Do psychosocial factors predict pain after participation in an ultramarathon race?

By

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DECLARATION

I, Jessica Rabbitte (RBBJES001), hereby declare that the work on which this dissertation is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree at this or any other university.

Signed by candidate

(Signature)

23/12/18

(Date)

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LIST OF ABBREVIATIONS

ACL	Anterior Cruciate Ligament
AFAQ	Athlete Fear Avoidance Questionnaire
ATP	Adenosine Triphosphate
BPI	Brief Pain Inventory
CLBP	Chronic Lower Back Pain
CNS	Central Nervous System
DOMS	Delayed-Onset Muscle Soreness
EIMD	Exercise-Induced Muscle Damage
ER	Endurance-Response
FAM	Fear Avoidance Model
FAR	Fear Avoidance Response
PCS	Pain Catastrophizing Scale
LBP	Lower Back Pain
PNS	Peripheral Nervous System
PSEQ	Pain Self-Efficacy Questionnaire
VAS	Visual Analogue Scale

GLOSSARY OF TERMS (USED IN THE CONTEXT OF THIS STUDY)

TERM	DEFINITION
Allodynia:	Pain response from stimuli that do not typically cause pain (1).
Biopsychosocial:	The interaction between biological, psychological and social factors in medical practice (1).
Catastrophic Thinking:	To contemplate irrational worst-case scenarios (1).
Central Sensitization:	The continually increase in neural transmission at different areas of the central nervous system. After an acute injury, the central nervous system reorganises itself resulting in a continuation of pain leading to hyperalgesia and allodynia (2).
Comrades Marathon:	This ±90 km ultramarathon is run annually between Durban and Pietermaritzburg in the Kwa-Zulu Natal Province, South Africa (3).
Fear Avoidance Behaviour:	Avoidant behaviour based on fear which can lead to the development of chronic pain (2).
Nociception:	The response of the sensory nervous system to painful or potentially painful stimuli (1, 2).
Opioid-Mediated Effect:	Exercise can trigger an analgesic response as a result of the pituitary gland and hypothalamus releasing β-endorphins which activate the central and peripheral μ-opioid receptors (4).
Pain-Related Fear:	A construct that integrates fear of pain, fear of injury and fear of movement (2, 4).
Psychosocial Factors:	The association of social factors, thoughts and behaviour (1, 2).

Recovery:	An important process to enable the positive effects of training (endurance running) and to decrease the negative effects of regular training and competition (5, 6).
Self-Efficacy:	Belief in one's own ability to succeed to successfully complete a goal (1, 2).
Ultramarathon	A footrace with a greater distance than the traditional marathon length of 42,1 km (3).

ABSTRACT

BACKGROUND

Participation in ultramarathon races is increasing globally. Although endurance running has numerous physical and psychological benefits, due to the excessive volume of training and the physical and emotional demands of completing an ultramarathon event, exercise-induced muscle damage and delayed-onset muscle soreness are common. Recovery is central to improving performance and is also a determining factor in return to training. Recovery requires both physical and psychological adaptation. However, there is limited research exploring the effect psychosocial factors play on pain recovery following competition, particularly in endurance runners. More specifically, the role fear avoidance beliefs, pain catastrophizing and self-efficacy play in pain recovery following an ultramarathon race. This information is important to contribute to the limited research on the association between psychosocial factors and recovery from pain in endurance runners. Additionally, this information may provide insight into pain recovery following the Comrades Marathon and reduce time away from running.

AIMS AND OBJECTIVES

The aim of this study was to investigate the relationship between psychosocial factors (fear avoidance beliefs, pain catastrophizing and self-efficacy beliefs) and pain recovery in runners following the 2017 Comrades Marathon. The specific objectives of the study were to explore whether the psychosocial factors of pain catastrophizing, fear avoidance beliefs and self-efficacy beliefs: a) predict pain in ultramarathon runners after competing in the Comrades Marathon; and b) affect recovery in runners competing in the Comrades Marathon.

METHODS

This study had a descriptive, longitudinal cohort design. Healthy ultramarathon runners between the ages of 20 and 60 who had qualified for and were intending to compete in the 2017 Comrades Marathon were included in this study. Participants who failed to provide informed consent, reported any signs of illness two weeks prior to the race or any relevant medical or surgical procedure that would prevent participation in the race, were diagnosed with a history of chronic pain or who did not complete the race were excluded. All participants were required to complete a medical and sports history questionnaire and baseline psychosocial questionnaires (Athlete Fear Avoidance Questionnaire, Pain Catastrophizing Questionnaire, Self-Efficacy Questionnaire) two weeks prior to the race at a presentation evening held at participating running clubs.

Recovery from pain was recorded by completing a pain logbook (Pain Severity Score of the Brief Pain Inventory) starting the evening of the day on which the Comrades Marathon was run and on each night for nine days following the race, with a total of 10 entries. The questionnaires were validated in previous studies by a panel of experