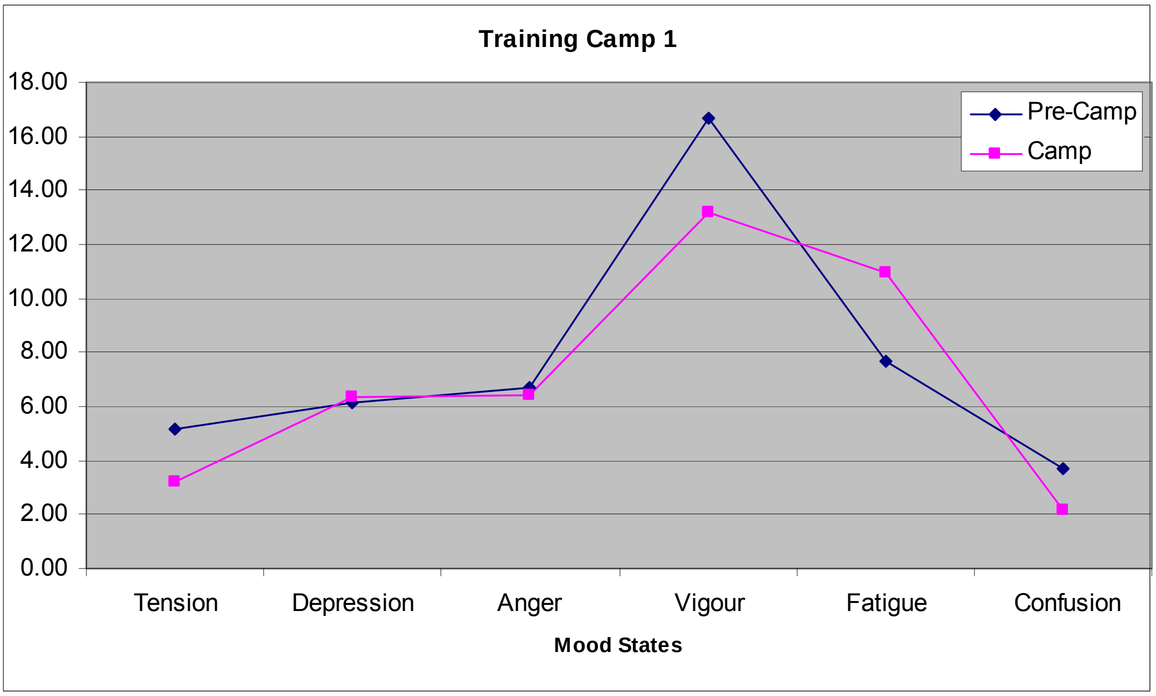

Figure 4.8: Changes in the 'Iceberg Profile' of POMS TC1

There was a 3% difference between the pre-camp TMD when compared to the duration of the camp (calculated from table 4.26).

Table 4.27: TC2 - Data values for pre vs. inter camp POMS scores

TC2 - Pre vs Avg of TC2 - showing change						
	Tension	**Depression**	**Anger**	**Vigour**	**Fatigue**	**Confusion**
Pre	4.43	3.86	7.14	14.29	5.00	1.43
Camp Avg (not inc. pre or post)	4.76	8.27	9.07	11.67	8.65	2.55
	TMD					
Pre	107.57					
Camp Avg (not inc. pre or post)	121.64					

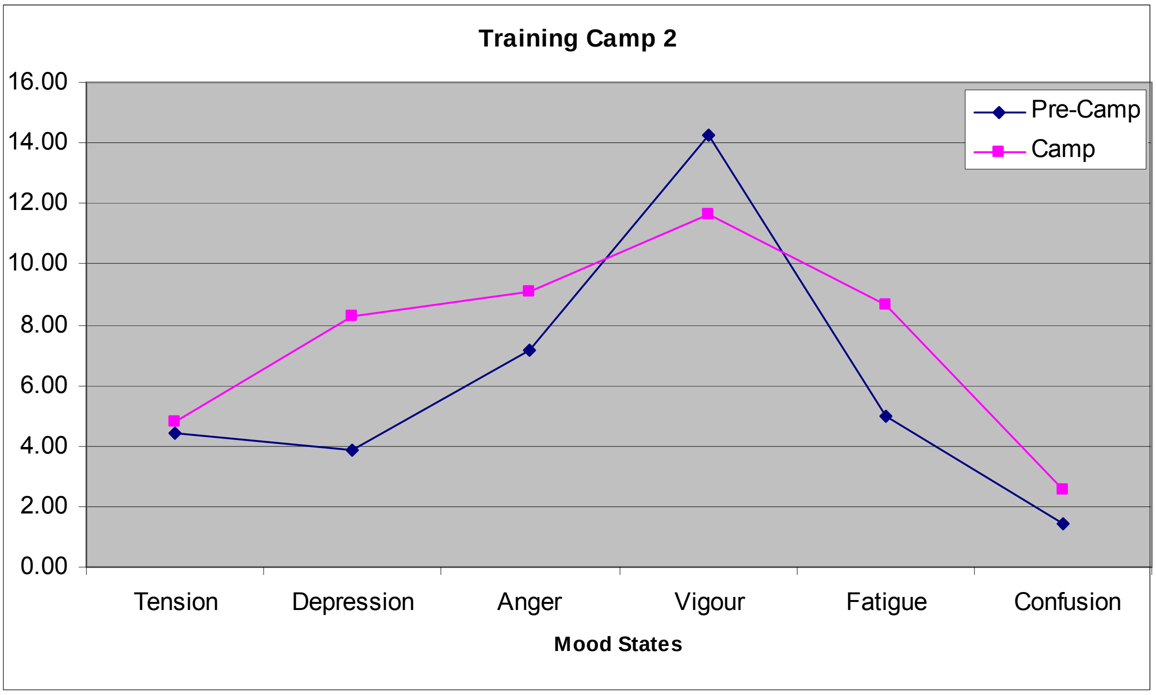

Figure 4.9: Changes in the ‘Iceberg Profile’ of POMS TC2

There was a 12% difference (calculated from table 4.27) for the pre-camp TMD when compared to the duration of the camp. TC2 appeared to have the greatest affect on the kayakers.

Table 4.28: TC3 - Data values for pre vs inter camp POMS scores

TC3 - Pre vs Avg of Camp - showing change						
	Tension	**Depression**	**Anger**	**Vigour**	**Fatigue**	**Confusion**
Pre	4.50	5.67	6.17	18.67	2.83	2.00
Camp Avg (not inc. pre or post)	5.49	6.46	7.61	13.10	8.34	1.51
	TMD					
Pre	102.50					
Camp Avg (not inc. pre or post)	114.34					

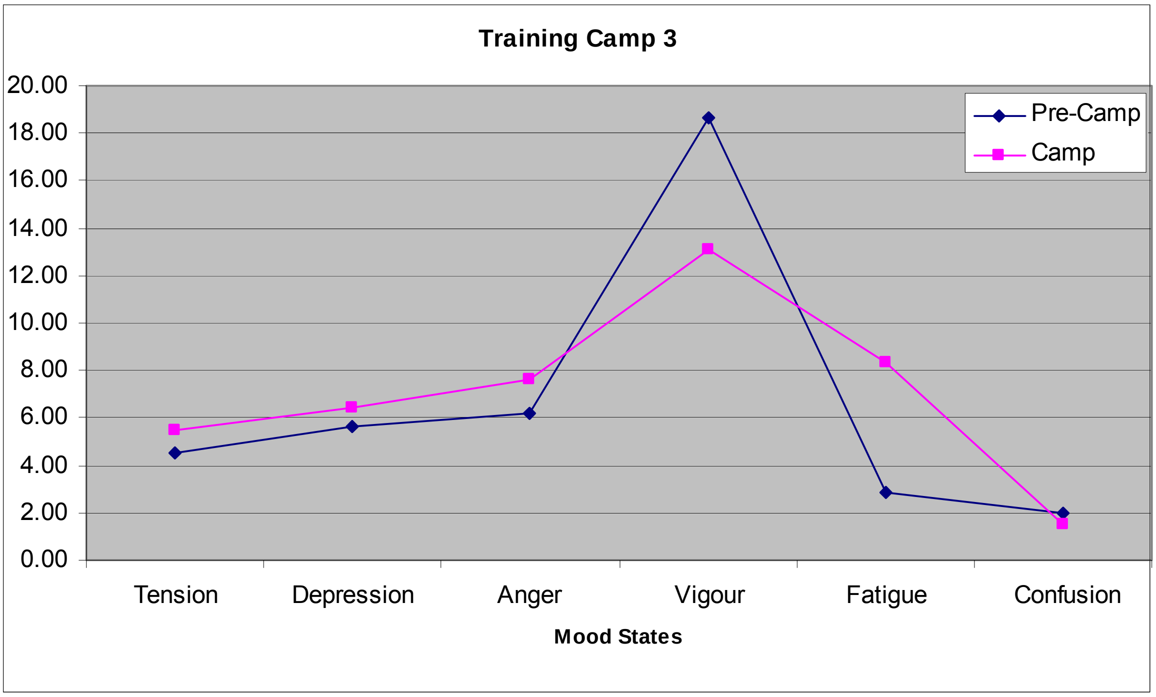

Figure 4.10: Changes in the 'Iceberg Profile' of POMS TC3

There was a 10% difference from the pre-camp TMD when compared to the duration of the camp (calculated from table 4.28)

4.1.4 Results of analysis of the Energy Index measurements

Figure 4.11 reflects the average energy index scores per measurement per camp. Technical output of these results is presented in Appendix E (on CD). In general, the energy index scores appeared to be higher at the initial phases of the training and decreased towards the end of each camp. The comparison of all 10 measurements over time within each camp indicated that TC2 had significant differences, detected at the 10% level of significance. The pre-test as well as week two Sunday measurements were significantly higher than the rest of the measurements (Chi-square=15.051, p=0.090).

Table 4.29: TC1 Energy Index scores

	Mean	Std. Deviation	N	Minimum	Maximum
Energy Index Camp 1 week 1 Pre-test	9.0000	7.64199	6	-2.00	17.00
Energy Index Camp 1 week 1 Wed	4.4286	15.76766	7	-22.00	21.00
Energy Index Camp 1 week 1 Sun	3.2857	16.37798	7	-19.00	20.00
Energy Index Camp 1 week 2 Wed	6.2857	11.35362	7	-10.00	21.00
Energy Index Camp 1 week 2 Sun	3.8333	14.00595	6	-15.00	19.00
Energy Index Camp 1 week 3 Wed	1.0000	15.42725	7	-25.00	15.00
Energy Index Camp 1 week 3 Sun	.4286	17.11585	7	-26.00	19.00
Energy Index Camp 1 week 4 Wed	-.8571	14.63362	7	-23.00	13.00
Energy Index Camp 1 week 4 Sun	-1.2000	7.22496	5	-13.00	5.00
Energy Index Camp 1 Post-test	1.5000	6.80686	4	-8.00	8.00

Table 4.30: TC2 Energy Index Scores

	Mean	Std. Deviation	N	Minimum	Maximum
Energy Index Camp 2 week 1 Pre-test	9.2857	10.64134	7	-14.00	18.00
Energy Index Camp 2week 1 Wed	5.7143	11.71487	7	-12.00	19.00
Energy Index Camp 2 week 1 Sun	3.8571	8.80206	7	-14.00	14.00
Energy Index Camp 2 week 2 Wed	.5714	11.47253	7	-16.00	14.00
Energy Index Camp 2 week 2 Sun	7.3333	7.65942	6	-4.00	18.00
Energy Index Camp 2 week 3 Wed	2.2857	13.54885	7	-16.00	16.00
Energy Index Camp 2 week 3 Sun	5.4286	10.73712	7	-18.00	15.00
Energy Index Camp 2 week 4 Wed	.1429	13.44654	7	-21.00	13.00
Energy Index Camp 2 week 4 Sun	-.5714	12.32690	7	-24.00	10.00
Energy Index Camp 2 Post-test	-1.5000	15.41104	6	-25.00	15.00

Table 4.31: TC3 Energy Index scores

	Mean	Std. Deviation	N	Minimum	Maximum
Energy Index Camp 3 Pre-test	15.8333	5.84523	6	9.00	22.00
Energy Index Camp 3 week 1 Wed	7.0000	11.76152	7	-11.00	17.00
Energy Index Camp 3 week 1 Sun	6.2857	12.71108	7	-10.00	22.00
Energy Index Camp 3 week 2 Wed	-1.6667	13.01794	6	-22.00	15.00
Energy Index Camp 3 week 2 Sun	4.7143	9.19627	7	-11.00	17.00
Energy Index Camp 3 week 3 Wed	5.4286	8.77225	7	-8.00	18.00
Energy Index Camp 3 week 3 Sun	5.8571	10.58975	7	-14.00	20.00

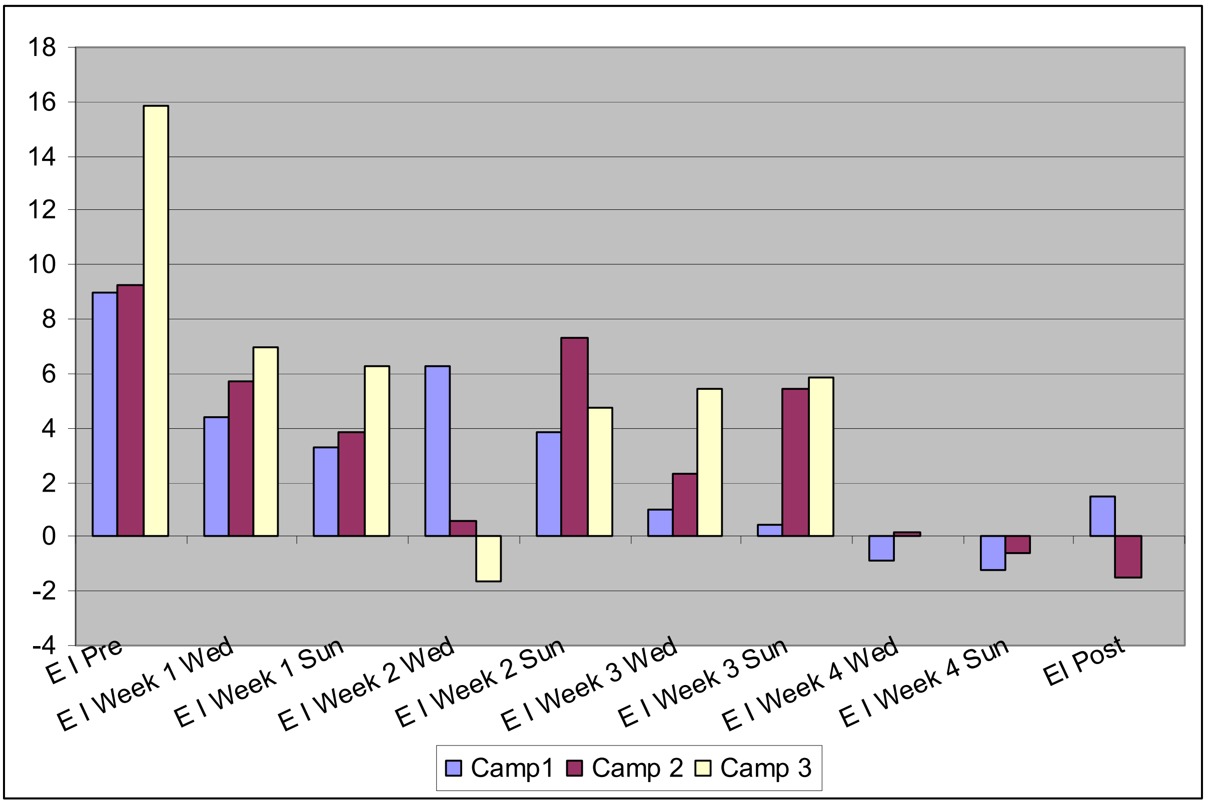

Figure 4.11: Energy Index scores per measurement per camp

The comparison of Wednesday as well as Sunday energy index results within camps indicated that only one statistically significant difference was found at the 10% level of significance (Chi-square=6.529, p=0.089). The energy index scores of week four in TC1 were statistically significantly lower than the previous three weeks. TC2 and TC3 had the same trends, as well as with Sunday measurements; but the declines were not statistically significant. The comparison of Wednesday and Sunday results within the same week indicated no statistically significant differences in any of the weeks in any of the camps.

When comparing camps at the same measurement interval, the energy index scores only differed significantly from one another between camps on the Wednesdays of week two. Energy Index scores were significantly higher during TC1 (Chi-square=5.182, p=0.075). Figures 4.12, 4.13 and 4.14 demonstrate the energy index during each training camp. The x-axis reflects 'days of rest' prior to the POMS assessment and relates to the Wednesday and Sunday scores i.e. ½ and1½ days respectively.

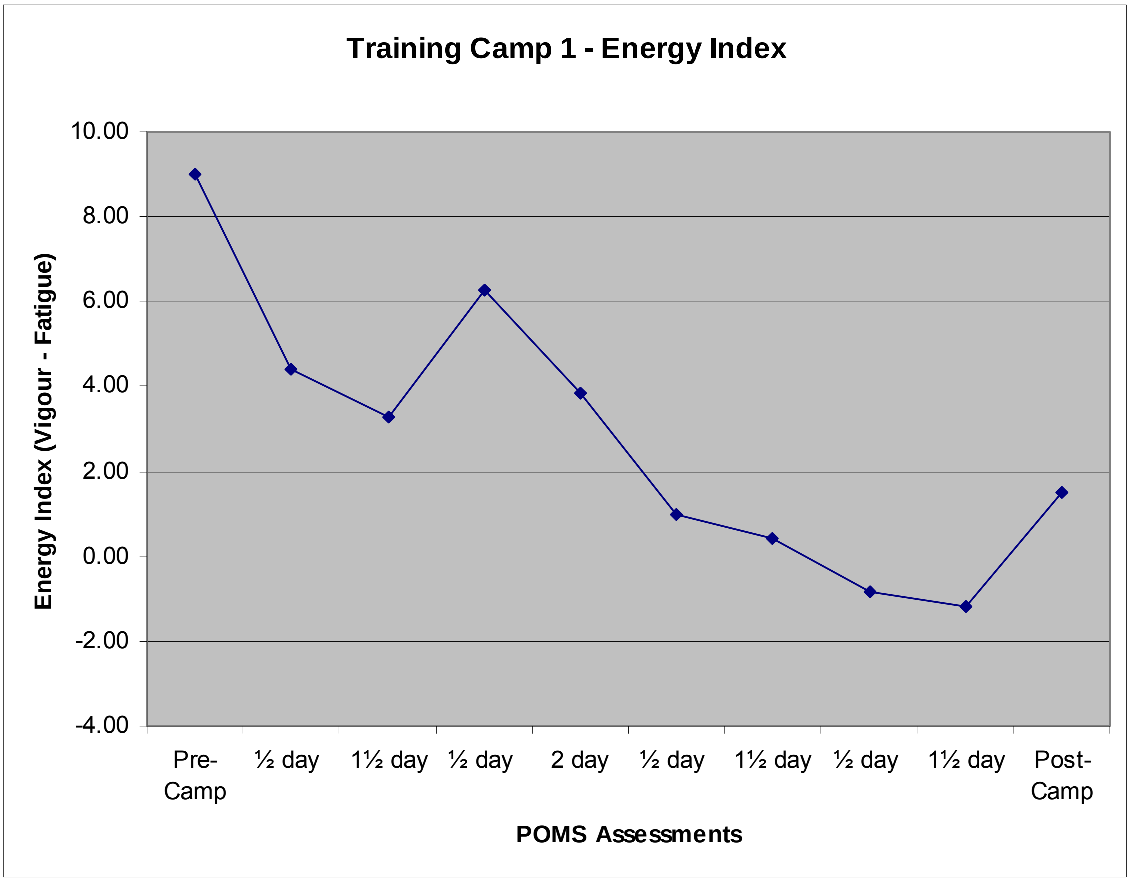

Figure 4.12: Changes observed with the energy index of TC1.

Table 4.32: Values for Figure 4.12

Pre-Camp	½ day	1½ day	½ day	2 day	½ day	1½ day	½ day	1½ day	Post-Camp
9.00	4.43	3.29	6.29	3.83	1.00	0.43	-0.86	-1.20	1.50

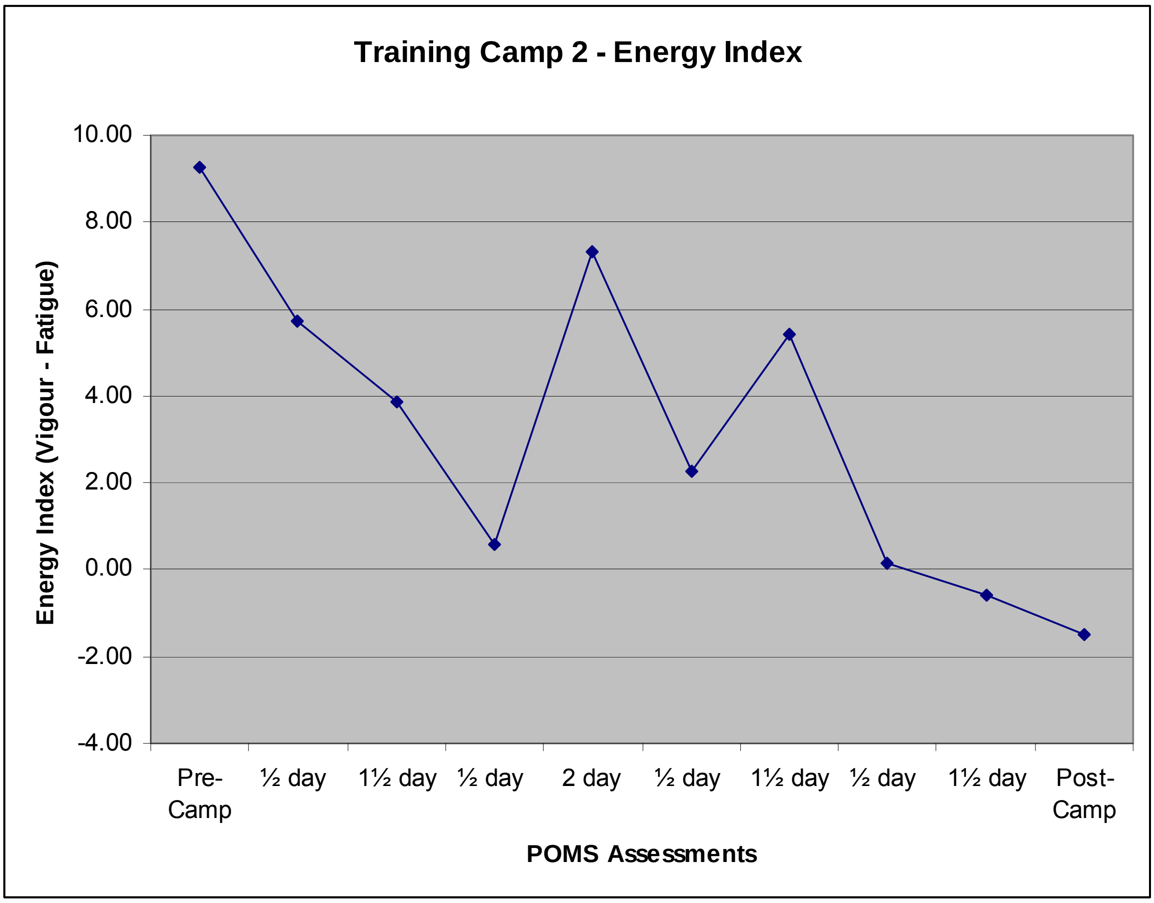

Figure 4.13: Changes observed with the energy index of TC2.

Table 4.33: Values for Figure 4.13

Pre-Camp	½ day	1½ day	½ day	2 day	½ day	1½ day	½ day	1½ day	Post-Camp
9.29	5.71	3.86	0.57	7.33	2.29	5.43	0.14	-0.57	-1.50

Lack of recovery at the post-camp score as well as the last 1½-day of rest could indicate overtraining. The two-day rest period at the half way stage of the camp is evident with the increase in score (7.33)..

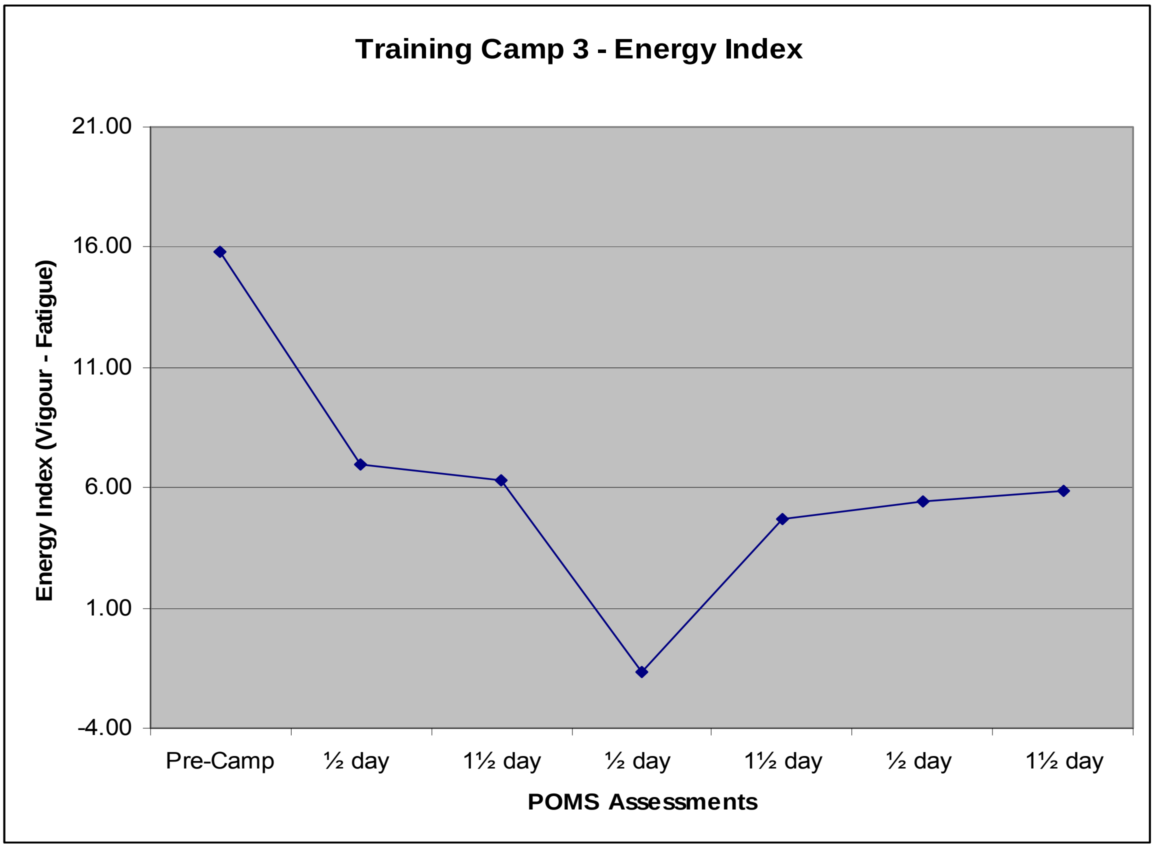

Figure 4.14: Changes observed with the energy index of TC3.

The big decrease in the middle of the camp is consistent with a decline in vigour and increase in fatigue, and a drop in TMD.

Table 4.34: Values for Figure 4.14

Pre-Camp	½ day	1½ day	½ day	1½ day	½ day	1½ day
15.83	7.00	6.29	-1.67	4.71	5.43	5.86

4.1.5 Results of the analysis of RPE measurements over time

The following analysis will focus on the comparison of weekly averages within each camp as well as comparing each week's results across camps. Friedman tests were once again used to determine whether statistically significant differences existed between these measurements. Technical output of these analyses, are presented in Appendix D (on CD).

Table 4.35: Weekly Average RPE scores

	Mean	Std. Deviation	N	Minimum	Maximum
RPE Weekly Avg Camp1 week1	16.18	1.52817	7	13.83	17.75
RPE Weekly Avg Camp1 week2	15.98	1.81564	7	13.50	18.85
RPE Weekly Avg Camp1 week3	16.41	1.82689	7	13.40	18.71
RPE Weekly Avg Camp1 week4	16.11	1.95696	7	12.67	17.96
RPE Weekly Avg Camp2 week1	15.94	1.81927	7	13.10	18.04
RPE Weekly Avg Camp2 week2	16.45	1.12479	7	15.10	17.75
RPE Weekly Avg Camp2 week3	16.59	.87943	7	15.67	18.08
RPE Weekly Avg Camp2 week4	16.84	.86438	7	15.60	18.25
RPE Weekly Avg Camp3 week1	16.47	.55616	6	15.46	17.00
RPE Weekly Avg Camp3 week2	17.33	.55715	6	16.71	18.08
RPE Weekly Avg Camp3 week3	17.19	.49348	6	16.25	17.71

It is interesting to note the steady increment in RPE scores. TC1 was predominantly base training/cross training with more emphasis on technique, aerobic conditioning, and strength. TC2 was focused on more kayak specific training and pre-season conditioning, which incorporated sessions pushing the lactate threshold. TC3 was race specific training and bringing the athletes to a peak, with short, high intensity sessions, as seen in weeks two and three of TC3. The highest RPE value occurred during the week with the highest TMD. TC2 shows the effects of training on the athletes as the RPE increase steadily each week. TC2 had a high perceived work load (Table 4.35), even though the total training times per week were less than TC1.

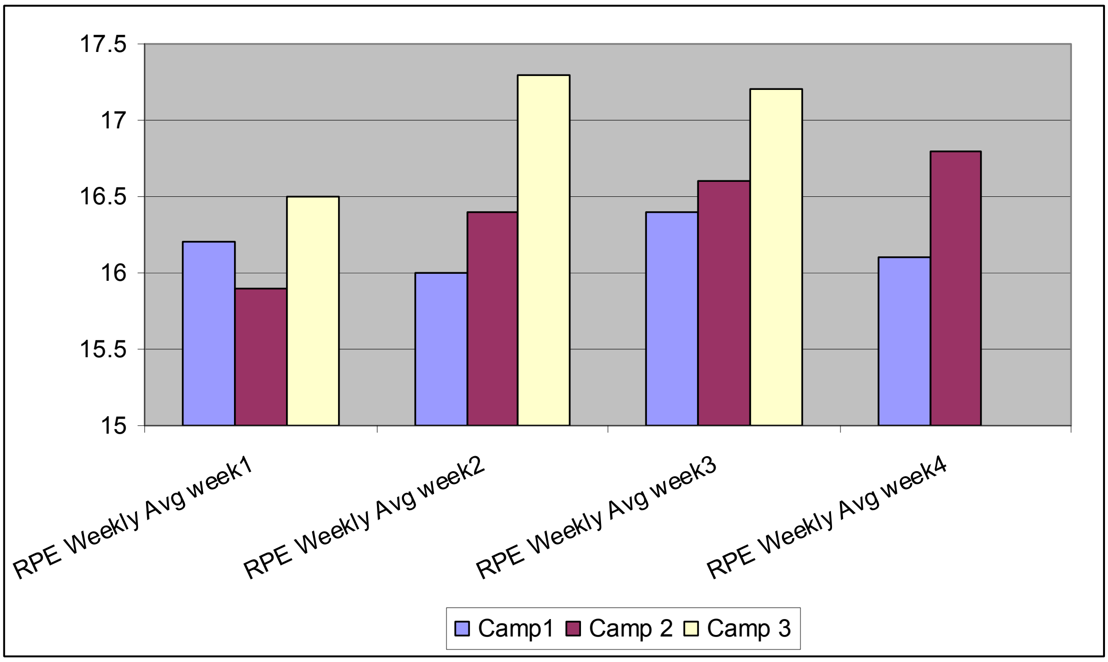

Figure 4.15: Average weekly RPE for each camp

Weekly average RPE scores were calculated for each camp (see Figure 4.15). In general, the RPE was higher during TC3. Further analysis will indicate whether these differences were statistically significant. The average RPE for TC1, TC2 and TC3 was 16.17 (s = 1.69), 16.45 (s = 0.95) and 17.0 (s = 0.51) respectively (appendix D).

The comparison of scores across weeks within the same camp yielded the following results. There were no statistically significant differences in the RPE scores across the weeks during TC1 and TC2. TC3 had a statistically significant difference in the scores from week one to three. During week one, the reported RPE was significantly lower than the two consecutive weeks. This difference was significant at the 5% level of significance (Chi-square=9.333, p=0.009).

The comparison of the same week across camps indicated that week two of the camps showed a statistically significant difference between the RPE reported. TC3 scores were significantly higher than during TC1 and TC2. This difference was significant at the 5% level (Chi-square=6.333, p=0.042).

4.1.6 Results of the analysis of training load measurements over time

The following analysis will focus on the comparison of weekly averages of training load scores within each camp as well as comparing each week's results across camps. Friedman tests were once again used to determine whether statistically significant differences existed between these measurements. Technical output of these analyses, are presented in Appendix D (on CD).

The weekly average was calculated for the training load scores in each camp (Figure 4.16). In general, the training load scores appeared to be higher during TC1 and TC2 than TC3. Further analysis will indicate whether these differences were statistically significant.

The comparison of scores across weeks within the same camp yielded the following results. All training camps showed statistically significant differences between the training load scores of the consecutive weeks. All these differences were significant at the 5% level of significance. TC1 training load scores of week four were significantly lower than the rest of the three weeks (Chi-square=9.343, p=0.025). TC2 training load scores of week one were significantly lower than the other three weeks (Chi-square=12.771, p=0.005). TC3 training load scores of week three, were significantly lower than the previous two weeks (Chi-square=9.0, p=0.011).

The comparison of the same week across camps yielded the following results. During weeks one and three, statistically significant differences were found at the 5% level of significance. Week one training load of TC3 was significantly lower than the other camps (Chi-square=8.333, p=0.016). The same tendency was found in week three (Chi-square=9.0, p=0.011).

Table 4.36: Weekly Average Training Load Scores

	Mean	Std. Deviation	N	Minimum	Maximum
Training Load Weekly Avg Camp1 week1	1086.58	303.23	7	972.00	1327.08
Training Load Weekly Avg Camp1 week2	1138.86	235.31	7	664.00	1667.00
Training Load Weekly Avg Camp1 week3	1062.52	369.13	7	516.00	1452.50
Training Load Weekly Avg Camp1 week4	839.88	381.30	7	251.67	1182.50
Training Load Weekly Avg Camp2 week1	1030.13	281.87	7	838.00	1237.50
Training Load Weekly Avg Camp2 week2	1103.83	353.89	7	943.33	1284.00
Training Load Weekly Avg Camp2 week3	1060.24	357.25	7	947.33	1259.17
Training Load Weekly Avg Camp2 week4	1276.06	564.48	7	1008.50	1640.00
Training Load Weekly Avg Camp3 week1	863.33	205.96	6	774.83	893.33
Training Load Weekly Avg Camp3 week2	974.17	447.56	6	889.17	1053.33
Training Load Weekly Avg Camp3 week3	455.06	206.93	6	411.67	531.67

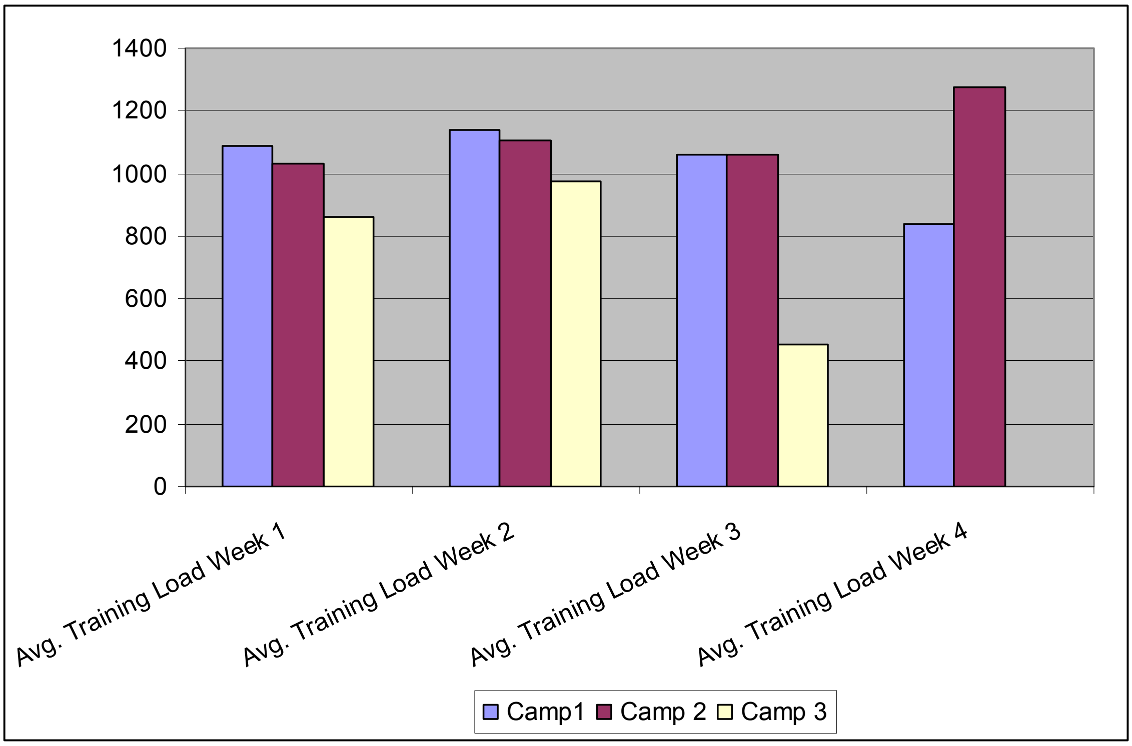

Figure 4.16: Weekly Average Training Load measurements

The average training load in TC1 week two was higher than TC2 and TC3, but the total training load (Figure 4.17) for this week was the lowest. This is due to the small number of participants and high and low outlying scores.

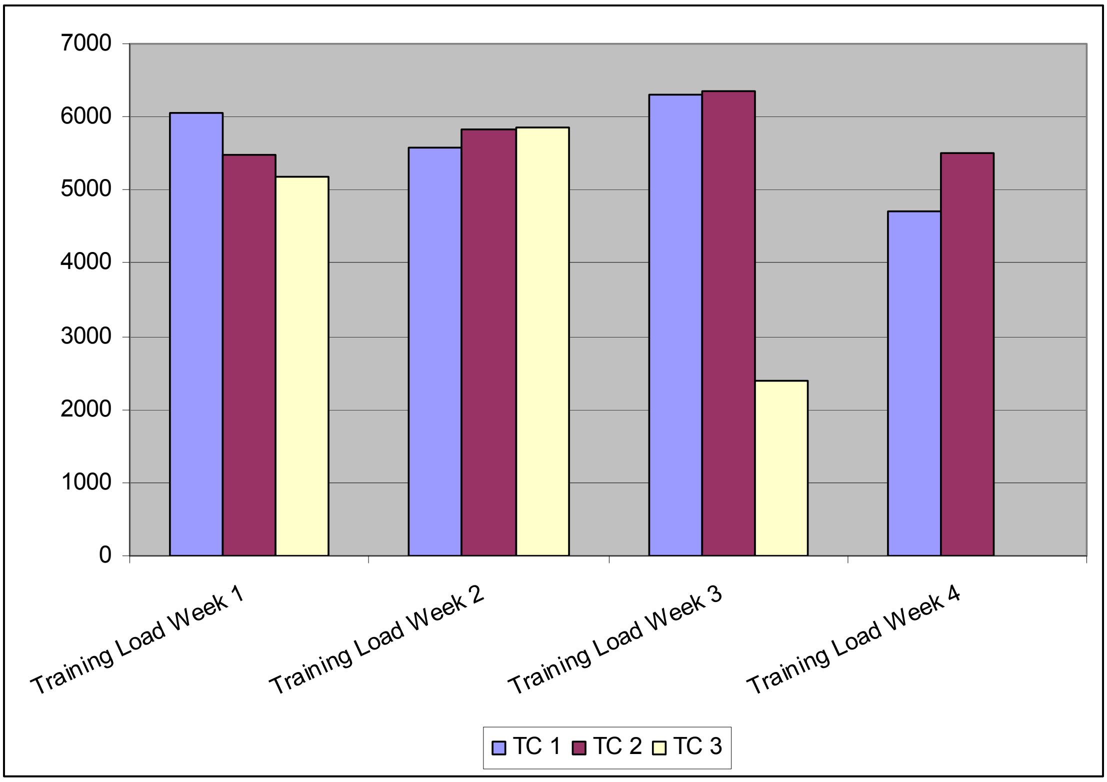

Figure 4.17: Total Weekly Training Loads

Highly trained tri-athletes can tolerate a weekly load of 7200 AU (Coutts *et al.*, 2008). Robson-Ansley *et al.* (2009) recommend that athletes should maintain a weekly training load between 4000–5000 AU. The values in Figure 4.17 fall between the recommended and tolerable values. TC3 week three values are the lowest and indicative of the tapering phase.

Table 4.37: Values for Figure 4.17

	TC 1	**TC 2**	**TC 3**
Training Load Week 1	6058.93	5487.14	5180.00
Training Load Week 2	5576.43	5820.36	5845.00
Training Load Week 3	6301.43	6361.43	2395.83
Training Load Week 4	4715.00	5506.29	-----------

4.1.7 Results of the correlations of POMS, RPE and Training Load scores

The relationships between scores were investigated by making use of Spearman Rank-order Correlations. The results of these analyses are presented in Appendices D and E. Only statistically significant correlations will be reported.

4.1.7.1 Results of the correlations of POMS and RPE

In order to determine a relationship between the POMS and RPE, average RPE scores were calculated for the Wednesday and Saturday of each week. This was done in order to align scores with the day the POMS were administered. The results are presented in Appendix F (on CD) and can be summarised as follows.

There was a statistically significant negative correlation (r=-0.685, p=0.090) between vigour and RPE scores at TC1 week one Sunday measurement. The higher the vigour scores reported the lower the RPE. Several statistically significant correlations occurred between Wednesday scores at TC1 in week two. Anger, confusion and TMD all had strong positive correlations with RPE scores (r=0.714, p=0.071; r=0.929, p=0.003 and r=0.821, p=0.023 respectively). Higher RPE scores are thus associated with higher anger, confusion and TMD scores. Vigour once again had strong negative correlations with RPE scores on both the Wednesday and Sunday of that week (r=-0.685, p=0.090; r=0.882, p=0.020 respectively). Week three of TC1, had several statistically significant correlations amongst Sunday measurements. Depression (r=0.782, p=0.038), fatigue (r=0.847, p=0.016) and TMD scores showed strong positive correlation with RPE scores. The higher depression, fatigue and TMD scores, the higher the RPE scores reported. Vigour once again had a strong negative correlation (r=-0.818, p=0.024). On the Wednesday of week four both depression and anger had strong positive correlations with RPE scores (r=0.685, p=0.090; r=0.764, p=0.046 respectively). Higher depression and anger scores are once again associated with higher RPE scores. On the Sunday of that week, fatigue had a strong positive correlation with RPE scores (r=0.821, p=0.089) indicating that higher fatigue scores are associated higher RPE scores.

The following results were calculated from TC2. Sunday results of week one indicated strong positive correlations between RPE and the following POMS scores: tension (r=0.691, p=0.086); depression (r=0.817, p=0.025); anger (r=0.847, p=0.016); fatigue (r=0.873, p=0.010) and TMD (r=0.836, p=0.019). Higher RPE score were associated with higher scores on these sub-scales and TMD. Week two Wednesday results showed the same trends with strong positive correlations between RPE and the following scores: tension (r=0.955, p=0.001); depression (r=0.919, p=0.003); anger (r=0.821, p=0.023); fatigue (r=0.937, p=0.002); confusion (r=0.811, p=0.027) and TMD (r=0.929, p=0.003). Thus, all sub-scales correlated significantly with RPE, but vigour, which showed no significant correlation. Higher scores on all the other POMS measurements were thus associated with higher RPE scores. On the Sunday of week two week, fatigue (r=0.943, p=0.005) and confusion (r=0.883, p=0.020) showed strong positive correlations with RPE. Week three Wednesday vigour scores showed a significant negative correlation (r=-0.673, p=0.098) with RPE scores. TC2 week four Wednesday RPE scores correlated highly positively with the following scores; tension (r=0.793, p=0.033); anger (r=0.847, p=0.016) and TMD (r=0.714, p=0.71). Vigour again had a strong negative correlations with RPE scores (r=-0.679, p=0.094). Week four Sunday measurements showed depression (r=0.812, p=0.050) and fatigue (r=0.771, p=0.072) had strong positive correlations with the RPE scores recorded at the same time interval. TC3 had no statistically significant correlations between any of the measurements. The RPE did not appear related to the POMS measurements during this camp.

4.1.7.2 Results of the correlations of POMS and Training Load

In order to determine a relationship between POMS results and training load scores, average training load scores were calculated for the Wednesday and Sunday of each week. This was done in order to align the scores with the day on which the POMS were administered. The results are presented in Appendix G (on CD) and can be summarised as follows.

The Wednesday scores of TC1 week of, showed statistically significant strong positive correlations between training load and confusion (r=0.786, p=0.036) and TMD scores (r=0.679, p=0.094). Higher training load scores are thus associated with higher confusion and TMD scores. A strong negative correlation (r=-0.685, p=0.090) was found between vigour and training load scores. Higher training load scores are thus associated with lower vigour scores and vice versa. Sunday measurements of both weeks one and two also indicated a strong negative correlation between these two variables (r=-0.857, p=0.014; r=-0.841, p=0.036 respectively). Wednesday fatigue scores of week two had a strong positive correlation (r=0.811, p=0.027) with training load scores. During week three of TC1 anger (r=0.898, p=0.006), fatigue (r=0.786, p=0.036) and TMD (r=0.857, p=0.014) all had strong positive correlations with training load scores. Higher training load scores are associated with higher scores on anger, fatigue and TMD. Vigour once again had a negative correlation with training load (r=-0.739, p=0.058).

The results of TC2 indicated that week one Sunday tension (r=0.739, p=0.058), depression (r=0.837, p=0.019), anger (r=0.857, p=0.014), fatigue (r=0.883, p=0.008) and TMD scores (r=0.847, p=0.016) all had strong positive correlations with training load scores. An increase in training load scores is thus associated with increases in tension, depression, anger and fatigue and TMD. Week two Wednesday results of this camp showed the same trend with depression (r=0.773 p0.042), anger (r=0.793, p=0.33), fatigue (r=0.973, p=0.000), confusion (r=0.745, p=0.054) and TMD scores (r=0.811, p=0.027) all showing strong positive correlations with training load scores. Week four Wednesday scores once again showed strong positive correlations with training load: tension (r=0.793, p=0.033); anger (r=0.847, p=0.016), TMD (r=0.714, p=0.071). Vigour scores once again had a strong negative correlation with training load (r=-0.679, p=0.094).

TC3 showed relatively few statistically significant correlations. Week one Sunday score only had one strong positive correlation between fatigue and training load (r=0.771, p=0.072). Week two Sunday tension and depression scores also correlated strongly with training load (r=0.770, p=0.073 and r=0.871, p=0.024 respectively).

4.2 WISCONSIN UPPER RESPIRATORY SYSTEM SURVEY (WURSS)

The analysis of the effects of sick/injured subjects during the camps was done with reference to the POMS, energy index, RPE, training load and time trials. Each variable is reported on the relative day of the sickness. See Appendix J (Appendices) for further specifics.

Athletes are very attentive to their bodies and the orientation of training sessions. A small change in homeostasis can cause irrational over-emphasis, or used as an excuse for poor results. In most cases, any sign of sickness causes high anxiety, especially during a training camp – which compounds the issue and adds more stress. Passive rest days during the camps allowed the athletes to take their minds off training. Athletes that have other interests can pursue these (although they can add pressure and strain). Distractions alleviate boredom and reduce the stress perception (Robson-Ansley *et al.*, 2009) and the ability to sleep for short periods during the day may be a useful skill for athletes to develop. Many athletes have a disturbed night's sleep before an important event.

TRAINING CAMP ONE

Subject One

POMS

Subject one reported being sick at P1W1, P2W1, P2W4 and the post-POMS. Subject one reported sickness during the first week of the camp, which subsided after four days. TMD reported in the first week was the lowest of the camp, while being sick, while the second week showed the highest TMD. This was possibly due to having higher expectations during training, or feeling the effects of the first week. Low vigour scores and high TMD in the pre-camp measurement may have predicted sickness at the beginning of the camp. No noteworthy differences in scores appeared amongst the other sub-states during sick periods. Sickness was reported post-POMS as well.

Energy Index

Subject one's pre-camp energy index was -2, which rose to 21 (1150% change from P1) and 16 (900% change from P1) in P1W1 and P2W1 respectively when symptoms of sickness were reported. This was the highest energy index of her camp. There were no outlying scores at W4P2 and post-POMS.

RPE

The average weekly RPE scores remained consistent over the four weeks, indicating a higher work rate despite sickness and injury in week four.

Training Load

The highest training load (1155 AU) of the week and the camp was recorded on Wednesday of week one, when sickness was reported. This was similar to week four recording the second highest score of the week (990 AU) on the sick day.

Subject Two

Subject two reflected her injury during week four of the training camp in RPE scores, and minimal training at a low intensity. The vigour score was the lowest of the camps scores, with no other outlying POMS sub-state scores. The weekly training load average for week three (516.00) and 4 (251.67) were the lowest of the camp as the injury started to have effect on duration of training and the intensity of the training.

Subject Four

POMS

Subject four had symptoms of sickness for P2W3, and she recorded her highest scores in tension, depression, confusion and TMD. The vigour score was the lowest recorded. Her anger and fatigue scores were continuously high throughout the camp and some of the highest in the group.

Energy Index

Subject Four had the lowest average vigour for the camp and the highest average fatigue score. She had the lowest energy index (-26) at P2W3 and the lowest of the group.

RPE

Despite sickness and injury during week four, her RPE scores remained similar to training sessions done when healthy. She rated an RPE of 18 for her steady state kayak technique session RPE, where the rest of the group that completed it, scored between 12.5 and 16.5.

Training Load

The training load during week four decreased substantially, even though the intensity remained the same over shorter sessions. The last four days of week four were noticeably lower and the weekly average was the lowest of the four weeks (739.17 AU).

Time Trials

Due to injury, there was no participation in the swimming time trials in week four. The same applied to the running time trial and the two 5000m time trials on Saturday week four. The sickness appeared not to effect the running time trial the following day (Tuesday week four).

Subject Five

POMS

Subject 5 reported being sick on three consecutive POMS recordings (P1W3, P2W3, and P1W4) but she was sick consistently throughout the camp. There were no outlying recordings in any of her scores. Fatigue, anger and TMD levels were continuously high, re-affirming comments about feeling tired from week four until the end of the camp.

Energy Index

She reported feeling tired and battling to sleep after week one of the camp, and then got sick a week later, which persisted for the remaining two weeks of camp. In comparison, the energy index was low to the rest of the subjects (except subject four). The lowest score was at P1W4 (-23), as well as a negative average score for the camp (-12.67). The only positive energy index was the pre-camp (6) which was the lowest of the group

RPE

The RPE for subject five was the highest in the second week. Over weeks two and three the RPE ratings were continuously at 18/19. She rated the final 5000m time trial as 20. Her slowest time during week four, was also her lowest rated RPE (14) and of the group. She also had the highest average RPE for the camp (18.19).

Training Load

Subject five had the highest training load for each session in week three. In week four she had the highest training load (2135 AU) on Monday, and started doing shorter sessions where it lessened but intensity remained elevated.

Time Trials

Subject five was ill on four consecutive running time trials i.e. for two weeks. She only ran twice while she was sick, and performed her fastest time (27m35s) of the training camp on one of the occasions. She did not take part in the following two time trials. Interestingly the time trial before she was sick (20th November) was her fastest at the time and second fastest of the camp, but the effects of being sick were evident when she ran her slowest time by 1min20s (29m50s) which was also at the end of the camp. In the Individual 5000m kayaking time trials she had the slowest time of the group on several occasions and most noticeably on two occasions when she was sick. She was able to stay with the group during the group time trial in most sessions. It is interesting to note that four out of the seven subjects reported being sick or injured in the fourth week of training. This suggests an overload in training for the athletes and a possible intervention at this stage. Subject one's symptoms continued three days post camp.

TRAINING CAMP TWO:

Subject One

POMS

Subject one was sick for the pre-camp POMS (three days prior to the start) and P1W1 where tension, depression, fatigue and TMD were highest out of the camp. Vigour was also the lowest over these two recordings.

Energy Index

Subject one had the lowest scores for energy index over the pre-camp and P1W1 (-14 and -12) and then returned to its sporadic nature like the other subjects, although there were trends with certain periods of the training camp.

RPE

There were no notable changes in RPE scores during the period that she was sick, although her RPE score for the following days training was one of the highest for the session (Saturday Week 1 = 19)

Training Load

There were no notable changes in training load, although the weekly average was the highest of the camp. The following days training after the sickness was the highest of the group.

Time Trials

Subject one did not take part in the two 5000m time trials when she was sick. Her times for the Saturday training (six 2000m time trials) following her sickness were the slowest of the group in three out of the four that she competed. She did not take part in the running time trial.

Subject Two

POMS

There were no outlying scores with the POMS while she was sick (pre-camp, P1W1), and appeared consistent throughout the camp.

Energy Index

Subject twos energy index over the two POMS were two of her highest scores in the camp (pre-camp 9; P1W1 15).

RPE

The two training sessions that Subject Two did while sick, were the lowest intensity sessions she did for the week. This could have been due to a conscious cautious effort to keep exertion low, or to feeling the effects of coming off the sickness. She commented that over three previous days (before the commencement of the camp), it had limited her ability to train.

Training Load

Subject two had the one of the lowest training loads of week one.

Time Trials

Subject two did not take part in the first two running time trials of the camp i.e. Tuesday and Saturday. In the two 5000m kayaking time trials, she had the second slowest time of the group for the individual trial. In the second trial, she finished second.

Subject Five

Subject five was sick for more than half of the training days in TC2 (13 days out of 24). She was severely ill after the camp and had to take anti-biotics. She was also sick for the same amount of time in TC1.

POMS

Subject five reported sickness for seven out of the ten POMS recordings. Subject four did not report any symptoms of sickness but had the highest scores for tension, depression, anger, fatigue and TMD for the camp. There were scores 40% higher than the next subject. Subject five had the lowest vigour and highest confusion scores for the camp. Her scores for all sub-states were generally higher than her non-sick days. It is possible to see the cumulative effect from the scores.

Energy Index

See Figure 4.19 for subject fives energy index. The pre-camp measurement was her highest score and had a steady decline to the post-POMS. There was a 300% drop in energy index from P2W2 to P1W3.

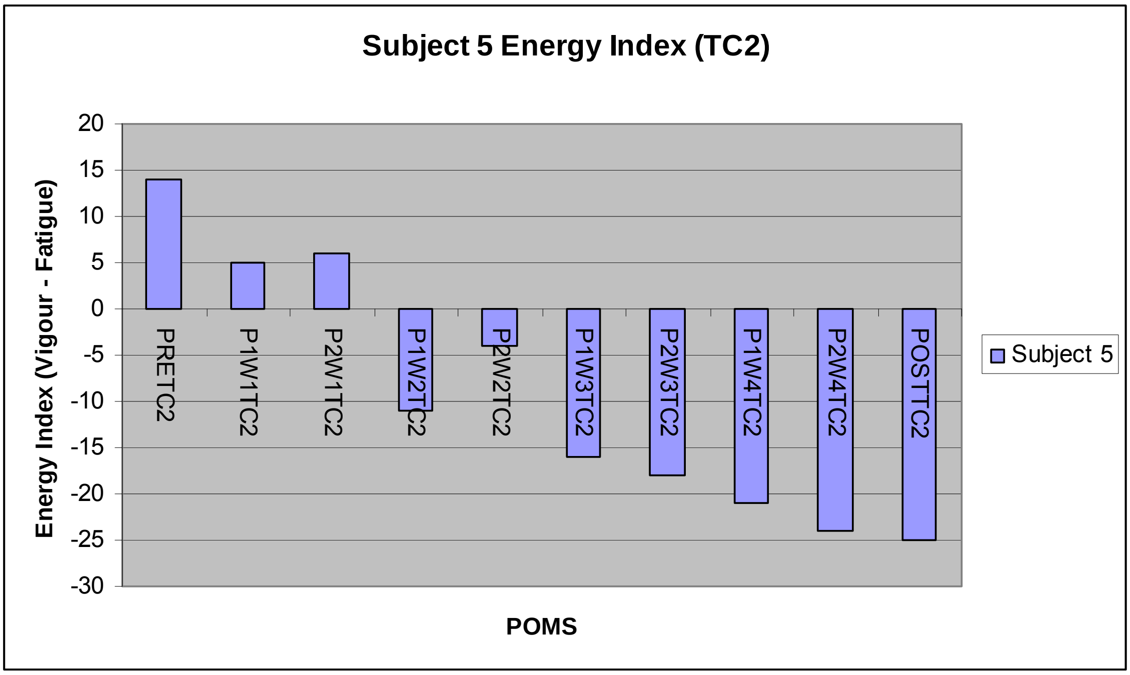

Figure 4.18: Subject five Energy Index

RPE

Subject five had the highest RPE average for weeks one, two and three and the second lowest in week three. Friday and Saturday of week three were the only sessions were she recorded an RPE lower than 16.

Training Load

Subject five had considerably high weekly training loads, with a maximum of 8715 AU in TC1 week three, and a camp average of 8026 AU. The group weekly average was 6361 AU, which was the highest load of the camp.

Time Trials

The time trial prior to her sickness was her fastest at the time and second fastest of the camp, but the effects of being sick were evident when she ran her slowest time by 1min20s, which was also at the end of the camp. In the fourth week Wednesday 5000m time trial, she was unable to stay with the group and had her second slowest time of the camp. This occurred in week two, where she did not report sickness, but had her slowest time trial of the camp and was not able to stay with the group. She had reported sickness symptoms before the camp, which had continued for a week into the camp. Her Tuesday running time trial was also the slowest of the camp.

In the weekly 2000m time trials, her times were the slowest out of the group in week one and two. She did not take part in week four, and in week four they were not different from the rest of the group.

Subject Seven

Subject Seven reported having Staphylococcus Aureus infection during week three of TC2, which persisted for two weeks.

TRAINING CAMP 3:

Subject One

Sickness was reported on Wednesday week one.

POMS

Subject one was sick on P1W1, and had the lowest vigour score of the group, as well as the second highest fatigue and TMD.

Energy Index

Together with subject four, the energy index was lower than the rest of the group (S1 = -9). She had a 189% drop in energy index from her previous score – pre-camp – which was her highest of the camp (pre-camp = 9)

RPE

There was no notable difference for RPE, on this day.

Training Load

Her training Load on this day was the lowest of her week (705 AU), and the second lowest of the group on the day.

Time Trials

There were no time trials performed on this day, and no indicators of sickness from her time trials, the day before.

The top-performing athletes in the group (most experienced and most commendable results from recent competition) had the most consistent time trials, mood states during the entire camp and consistent RPE ratings, clearly showing a mentality over the camp period that is conducive for high performance.

CHAPTER 5
DISCUSSION OF RESULTS

5.1 INTRODUCTION

At the outset, the author believes increased sensitivity from training influenced the POMS results, stemming pre-dominantly from socio-psychological issues outside of training. In this study there was continuous tension and insecurity with the five female athletes competing over four spots in the K4. This created a very dynamic situation, especially for recording emotional responses.

A concern was that the athletes would not answer the POMS questions truthfully, or provide socially desirable answers. Interacting and being part of the training camps, the athletes generally gave a fair insight into how they were feeling. Problems have been identified with people giving socially desirable answers (Weinberg & Gould, 2007), so that they appear in a different light to how they actually feel, or to hide a pre-competitive emotion. This would create further issues in using the POMS for selection purposes. A potential issue with this study was the athletes delaying or avoiding the POMS until they were ‘ready’ or had time to do it, effectively giving socially desirable answers. A control for social desirability effects needs to be implemented in future studies. Subjects three and six had consistent mood responses throughout all the camps, which could raise suspicion over the scores. They were the top performing athletes at the national championships prior to attending training TC3, which could reflect a heightened focus and attention to training on the camps. Zero scores in the POMS are potential socially desirable scores (Terry & Lane, 2000) which occurred in all three training camps. Gould and Maynard (2009) found in studies that medallists reported greater emotional control than non-medallists did, while mental imagery scores were higher for the non-medallists. Athletes that have been competing for longer and exposed to more circumstances are more mentally prepared to deal with situations when they arise.

The timing of the POMS assessment may be an issue. The more time that elapses post performance or training, the more influences that can disrupt the athletes perception of it, including the performance. The response set used can enhance or generalise the mood assessment from right now to over a few days prior (e.g. feeling today, feeling the past week). Meeusen *et al.* (2006) noted that timing of the test is important due to pre- versus post exercise and morning versus evening conditions varying. The time period before or after assessment is important too, as mood state can be influenced during it. The POMS does not account for status and events that lead up to the assessment. Problem areas possibly affecting the athletes in this study include comprehension of mood adjectives in the inventory, no clear thought process of how they are actually feeling and rushing through words just to complete it. Furthermore, the effects of individuals having good or bad training sessions can have marked effect on POMS, which would have fluctuated throughout the camp.

The results compared POMS scores, RPE, training load and energy index scores over time and across camps and discussed as follows:

5.1.1 Tension

Tension scores did not differ significantly within camps across the ten measurements as well as when comparing Wednesday and Sunday results across the weeks within each camp. The comparison of Wednesday and Sunday results within the same week produced the following results. Week three of TC1 had a statistically significant difference between the Wednesday and Sunday tension measurements. Sunday tension scores were higher than Wednesday scores. This may have been a cumulative affect of training. TC2 week one and two had a statistically significant difference between Sunday and Wednesday measurements, with lower Sunday tension scores. TC3 showed similar results to TC2 with Sunday tension scores in weeks two and three being lower than Wednesday scores. A comparison of similar weeks across camps showed no statistically significant differences between the camps. Tension levels appeared greater during weeks in TC2 and TC3 than in TC1, but were not statistically significant. The general trend was lower Sunday than Wednesday scores, with the exception of TC1.

In Table 2.3 (TC1) tension scores were similar with Kentta *el al,* (2006) pre-camp scores (5.1). Their highest score occurred in the first post-training score with a gradual decline to the end of the camp (lowest score 1.9). In comparison the highest tension score occurred on Sunday week three (5.71) and the lowest in the post-camp score (1.00). The lowest tension score in TC2 was 2.43 on Sunday week three, and the highest score in the post-camp measurement (8.50), which is cause for some concern and a possible symptom of overtraining. High scores marked the tension scores in TC3 on Wednesday week two and Wednesday week three (8.50 and 7.57). These scores are not ideal for a pre-Olympic training camp at those points in time.

Tension appeared to be consistent across all the camps, and that Sundays where a day and a half of full rest was had, had an effect on the tension scores. Pre-empting and the knowledge that they have a full day to recover might have an affect on the athletes' perception, as well as the ability for the body to reduce stress levels over that time, physiologically and psychologically. The higher Sunday scores compared to the mid-week scores may be due to factors outside of the training environment. Familiarisation of POMS procedures could have allowed for more accurate recordings in TC2 and TC3. An explanation for TC2 and TC3 higher weekly scores might be the proximity of the Olympics, selections for team boats, expectations from training and attending the Olympics for the first time.

5.1.2 Depression

When comparing **Depression** scores across the ten measurements within camps, there were no statistically significant differences. There were observations of the following trends. TC1 depression scores showed random movement up and down with lower scores towards week four and in the post-test. Depression scores during TC2 were lower at the pre-test with higher scores in the camp. TC3 depression scores appeared higher towards weeks two and three. The comparison of similar days within each week within camps showed no statistically significant differences in depression scores. The comparison of Wednesday and Sunday results within the same week produced the following results. TC1 week one had a statistically significant difference between the

Wednesday and Sunday depression measurements with Sunday depression scores being higher than Wednesday scores. TC2 had no statistically significant differences. TC3 results indicated a significant difference between scores in week two, with Sunday depression scores being lower than Wednesday scores of the same week. A comparison of similar weeks across camps showed two statistically significant differences. Week one Wednesday depression scores were significantly lower during TC1 than the other camps. The week two Wednesday depression score was higher in TC3 compared to TC1 and TC2. The depression scores showed no general trend. There is concern that the highest levels of depression were experienced in TC3 week two, with Sunday rest that allowed for the scores to drop. The link between emotions and cognitive processes allows the potential mood responses to influence the goal setting process (Lane *et al.,* 2001). People in a depressed mood are affected negatively by tension, anger, and may set less challenging goals and perform poorly.

Table 2.3 (TC1) showed generally higher scores when compared to Kentta *el al,* (2006) depression scores. Their highest score was 6.0 with this study peaking at 8.86, with several similar scores through out the camp. The post-camp measurement was considerably lower than all previous measurements. The lowest depression score in TC2 occurred at the pre-camp measurement (3.86), with the highest (10.86) on Wednesday week three after the prolonged rest period. This may show the athletes response to returning to the training environment. The post-camp score was also one of the highest (10.67) as well as the Wednesday week one score (10.43), all at significant stages of the camp. TC3 Wednesday week two also marked the highest depression score (11.67), with it decreasing considerably to the end of the camp (3.86). Kentta *et al,* (2006) deduced the kayakers in their study were not overtrained, due to low depression scores (despite high fatigue and lower vigour scores). With depression scores being generally higher than Kentta *et al*, (2006), as well as higher fatigue and lower vigour scores at various stages, it may be possible to deduce an overtrained state with the subjects.

An athlete expresses the depressed component more in overtraining (Meeusen *et al.,* 2006, Jones & Tenenbaum, 2009). (Morgan *et al.,* 1987) noted that up to 80% of athletes with overtraining syndrome, also experience elevated levels of depression. Research has shown combined elevations in depression and anxiety to be a common feature in athletes who are not adjusting well. The relationship between an athlete's maladjusted state and the various mood states that manifest can be described in the context of an adjustment disorder with the subtype of depressed mood and anxiety (DSM-IV-TR, 2000: 679 in Jones & Tenenbaum, 2009).

5.1.3 Anger

The analysis of **Anger** scores produced the following results. TC1 anger scores were higher during the first two weeks and decreased towards the end of the camp. Anger scores during TC2 showed random up and down movements with the highest score on the Wednesday of week three. TC3 anger scores fluctuated randomly and were not statistically significant. The comparison of similar days within each week within camps produced the following results. No statistically significant differences occurred between Wednesday or Sunday scores in TC1 and TC2. TC3 results indicated no significant differences when comparing Wednesday measurements, but Sunday measurements did show a statistically significant difference. Anger scores during week one were significantly higher than weeks two and three. The comparison of Wednesday and Sunday results within the same week produced the following results. The scores differed considerably in some cases but were not statistically significant between Wednesday and Sunday Scores of the same week for both TC1 and TC2. During TC3, Wednesday and Sunday scores differed significantly from one another during all three weeks. Week one Sunday anger scores were higher than Wednesday scores while Sunday anger scores were lower than Wednesday scores in weeks two and three. A comparison of similar weeks across camps showed no statistically significant differences found between the measurements between camps. Anger levels appeared greater during weeks in TC2, but were not statistically significant. There was no apparent specific trend in anger scores as results differed from analysis to analysis.

The highest anger score in TC1 occurred on the Sunday measurement in the first week (10.6) with the same value and time as Kentta *el al,* (2006) measurement. The lowest anger score occurred after a long recovery in week two (3.17). Scores seem to fluctuate in random patterns similar to Kentta *el al,* (2006) study. Similar to the depression score in TC2, the anger score was the highest (14.00) on Wednesday week three after the prolonged rest. The lowest score followed this measurement on Sunday week three (5.14). This could again indicate an acute response to returning to the training environment. The anger score in TC3 (12.17) was the highest again on Wednesday week two, and dissipating to a level similar to scores of Kentta *el al,* (2006).

Ruiz and Hanin (2011) noted that the relation between anger and performance is not always detrimental. They found in their research that 75% of the karate athletes measured found anger experiences facilitating the performance, specifically by providing more energy. They did find individuals who at different events had positive and negative effects from being angry. Subject five had continuous elevated levels of anger, considerably more than other athletes during all three training camps did. Anger has the potential to affect performance by either disrupting or enhancing the focus of attention, information-processing and decision-making, execution, and control of action. Anger can disorganise and impair performance or, conversely, energise and organise behaviour towards the attainment of a task (Jones, 2003 sited in Marcora *et al*., 2009). Subject five's perception of anger and its facilitative impact could have determined her confidence, motivation and powerful skill execution i.e. kayak technique. Robazza and Burtoli (2007) found in a study that self-confidence appeared closely associated with the control of anger.

5.1.4 Vigour

Vigour scores declined decline steadily from the pre-test to the later tests during TC1 and TC3, but were not statistically significant. Decreased vigour and increased fatigue is a sign of prolonged training distress (Meeusen *et al.,* 2006). Santhiago *et al.* (2011) conducted similar research over 14 weeks with swimmers, regarding the POMS, and found a progressive increase in vigour scores at the different phases of training, building up to a taper. The taper period (four weeks) had a marked decrease in vigour scores. The vigour scores recorded were higher than this study (see Table 5.1); however, the negative sub-scales were generally higher as well, including TMD. Santhiago *et al.* (2011) typically found that their subjects presented typical iceberg profiles. They noted further that periods marked by high volume and intense training (T1 and T2) show decreased vigour and increased negative scores. T2 in Figure 5.1 demonstrates this.

Vigour scores in TC2 showed a statistically significant difference when comparing scores across the ten measurements. The Wednesday scores of weeks one, two and at the post-test were significantly lower than the rest of the camp. The comparison of similar days within each week within camps produced the following results. Wednesday measurements during TC1 and TC3 showed significant differences. TC1 week four Wednesday vigour score was significantly lower than the rest of the camp. TC3 week two Wednesday vigour score was significantly lower than the rest of the camp. Sunday scores at all three camps did not differ significantly from one another. The comparison of Wednesday and Sunday results within the same week produced the following results. TC2 and TC3 showed no significant difference between Wednesday and Sunday scores in any of the weeks. TC1 week two Sunday scores were lower than Wednesday scores in most cases. The extended rest period, should possibly have elevated the vigour scores. This was after having two weeks of intense training with two weeks still to go.

A comparison of similar weeks across camps indicated that vigour scores differed significantly at the pre-tests with TC2 scores significantly lower than the other two camps. Wednesday scores at week two also differed significantly with TC1 having the highest scores. Differences in vigour scores did not show a specific pattern and significant differences may be related to particular training activities at that point in time. It is interesting to note the lowest vigour scores in the middle of TC2 and TC3 with similar scores at the end of the camps. In contrary to TC1 week two Wednesday, that had the highest score between the camps. Lovell *et al* (2010) research on English soccer leagues produced higher vigour scores than this study, but then had big drops in score as the season went on, similar to this research.

The highest vigour score occurred in TC1 (16.67) was at the pre-camp measurement the same as Kentta *el al,* (2006) (18.5). The lowest vigour score was in Sunday week three (11.29), a similar time to Kentta *el al,* (2006) lowest (13.0). This could indicate that three weeks of intense training may be suitable for athletes to experience symptoms of over-reaching. Similar to TC1, the pre-camp TC2 vigour score was the highest of the camp (14.29) and remained relatively elevated but with a noticeable decline to the post-camp lscore (9.33). TC3 vigour scores were considerably high, with the highest score at the pre-camp measurement (18.67) and the highest of all three training camps, which is positive going into a final preparation phase. The Wednesday week two was also the lowest of the vigour scores, and though out all three camps. This is directly related to the high tension, depression, fatigue and TMD scores.

Kenttä *et al.* (2006) noted that of the six POMS factors, the vigour and fatigue scores tend to show the greatest changes in response to training, where previous research using the POMS has only vaguely touched upon the process of recovery. Competition can be detrimental to mood, and a relative absence of competition is desirable to enhance mood, which is unavoidable on training camps, where team dynamics, training each day for extended periods as well as comparative time trials occur. Whether in training or in competition, the outcome has an affect on the athlete. 'Winners' may experience negative moods due to unhappiness about the relative performance. Berger and Motl (2000) found that 'losing' individuals reported decreases in vigour and increases in anger and TMD. The detrimental effects of losing on mood are observable immediately after the exercise and up to two hours post-event, and possibly longer depending on the importance of the event or competition.

5.1.5 Fatigue

Fatigue scores showed the following trends. TC1 fatigue scores increased over time, while TC3 scores increased up until the Wednesday of week two but then steadily declined. This indicates high intensity in the first two weeks, with more rest time or shorter sessions for the last week, in preparation for the Olympics. These fluctuations were not statistically significant. There were considerably lower scores in week two of

TC2. Scores peaked on the Wednesday of week four with higher scores on the Sunday and during the post-test. This represents a challenging four weeks of training, showing potential signs of overtraining.

The comparison of similar days within each week within camps produced the following results. TC1 and TC3 had no significant differences between Wednesday and Sunday scores respectively. TC2 had a statistically significant difference in Wednesday scores across the weeks, being the lowest in week one and highest in week four. Week two of TC2 had significantly lower Sunday Scores. The comparison of Wednesday and Sunday results within the same week indicated no statistically significant differences in any of the weeks during TC1. Both TC2 and TC3 showed significant differences between Wednesday and Sunday scores of week two. During both camps the majority of the paddlers had lower Sunday fatigue scores than Wednesday scores. Fatigue scores at the end of the week show accumulation of training. The end of week two scores, specifically for TC1 and TC2, were after a full two-day recovery period. When comparing camps at the same measurement interval no statistically significant differences were found.

The lowest fatigue score in TC1 was at the pre-camp measurement (7.67) and the highest on Sunday week four (13.6) which indicates the nature of the training camps. In comparison Kentta *el al,* (2006) lowest score (4.4) was at the beginning of the second week and the highest at the beginning of week three. This could represent the structure of the coaches training programs. Fatigue results in TC2 showed a steady increase from the lowest score in the pre-camp measurement (5.00) to the highest score on Wednesday week four (12.14). TC3 pre-camp score was the lowest of the camp, a good start to a final preparation phase. The scores elevated quite markedly through, and Wednesday week two was the highest reading (11.33).

Mood has been conceptualised as a single continuum from no energy to as much energy as possible (O'Connor, 2006). With a lack of energy, an individual should aim to improve this by eating, drinking, taking dietary supplements, sleeping or engaging in other behaviours (O'Connor, 2006). Borresen and Lambert (2009), found that when relating the POMS fatigue subset to the Banister model for predicting performance, they suggested it could represent a more global fatigue score i.e. occupational, lifestyle, illness or in the case of this research, not just the effects of the physical training. When comparing results to Lovell *et al's* (2010) study on English soccer players, the fatigue levels were associated with professional players in the early part of the season. The scores increased as the training camp progressed but were not as high towards the middle and late part of the season.

5.1.6 Confusion

The **Confusion** scores had no statistically significant differences across all ten measurements in any camps. These scores showed random trends across the measurements. The comparison of similar days within each week within camps indicated no statistically significant differences when comparing Wednesdays as well as Sundays within each camp. The comparison of Wednesday and Sunday results within the same week indicated no statistically significant differences in any of the weeks during TC1 and TC2. TC3 week three had a statistically significant difference between Wednesday and Sunday scores with the latter being lower in the majority of cases. At the same measurement interval, confusion scores on Wednesday's week three were significantly lower in TC1. The training activities did not affect the confusion scores.
Tables 4.23, 4.24, 4.25 showed no significant scores through any of the camps. All confusion scores were generally lower than Kentta *el al,* (2006) recorded scores.

5.1.7 Total mood disturbance

Total Mood Disturbance (TMD) scores were much lower during TC1 compared to the other camps. TC1 and TC3 showed no statistically significant differences across the measurements from the pre-test to the last test completed during these camps. TC2 scores were significantly lower on Sundays during weeks two and three. This is significant in showing that the increased rest period was substantial enough to bring a decrease in the TMD, which is beneficial to the athlete. The comparison of similar days within each week within camps indicated no statistically significant differences when comparing Wednesdays as well as Sundays within each camp.

The highest TMD score in TC1 occurred on week three Sunday (123.43) with a similar value on week one Sunday. Interestingly the post-camp measurement was the lowest of all scores (106.00) and perhaps to be expected. The TMD scores in TC2 are similar to that of the Fatigue scores in that they increase from the lowest score in the pre-camp (107.57) to the highest score on the post-camp measurement (133.83). This is also cause for some concern and is directly opposite to TC1, possibly indicating overtraining and the response to the high training load. The pre-camp measure of TC3 was the lowest (102.50) of all three camps, and is in line with the high vigour and low fatigue score also recorded. The TMD remained relatively stable, with Wednesday week two recording the highest score (131.33). The Sunday week three measurement (108.57) indicated some stabilizing of the mood.

Rietjens *et al. (*2005) found in a study by Morgan *et al*. (1987) that a strong dose-response relationship between training load, accomplishment of the training sessions and mood disturbance existed. The inverted iceberg profiles indicated the overtraining syndrome. Meeusen *et al.* (2006) noted that inadequate nutrition, illness (upper respiratory tract infection), psychosocial stressors (work, team, coach, family-related) and sleep disorders can be confounding factors, and were present during the training camps. Elite athletes that get used to training stressors may be prone to overtraining when confronted with non-training stressors (Roose *et al*., 2009). As the athletes were out of their comfort zone (being away from home), there was a possibility of this occurring on training camps. With the dynamic of training camps, it allowed them to deal with adverse situations away from the stability of home. The athletes had experience from previous camps before.

A study by Rietjens *et al* (2005) showed subjects experienced an increase in anger and decrease in vigour after one week of intensified training, as well as having elevated fatigue scores. The result is similar to this study in the flattening of the classical iceberg profile usually found in athletes. This was the case with TC2 (Figure 5.1) with decreased vigour and increased fatigue. TC3 had a more favourable iceberg profile. Rietjens *et al.* (2005) found a clear trend of TMD increasing (they used a shortened version of the POMS, and did not include confusion) over a three week period. The first week of intensified training recorded the highest measurement, with no significant differences compared to baseline scores but showed sustained increased mood and fatigue scores. Goss (1994) noted that that the most consistent mood states measured by the POMS in athletes, were also hardier than other athletes were. Kayaking technique is very important with emphasis on it in every session to optimise the stroke. A negative mood state can act as a distraction and influence motivation during technique focused sessions.

Table 5.1: Training Camp averages for all POMS (including pre/post scores) sub states and normative values for athletes grouped by level of achievement (Terry & Lane, 2000).

	Training Camp 1 (n = 7)		Training Camp 2 (n = 7)		Training Camp 3 (n = 7)		International athletes (n = 622)		Club Athletes (n = 628)	
Mood	M	s	M	s	M	s	M	s	M	s
Tension	3.25	5.72	5.06	7.54	5.36	8.57	5.66	4.97	9.62	7.19
Depression	6.00	9.13	8.03	10.15	6.36	7.51	4.38	6.43	8.67	9.49
Anger	6.35	8.05	9.07	10.82	7.43	9.03	6.24	7.02	9.91	8.05
Vigour	13.44	5.53	11.74	5.19	13.81	5.93	18.51	7.24	15.64	5.84
Fatigue	10.60	8.91	8.47	8.43	7.64	6.86	5.37	5.51	8.16	5.94
Confusion	2.30	3.93	2.37	4.34	1.57	2.89	4.00	3.79	7.38	4.86
TMD	120.6	32.66	121.4	40.20	113.0	33.19	N/A	-	N/A	-

In comparing TC1, TC2 and TC3 to international and club level athletes' norms, the following is observable. Tension scores were comparable to international athletes in TC2 and TC3 but lower in TC1. Depression and anger scores in TC2 and TC3 were at a similar level to club athletes. Vigour was lower than international and club athletes' norms in all camps, and specifically 63% lower in TC2. Fatigue was 97% higher in TC1 than international norms. The normative values developed did not include TMD scores.

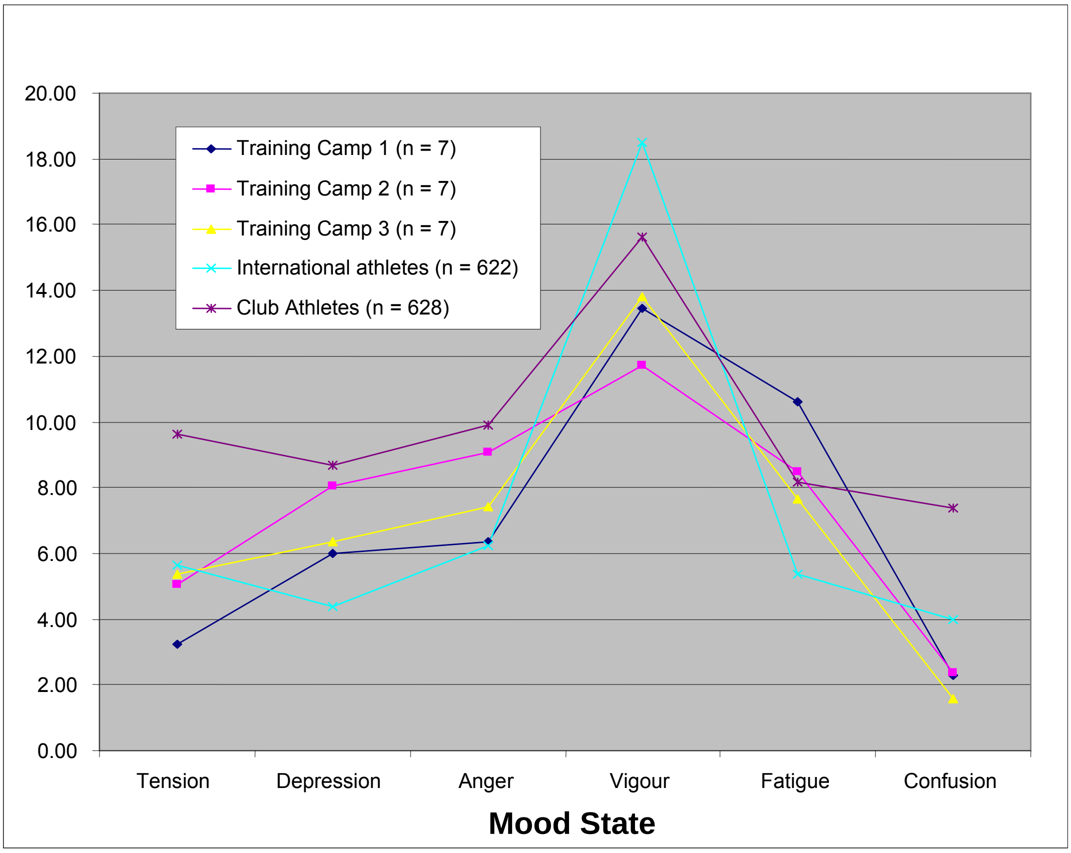

Figure 5.1: The 'Iceberg Profiles' of the training camps (including pre and post POMS) compared to International and Club Athletes level of achievement.

The comparison of Wednesday and Sunday results within the same week indicated no statistically significant differences in any of the weeks during TC2. TC1 showed a statistically significant difference between Wednesday and Sunday scores in week one with higher Sunday than Wednesday scores. This is counter-productive especially after the first week. Halson and Jeukendrup (2004) found reports of increased total mood scores for the POMS with periods of increased training that have not resulted in a state of overtraining. Swimmers had a change in total mood scores after three days of increased training, as well as ten days, both in the absence of changes in performance. Over a four year period the POMS was able to predict 'staleness' in 80% of the cases in college swimmers (Halson & Jeukendrup, 2004). The POMS can reduce the incidence of burnout, by training with improved in mood states and easing off when the mood state deteriorates (Budgett, 1998).

TC3, week three scores differed significantly with Sunday scores lower than Wednesday scores. This was the final POMS recording and a lower score shows the values had nearly returned to pre-camp measurements. When comparing camps at the same measurement interval the TMD scores only differed significantly from one another between camps on the Wednesday of week three. TMD scores were significantly higher during TC2. Changes in TMD appeared dependant on circumstances and showed no general trend. The iceberg profiles in Figure 5.1 showed more readiness in TC3. All training camps have better tension, depression and anger values than club athletes (5.66, 4.38, 6.24) but not more than the international scores (9.62, 8.67, 9.91).

Less tension, anger, depression, fatigue and confusion and more vigour, are common results shown with athletes that have attained their goals. There are differences between pre- and post-event POMS results, possibly dictated by many factors. With so many conflicting studies (Prapavessis, 2000), there is a degree of relativity to the athlete and how they perceive the upcoming event, qualifying for a team and racing for an Olympic medal. The POMS raw scores (Appendix K – on CD) of each subject clearly show a big difference between subjects four and five, when compared to subjects three and six on the subscales. These results indicate the different coping mechanisms athletes have and how they are able to succeed in carrying through the training camps. Subject five reported sickness/injury for TC1 and TC2 with the highest POMS scores. The cause or effect of health/sickness (Appendix J - Appendices) and POMS scores is debatable. Mood disturbances correspond to performance decrements and biological changes such as immuno-suppression and reduced muscle glycogen (Senttä *et al.*, 2006).

Beedie *et al.* (2000) found that athletes at different levels of achievement report essentially the same moods. This supports Rowley *et al.* (1995) who questioned the utility of the POMS in predicting athletic success, but can still predict the performance outcome (Beedie *et al.,* 1995) i.e. an athlete may win a time trial but may have a slower time than usual. They found that successful performances were associated with lower tension, depression, anger, fatigue and confusion, and higher vigour scores compared to unsuccessful performances. In Table 5.1, the comparison of vigour scores are below the international and club norms for all three camps. It is a concern that TC3 did not have a higher vigour score. Fatigue scores in TC3 are the lowest of all the training camps. They are lower than the club norms but still higher than the international norms. Mood state improvement during the tapering and competition phase is essential (Budgett, 1998). Subjects four and five continuously had high anger scores, which support Beedie *et al.* (2000) findings of facilitating a successful performance, which pertained to subject five. This could indicate that the iceberg profiles seen in Figure 5.1 did not represent the outcome of the training, but possibly on other aspects of the athletes' daily living. Lovell *et al.* (2010) found in a study over a season on soccer players of varying ability, that professional level players exhibited more positive profiles than lower groups. The professional player's vigour scores had the biggest drop though the season, with the highest rise in the negative states, but still maintained the iceberg profile. The results indicated scores returning to pre-camp values, but subjective anecdotal responses almost two weeks post camp indicated physiological and psychological disturbances, marked by irrational thoughts and actions. Athletes need to develop consistent emotions and mood states with performance e.g. racing angry one day then racing with an *iceberg profile* the next day. Creating a psychological history of the athlete pre/during/post training or competition allows researchers or sport scientist to make references or inferences

When comparing these results to a study done by Santhiago *et al.* (2011), who also monitored athletes over an extended period of time (14 weeks) over different training periods. Comparing the results show that vigour scores are substantially higher, and their tension, depression, anger and confusion scores are generally higher in Santhiago *et al.* (2011). The fatigue scores were similar. The tapering period (four weeks, compared to three weeks for this study), showed a decrease in vigour and increase in TMD recorded. The TMD is considerably lower in TC3 compared to their taper period.

Santhiago *et al.* (2011) stated that decreasing training volume and increasing training intensity are fundamental for the reduction of the TMD.

Many coaches, athletes and support staff neglect factors surrounding the training load, apart from biological processes, as having any significant influence (Jones & Tenenbaum, 2009). This has resulted in an under utilization of psychological inventories. Jones and Tenenbaum (2009) noted an additional subtype of Adjustment Disorder with mixed anxiety, depressed mood and anger as important subtype to include. Raglin and Morgan (1994), and Jones and Tenenbaum (2009) found items commonly appearing in the analyses of an overtrained athlete's mood were 'worthless, miserable, guilty, unworthy, sad (all from the depression scale), and bad-tempered and peeved from the anger scale'. Psychological mechanisms that potentially influence the relationship between exercise and mood alteration are improved self concept, feelings of self efficacy, enjoyment, expectancy of psychological benefits and an increased sense of control (Berger & Motl, 2000). An important self-regulatory mechanism is a change of location for the athlete. Training camps often induce 'cabin fever' where the familiarity of training and the same scenario leads to frustration and irritation of the athlete. Being able to search for positive stimuli and escape from the 'negativity' is important. Absence from comfort zones builds up tension, resulting in questioning the duration of training camps as well as location. Certain sports require it out of necessity, circumstance, due to training facilities or environmental conditions. Gould and Maynard (2009) stated that successful teams, compared to unsuccessful teams at the Olympics, experienced a resident training programme, more family, crowd and friend support.

Athletes find it important to have a system of support, especially during strenuous training periods. The dynamic of the training camps often caused distrust in the athletes and confronting causes of mood or regulating the distraction was difficult with out losing focus on training. Baker *et al.* (2000) reported that athletes reporting high negative personal rapport behaviours correlated with higher amounts of sport anxiety. There was a dynamic situation with the K4 anecdotally reported, as the coach and administration wanted the four fastest kayakers (based on time trials and National Championship results) in the boat. Due to the nature of K4 and the subjective feeling in the boat there was much discrepancy between the paddlers and the coach. Despite this, the coach did maintain a level of preparedness in the athletes throughout all competitions and the Olympics. Gould and Maynard (2009) stated that teams that performed below expectations at the Olympics experienced problems with focus and commitment as well as team cohesion and planning. In TC3, confirmation of the final team selection for the K4 was ongoing. This is an important aspect in Olympic preparation (Gould & Maynard, 2009) as the timing of team trials and selection are a critical factor for performance by coaches and athletes. Especially if the selection process is too close to the competition.

The effectiveness of any strategy is highly subjective, but athletes generally believe that they have the power to alter moods, allowing for an optimum performance. Track and field athletes were accurately able to predict their finish position in races, based on information obtained from previous races against the same opponents (Martin & Gill, 1991). Together with characteristics of the course, the outcome of previous races and the degree of effort they were prepared to expend, allowed them to predict their finishing times. The athletes became very familiar and had constant cues to their performance in training camps. This can be detrimental or beneficial in a number of ways if looking at performance gains compared to 'better' athletes. Adverse affects occur if there is no improvement in performance or 'superior' athlete are beaten in training or racing.

5.1.8 Energy Index

In general, the **energy index** scores appeared higher at the initial phases of the training and decreased towards the end of each camp. The comparison of all ten measurements over time within each camp indicated significant differences only during TC2. The pre-test as well as the week two Sunday measurements were significantly higher than the rest of the measurements. This indicates the athletes were recovering with the prolonged periods of rest and in a functional state of overreaching, as well the importance of recovery. The difference and decline in energy index during the camps are seen in Figures 4.12, 4.13 and 4.14. Large shifts in POMS vigour and fatigue scores are expected in most athletes that undergo intensified training (Milesi *et al.*, 2006). Kentta *et al,* (2006) found in their research that the energy index varied more than RPE ratings. They noted that a daily training load of three sessions causes a decrease in energy, whereas both short-term and long-term recovery results in a rebound increase. The results from this study replicated the findings of Kentta *el al,* (2006) where the energy index gradually declined each week, indicating an accumulation of fatigue. The recovery periods are also evident in TC1 and TC2 specifically (Figure 4.12 and 4.13). The rebounds observed are consistent with the super compensation theory (Garci-Pallares *et al.*, 2010). Kentta *et al,* (2006) note that based on the effects of the recovery periods it is important to schedule rest on training camps, where the coach and athlete may disregard recovery, because of the available training time.

The comparison of Wednesday as well as Sunday energy index results within camps indicated that only the energy index scores of week four in TC1 were statistically significantly lower than the other three weeks. Although the same trends were found for the other camps as well as Sunday measurements, none of these declines were statistically significant. Kentta *et al,* (2006) noted long recovery produced suitable rebounds, but never more than baseline values, whereas the short recovery was insufficient at all times to produce a rebound from pre-assessments the day before. The structure of their athletes programme differed from this one, where they had a complete rest on Thursday. The comparison of Wednesday and Sunday results within the same week indicated that no statistically significant differences were found in any of the weeks in any of the camps. This indicates that longer rest periods were not more beneficial than shorter rest periods, although rebound spikes are evident in Figures 4.12, 4.13, 4.14. When comparing camps at the same measurement interval the energy index scores only differed significantly from one another between camps on the Wednesdays of week two. Energy Index scores were significantly higher during TC1. TC3 was most significant for the females, as they were training in team boats. The low subject number affected the statistical significance. The importance from a practical point of view is the effect on the team. If one of them had an energy index that was almost 2/3rds lower than the rest, this would affect team performance.

Subjects three and six may be described as hardy, highlighted by their consistent POMS scores. Athletes' progression through the ranks is marked by appropriate psychological attributes because their adaptive personalities facilitate the adjustment (Deaner & Silva, 2002). The 3Cs of hardiness provide the courage and motivation to think, feel, and behave in ways conducive to athletes reaching and performing at high levels of competitive sport. This is achieved by managing demanding and unpredictable circumstances and striving in adverse opportunities. Sheard and Golby (2010) found in research that international (elite) athletes possessed greater levels of hardiness than sub-elite counterparts did. This stemmed from exposure and dealing with aspects of poor performances, injury, constant pressure to perform to a high standard, coach stress, frequent and long training sessions, interpersonal conflict, and persistent media and public scrutiny.

5.1.9 RPE

No statistically significant differences were found in the **RPE** reported across weeks within the same camp during TC1 and TC2. TC3 scores during week one were significantly lower than the two consecutive weeks. The comparison of the same week across camps indicated that week two scores of TC3 were significantly higher than the other camps. Kentta *et al,* (2006) found no differences observed in their RPE scores over three weeks in the paddlers, which indicated a consistent perception of the exercise intensity performed. Kentta *et al,* (2006) average RPE was 15.6 (s = 1.9) compared to 16.17 (s = 1.69), 16.45 (s = 0.95) and 17.0 (s = 0.51) in this study. Individuals learn to exercise at a specific RPE that coincides with the more objective physiological measures of exercise intensity. Experienced athletes that can "listen" and "know" their bodies have a high correlation with the readings on the Borg scale and the corresponding heart rates. Higher RPE scores were expected in TC3, due to shorter sessions, at higher speeds for race preparation.

Even though rest is necessary and opposes the athlete's instinctive nature to push harder, with guidance and experience, they know to rest and 'listen' to their body. Rietjens *et al*. (2005) the negative effect of training is the increase in effort used to complete each training session. The high RPE values could be related to inexperience or that training was actually causing strain. The easy kayak sessions after gym, and technique sessions (16km steady) were done at a lower intensity, which allows the athletes to recover and bring about a positive mood. The RPE recorded during this study occurred post exercise where the athletes had time to reflect on their effort during training, and use many cues and variables to influence the decision i.e. previous days session, duration of training camp, future training session. Environmental, physiological, psychological and other factors can influence perception.

The training load on the training camps of this study were predominantly maximal for each session with the RPE reflecting this. Swart *et al.* (2009) stated that with increased familiarity to a regular exercise task, so the RPE strategy becomes more aggressive, and presumably, with less metabolic and cardio respiratory reserve. A trend with the athletes in TC1 and TC2 was higher week three scores (barring sickness), and a decrease in week four (See appendix K – on CD). This could be a sign in the development of overtraining. By monitoring an athlete's RPE for similar training sessions, indication can come from the sudden rise in effort to maintain or perform at previous standards (Kenntä & Hassmen, 1998). Training intensity and spacing of the training are the most important factors in optimising performance, and minimising the risk of overtraining (Budgett, 1998). Sgherza *et al.* 2002 (cited in Marcora *et al.,* 2009) noted that exercise performance is limited by perception of effort rather than cardio-respiratory and musculo-energetic factors. Marcora *et al.* (2009) reasoned that mental fatigue might affect the central processing of the sensory inputs, which generate perception of effort during exercise. Garcia-Pallares and Izquierdo (2011) noted that residual fatigue from previous aerobic training could reduce the quality of subsequent strength training sessions, due to the neuromuscular systems ability to generate force, and the absolute volume of training. This may also influence the athletes RPE as the time between kayak sessions and gym was sometimes less than half and hour. Strength training before a paddling session (preferably six to eight hours before) allows kayakers to achieve significant improvements in aerobic power, maximum strength and muscle power. Training at 70% of one rep max repetitions rather than until failure, allowed for adaptations of strength, and speeding up recovery to perform subsequent endurance training.

High Intensity training was prominent during TC3. Lactate levels and oxygen debt, associated with anaerobic work are big influences on perceived exertion (O'Sullivan, 1984). Conversely looking at RPE, higher ratings over a period of days, or for training sessions may be symptoms of overtraining. This is a potential indicator for over-reaching, although not that detectable or accurate. Hedelin *et al.* (2000) placed an RPE value of 17 or higher in the category "high intensity/anaerobic training". They also noted that 16 on the RPE scale corresponds to a four $mmol.L^{-1}$ lactate level. The athletes average RPE during the training camps were indicative of the high intensity expected at the camps. The lowest camp average was 13.69 in TC1 (subject two although she did have an injury for most of her training), the next lowest was 14.30 by subject six in TC1. The Highest average RPE was 18.19 for subject five in TC1. There were no RPE average values below 16 for TC3. The RPE scores in TC3 were not related to the POMS scores. Athletes with overtraining syndrome have a decreased perception of recovery, using it as a marker for detection. Kenntä and Hassmen (1998) found that RPE increases considerably at given workloads in overtrained athletes. Budgett (1998) reported that sprinters and power athletes do not suffer from the overtraining syndrome, possibly due to the long period of rest between intervals. Confusion has occurred with terminology and lack of diagnostic criteria for overtraining due to different theories and types of research, as well as language and translation barriers. There is a need for an international standard to be developed.

Kenntä and Hassmen (1998) define psychological stress as intra-individual arising from internal stressors. They give an example of the imbalance between athletic expectations and the performance capabilities, while social stressors arise from the interactions with other people. Together with physiological stress, these account for the total stress experienced by an athlete e.g. living together on training camp, the K4 situation with five female paddlers, being away from home, the different personality types. The training camps were four weeks long in a remote location, taking the athletes out of comfort zones, day-to-day training routine and schedule. Gould and Maynard (2009) found in previous research that successful Olympic athletes were highly committed and focused due to a resident training programme, more family and friend support, and used mental preparation to a greater extent,. The teams that performed below expectations experienced problems with focus and commitment as well as team cohesion and planning. Training moves through a ratio between physiological and psychological over macro-cycles. There is more focus on psychological aspects closer to competition, as physical and physiological conditioning is similar at this time for elite athletes.

Borresen and Lambert (2009) stated there is no identification of a single physiological marker that can accurately quantify the fitness and fatigue responses to exercise or predict performance. The correlation between training and the observed changes in these physiological variables is highly personal and depends on many factors that influence an individual's tolerance of an exercise load. Ensuring adequate ingestion of carbohydrates to match the demands of heavy training (replacement of glycogen stores) is required as well as fluid intake. Rest is almost more important than the training and is the marked feature of overtraining (low rest), ensuring no physical activity during recovery and sufficient sleep. The elimination of non-training stressors is important for relaxation as well as 'time out' to allow the athlete not to become preoccupied with the sport. A misinformed coach or athlete cannot differentiate between the fatigue experienced after each training session and then chronic fatigue resulting from a block of training (Lambert & Borresen, 2006).

Regeneration strategies (counselling, relaxation therapy, and sauna) used in Eastern European countries is not that common in South Africa. It is a minor sport and the level of professionalism is still growing. Active rest is a recommendation to accelerate the recovery process which incorporates low volume and low intensity training, which was utilised during the training camps e.g. 8km easy kayak session (see Appendix H - Appendices) (Kenntä & Hassmen, 1998). This is to increase blood flow to the muscles and can be done through means of another sport or discipline, where no measure of performance exists. Athletes are continuously weighing up current performance with so many variables that it is possible they can 'psyche' themselves out. They need to be mentally strong and realistic without deterring their determination. Athletes training together have continuous references and evaluations of themselves. All athletes were subject to the same training programme in this study, which falls under the Eastern bloc approach to training. It has been criticised, especially with the need in top-level competitions for individualised specific training. Optimising the recovery process allows the athlete to tolerate more frequent and intense training, and still respond positively. Each athlete is unique in responding to training stimuli and recovery. Athletes often report a restless night's sleep as an indicator to recover, and their bodies not coping. Birch and George (1998) recognise these symptoms with sympathetic overtraining in sprint events and team sports.

Gearity and Murray (2011) also noted the effects that coaches have on athletes and the likelihood of them using stress coping mechanisms, which may manifest in other areas. They discovered five areas that athletes recognise in bad coaches - poor teaching by the coach, uncaring, unfair, inhibiting athlete's mental skills, and athlete coping. It is important for the coach and the athlete to be honest when overcoming interpersonal difficulties, which come about when both are trying to be in control of the situation. If training is not going well and performance suffers, is it due to insufficient work (or the wrong type of training for that athlete), or overtraining. It is important for the achievements to be compatible with the objectives. The recovery used in this programme of two full days training, half day training, two full days training, half day training, a day and half rest, with two full days at the end of the week every two weeks, seemed sufficient for the athletes to complete the full four weeks.

5.1.10 Training Load

The comparison of **Training Load** scores across weeks within the same camp yielded the following results. All three camps had statistically significant differences between training load scores of the consecutive weeks. TC1 training load scores of week four was significantly lower than the previous three weeks. During TC2, the scores of week one were significantly lower than the other weeks. TC3 scores of week three were significantly lower than the previous two weeks. The comparison of the same week across camps indicated that the training load of TC3 week one and three was significantly lower than the other camps. TC3 could have yielded these results due to the final preparation of the athletes for the Olympics, and the reduced training time during the training sessions. Training load differed across weeks within the same camp, with TC3 lower than the other camps. The training loads were consistent for each individual, which was likely due to the shorter more intense training sessions. Lambert and Borresen (2008) postulated that athletes participating in proportionally more high-intensity exercise, the session-RPE method underestimates training load compared with the objective methods.

Budgett (1998) reported that intensive interval training, where one to six minutes is repeated several times, potentially leads to overtraining. Short sprint intervals with more than three minutes rest are adequate. If any of the athletes were overtrained, TC3 would have shown this, but TC2 recorded the highest load, and the increasing TMD confirmed this. TC2 appeared to have the greatest impact on the moods of the kayakers. The training loads were higher in this camp suggesting the training had an impact during this camp on mood state. However, there were no correlations between training loads and mood state in TC3, suggesting that factors other than training were responsible for the mood changes. Foster *et al.* (2001) found that muscularly strong individuals are comparatively poor at rating aerobic exercise session and pay more attention to muscle tension than dyspnea. With familiar modes of training, the athletes may adapt.

Rietjens *et al.* (2005) increased the training load in an intervention study by 100%, which equated to 870 min per week, in well-trained male cyclists. The athletes' body fat and body mass did not significantly change after two weeks after intense training. The kayakers body mass was not monitored on the training camps in this study. Rietjens *et al.* (2005) found in a two week intensified training period that physical performance was unaffected e.g. time trials. Rietjens *et al*. (2005) noted that a large increase in training volume rather than training intensity result brings about overreaching or overtraining, which confirms this research's findings. Weinberg and Gould (2007) reported that exercise and increased levels of fitness are associated with increased levels of self-esteem and self-concept. If performance measurement over a period of intensified training remains unchanged, an athlete may not be overreached. The time trial performances over the camps did not give any indication of this, as times remained consistent through out each camp. The time trial results are faster in TC3, due to the tapering phase of training, as well as conditions being more suitable, with no tidal influence, as for TC1 and TC2.

From Figure 4.16, it is possible to see the weekly training loads for the athletes and the responses to the training programme. Week four of TC1 and TC2 was significantly lower than previous weeks, possibly due to the structure of the training programme. The training loads give an indication of this and the progressive overload. Week three in TC3 was much lower due to the tapering phase before the Olympics. With reference to Table 3.1, TC1 and TC2 had similar weekly training sessions, with a total of 80 and 76 sessions respectively. TC3 had 53 sessions over a three week period. Figure 4.17 gives evidence that the athletes were within a functional range of training, falling between a tolerable weekly load of 7200 AU (Coutts *et al.*, 2008) and the recommend load of 4000 – 5000 AU (Robson-Ansley *et al.* 2009).

A few training sessions of underperformance are usually pre-cursors to, sleeplessness and waking tired, and reported in 90% of cases (Budgett, 1998). Athletes commonly ignore fatigue, heavy muscles and depression, for a variety of reasons. Egan *et al*. (2006) proposed that the more motor units recruited, the motor cortex may send stronger signals to the sensory cortex, which may increase perceived effort. In their study, they found that traditional training and super slow training had higher RPE than maximal power. This is contradictory to this study which found the slower, longer training to be generally easier, although the RPE may have fluctuated as the training camp progressed, but not in all subjects. RPE increased with sickness in the WURSS. The RPE for the separate sessions on days with resistance training was indistinguishable, thus it is a combined session RPE recording for that training block. In their study, Egan *et al.* (2006) took RPE measurements 30 minutes after completion of the exercise. The RPE was recorded post exercise for each morning and afternoon session for this study in the athletes own time. (Lambert and Borresen, 2008) note the practical usefulness of the session-RPE method in quantifying training load when monitoring training needs to be quick and easy. This recommendation should be considered in the context that there are many factors that can affect an athlete's personal perception of physical effort and that these factors need to be considered when using RPE.

Garcia-Pallares and Izquierdo (2011) found that using an intensified block training period (five weeks for base phase focusing on two specific components) compared to the traditional periodised training period (12 weeks for each phase i.e. base) in elite kayakers resulted in a more effective training stimulus for the improvement of kayaking performance. Modern sprint kayaking training is evolving and becoming refined, using new block training methods, which have produced favourable results. The type of training programme constructed for the athletes in this research (little individualisation and personalisation), may be phased out. Le Meur *et al.* (2011) noted the importance of sport science to reduce the trial-and-error approach of traditional training. Garcia-Pallares and Izquierdo (2011) found further that the number of weeks in succession as well as the number of sessions per week would also influence the strength aspect of training i.e. not more than three sessions per week for 8 to 16 weeks, or over 20 weeks. Le Meur *et al.* (2011) confirmed the effectiveness of tapering, and suggest two weeks is optimal, but could be shorter or longer depending on inter-individual differences as well as the over-reaching period of training before. The coach allowed 'individual' sessions over the third week of TC3.

5.2 CORRELATION ANALYSIS BETWEEN THE VARIOUS MEASUREMENTS.

The following section gives a summary of the **correlation analysis** between the various measurements. The following identified trends were significant during TC1. The higher the vigour scores reported the lower the RPE. Higher RPE scores were associated with higher anger, confusion and TMD scores. Higher depression, fatigue and TMD scores were associated with higher RPE scores reported. Higher depression and anger scores were once again associated with higher RPE scores in week four of this camp. On the Sunday of that week, higher fatigue scores were associated with higher RPE scores. The general trend was higher vigour scores associated with lower RPE, and high RPE associated with higher anger, confusion, depression, fatigue and TMD scores during TC1. The investigation into concurrent strength and aerobic training has not been fully conclusive, with effects of such training potentially manifesting in these results. Researchers are aware of the negative affects of this training and tried combining or identifying various factors to minimize the negative effects (Garcia-Pallares & Izquierdo, 2011).

The following results were obtained during TC2. Not all correlations were significant during the weeks; the following general trends were detected. Higher RPE scores were associated with higher scores on the following POMS scores: tension, depression, anger, fatigue, confusion and TMD. Vigour tended to have negative correlations with the RPE indicating that higher vigour scores are associated with lower RPE scores. TC3 had no statistically significant correlations between any of the measurements. The RPE did not appear related to the POMS measurements. Halson and Jeukendrup (2004) found in research that there was a lack of performance measures during intensified training periods as well as no report of the quality and quantity of the training. The data collected in this study included RPE, session load and performance markers which can be used to measure the athlete. Berger and Motl (2000) stated there are no definitive statements regarding a causal relationship between physical activity and mood enhancement. The underlying mechanisms of observed mood changes are also unclear. Athletes respond differently to the same training load and the variance in training adaptations may be due to factors such as sex: training history; psychological factors; initial training status; mode, duration, intensity and frequency of training; recovery potential; exercise capacity; non-training stress factors; stress tolerance; and genetics (Borresen & Lambert, 2009). A possible reason for the lack of significance between the POMS and RPE is the lack of sensitivity in the RPE measure in relation to mood. TC3 was a peaking/tapering period meaning the nature of the designed programme was of a very high intensity for most of the sessions. The factors that affect training adaptations pertain to the subjects in this research, but the degree of influence varies during certain training periods, as well as the response by the athlete e.g. initial training status in TC3. The athletes reactions to these factors were not very comparable, due to the low level of experience (less than three years for most, one kayaker had been competing at international events for over five years) in preparing for such an event.

There are clearly levels of achievement and anxiety control, when striving towards a goal i.e. to compete at the Olympics; one has to go through a series of processes - attaining a level of fitness to compete; trial selection; team selection; Olympic qualification; racing at the Olympics. Olympic medallists compared to non-medallists internalise strategies so much that they react automatically to adversity (Weinberg & Gould, 2007). Individuals who have an elevated anxiety trait could be regarded as having a lower capacity for tolerating stress and may be more likely to develop overtraining syndrome (Kennta & Hassmen, 1998). Athletes with more competition experience are more likely to develop methods of managing moods (Stevens and Lane, 2001), which pertains particularly to subject six who had eight years of international racing experience, including racing through the junior ranks. The athletes monitored of coping differently with extraneous variables on training camps, with more experienced athletes possibly coping better. This is in line with research in developmental psychology that found younger and older athletes differ in self-perceptions, social influences, emotional responses, motivations and self-regulation concerning sport and exercise (Weiss, 2003). The volume and intensity of the training are not direct causal effects on the athletes' mood states (vigour and fatigue), but are highly influential (Kentta *et al,* 2006) Psychosocial factors, the duration of the camp as well as interpersonal dynamics with other athletes and the coach are all interplayed to create the situation that the athlete reports.

5.3 WISCONSIN UPPER RESPIRATORY SYSTEM SURVEY

Lavallee and Flint (1996) found in their study that severity and rate of injury was related to tension/anxiety anger/hostility and total negative mood state on the POMS scale. Overtrained athletes anecdotally report an alteration in immune system function and the use of markers of immune function as a diagnostic test for overtraining has been suggested. In overtrained athletes, susceptibility for infections and frequent illness is often reported (Rietjens *et al.,* 2005). The high incidence of flu like symptoms during the training camp could be due to the athletes coming into the camp slightly fatigued, despite a reduction in training the week before. This could also be related to athletes suffering illness post intensified training period (Rietjens *et al.*, 2005). Niemann (1994) noted that athletes suffering from frequent upper-respiratory tract infections might also be a sub-group of overtraining. Whether immune function is seriously impaired in overtrained athletes is unknown as the scientific data are not available (Halson and Jeukendrup (2004). Subjects one and five in particular, experienced URTI symptoms in all three training camps.

The high incidence of illness over TC1 and TC2 is inline with Spence *et al.* (2007) findings. There are also anecdotal responses of staphylococcus infections over this period, which recurred during the rest of the training year up to the Olympics. Lovell *et al.* (2010) noted that sedentary individuals can tolerate infections of the upper respiratory tract, but the potential problem for athletes is interfering with both competition performance and training. They go on to say that high intensity, long duration and exercise in the absence of adequate recovery is generally accepted as having a negative impact on immune function. Kentta *et al,* (2006) note that is important to identify athletes who have not shown sufficient recovery based on their energy index or POMS scores following a period of rest.

Subjects four and five were able to use anger and tension as positives to produce favourable performances. Expressed anger can be directed at the source of the frustration, and can be channelled into determination to succeed (Lane *et al*., 2001, Robazza & Burtoli, 2007). Subject five reported illness for a majority of TC2 and parts of

TC1. There is a tendency to perceive symptoms of anger and tension as debilitative, while they facilitate others. The athletes training age is very important when it comes to training and racing. Experienced athletes become more aware and in tune with their bodies, conditions and feelings associated with the competition environment.

Mismatching enthusiasm with skill level is a common cause of injuries amongst athletes. Elite athletes commonly push harder in training, in expectation and anticipation of events in the future. Interestingly in a study done an Olympic team over a 12 month training period in a variety of sports (Halson & Jeukendrup, 2004), 15% of the team (257 athletes) were in an overtrained state, where 50% of these developed in the three month competition period. The diagnosis was whether the athletes had been feeling constant fatigue and an unexplained underperformance. There was a higher incidence among males and when the sports were divided between anaerobic and aerobic, no significant difference was found.

Spence *et al.* (2007) found that most illnesses in elite athletes occur during the heaviest training periods, with symptoms usually lasting for approximately one week. Using the WURSS-44, the elite athletes reported greater functional impairment and loss of quality of life; and given the possible negative effects of illness on training and competitive performance, the greater reported functional impairment in the elite athletes might relate to a higher intrinsic sensitivity to the presence of illness symptoms. This could possibly have been the case with the subjects in this study and reporting illness, whereby they were still able to train and carry out competitive time trial results.

Athletes need to keep a balance with their lifestyles. Training and focusing for long periods, means sacrificing socialising or partaking in activities/hobbies that are not favourable to the athletes' preparation. Pisarek *et al.* (2011) noted a holistic approach to health issues. This stems from the viewpoint that health is a process conceived of a dynamic balance between a person and his/her environment. The off-season is an important aspect of the Olympic training cycle, to use as a period of recuperation and enable the previous training block as a foundation. Athletes usually restore balance in the period of three to six weeks following the competition phase.

The British Olympic Medical Centre has shown that performance and mood state improve within five weeks of physical rest (Budgett, 1998). Light exercise also helps in speeding the recovery from chronic fatigue. Injuries have been related to a players emotional insecurity and related anxiety, seen as manifestations of emotions. Aspects like losing one's place in the team, family problems and financial worries are concerns that will cause instability. Pisarek *et al.* (2011) found that personality traits were the best predictors of health practice such as daily practices concerning sleep, recreation and physical activity. They were how ever, not found, to be predictors of preventive behaviours such as following health recommendations or seeking information on health and sickness.

5.4 TIME TRIALS

Meeusen *et al.* (2006) noted the inability to sustain intense exercise, a decreased sport-specific capacity when the training load is maintained or even increased is an indication of overtraining i.e. a 2000m test to determine that a 500m athlete is fatigued. If the time trials are part of the normal training programme this could be viable but generally should be more event specific. This may not be possible at different times in the season and varying conditioning of the athlete. While Kenttä *et al.* (2006) stated that there is no agreement in the literature as to how much decrement in performance indicates overreaching.

There was no indication in the time trial results of a decreased capacity to perform, as the times fluctuated (possibly due to environmental conditions). The 2000m time trials measured in TC3 were more reliable, taking place on a 1000m sprint course. There were no outlying times or indication that the athletes were taking strain with the training. The times remained consistent for each time trial session. Meeusen *et al.* (2006) noted that overtraining is characterised by a 'sport specific' decrease in performance, together with disturbances in mood. The periodization of the years training did not allow for comparisons between the events that the athletes were training for as the programme was designed for one peak during the year (i.e. World Champs/Olympics). This is where new training methods and approaches have become more individualised to suit athletes that may become fatigued with higher volume in training. Robson-Ansley *et al.* (2009) postulate that performance tests are more useful to determine whether an athlete has recovered from an intensified period of training. Based on the time trial results, and, the athletes ability to maintain normal training with diminished sport-specific capacity (Meeusen *et al.,* 2006), there were no signs of overtraining.

CHAPTER 6

SUMMARY, CONCLUSIONS AND RECCOMMENDATIONS

Sprint Kayaking is a technically challenging, and physiologically complex sport, to attain an elite level. The high aerobic, anaerobic and strength conditioning required for this requires dedication, commitment and adhering to a training structure aimed at developing these factors. The psychological component, as with most elite level sports, is a determining factor, in the process and outcome of training.

With the integration of sports science and developing athletes to compete at an Olympic level, so training methods are evolving and adapting to changes in equipment and conditioning. In the pursuit of this, the athletes subject themselves to physical and mental stress enduring negative consequences i.e. overtraining. Budgett (1998) noted that overtraining for one athlete might be insufficient training for another. Each individual tolerates different levels of training, competition and stress at different times depending on level of fitness and health through out the season. All aspects of an Olympian's life have the potential to influence optimal performance (Gould & Maynard, 2009). In concurrence with Kentta *et al,* (2006), the consistent decline in energy index scores meant the athletes found it increasingly difficult to cope with the training programme. The coach in their study confirmed to them as well with subjective observations.

Monitoring the effects of training can range from the biochemical level to the subjective moods. The POMS and RPE have proved to be effective tools for monitoring athletes, with conflicting evidence to their application. The subjective responses of athletes to training are becoming more influential on the structuring of training programmes. Research on sprint kayaking was found to be limited as well. Assessment of training using behavioural indicators such as mood states and perceived exertion appears to be a crucial means of reducing the extent of overtraining in athletes.Канttä *et al.* (2006) noted it might be easier to maintain intense periods of training and monitor the recovery with the POMS, instead of determining the extent of the training load. The training programme can be adapted if the athlete is not recovering. Shorter training camps, may increase intensity, but allow for greater athlete recovery and less time out of comfort zones. The session RPE has many uses for coaches and future training programmes. It can be a very functional and insightful tool for the coach and individual athletes' i.e. monitoring athlete loads compared to intended loads, ensuring that you have appropriate periodisation, detecting athletes who are not coping with training, monitoring loads of different groups within a team/squad (Coutts *et al.* 2008).

The kayakers were monitored over a year at different stages of the build up to the Olympics. The data collected reflected a realistic and natural scenario of athletes preparing for peak performance. It also reflected a classic periodised training programme. The data is comparable to other studies regarding the POMS. Kentta *et al,* (2006) found recovery was also not complete in the post-camp measurements. The general trend for the training camps was high vigour scores associated with lower RPE scores; and high RPE were associated with higher anger, confusion, depression, fatigue and TMD scores during the camps. This was inline with the sub-hypothesis stated. The limited number of subjects in this study and wide scatter of data is cause for discrepancy. This may align with Gould and Maynard (2009) who found in the literature that the POMS might not be sensitive enough to distinguish between successful athletes. This indicates the need for personalised training and subjective response monitoring, especially at the elite level. The WURSS reflected that not all athletes could handle the same workload. The significance of some correlations may have been due to subjects with extreme values, instead of the group.

Robson-Ansley *et al.* (2009) noted that athletes on the fringes of reaching national standard might not have access to sports science, so it is imperative that these potential Olympians are not lost due to poor monitoring and management of fatigue. The participants involved in this study qualified for the Beijing Olympics placing them on world standard. The biggest sprint kayak team to attend the Olympics enhanced the evolution of sprint kayaking in South Africa. The training methods and recovery methods of these participants was under and investigation and scrutiny. There were aspects to the process of preparing for the Olympics '*expected*' or recommended with no evidence to support them, nor had been tested before i.e. massage as a recovery tool, dietary intake etc.

The POMS can be influenced by aspects other than training, stress from not completing training sessions, not training at the desired intensity in relation to teammates, psychosocial reasons or health reasons. Each symptom is relative, and this re-iterates the author's view of the need for sport psychology to become more involved in sport, and especially in South African sport. Standardised monitoring with use of the POMS has been suggested (Roose *et al.*, 2009) owing to the difficulty in using it as a predictive measure for overtraining. Different time frames for the measured responses and small numbers of participants, as used in this study, were also restricting factors. By using a smaller time frame with the POMS response set e.g. "right now" allows the fact that mood is a transient construct that fluctuates according to situational and personal factors. This would affect the RPE recordings.

Conducting a training and recovery monitoring system, can be time consuming, expensive and impractical. Researchers are continuously revising and integrating methods to assessing athletes e.g. Adjustment Disorder (Jones & Tenenbaum, 2009). It has been argued that effective psychological preparation cannot stand alone, and should be integrated with all other elements of the athletic preparation, namely the physical (Vealey, 1988) along with tactical, and technical in the aim of producing consistent training. There have been attempts to describe the 'ideal' personality of a champion athlete, which have been unsuccessful, and an all-embracing theory of personality for sport, has not yet emerged (Cockerill, 1990).

The general trend in this study was higher vigour scores associated with lower RPE and training load, and high RPE associated with higher anger, confusion, depression, fatigue and TMD scores, concluding the objectives of the study. There was a relationship between increasing POMS scores and the training camps duration. A relationship also existed between RPE and duration of the training camp, which was not causal of the

POMS scores entirely. The energy index was generally higher in pre-camp measures and extended rest periods during the camps. With similar findings to Kentta *et al*, (2006) it possible to deduce the POMS and RPE indicated a state of overreaching was reached in the kayakers, as they did in their research. Monitoring for an extended period after the training camps would be more conclusive of overtraining as well as on a daily basis and using performance measures. This would allow for optimised and individualised training loads. In accordance with Kentta *et al* (2006), regular use of the POMS may help detect under recovery, preventing staleness and unwanted rest for extended periods. Future studies will enable a retrospective view of these results.

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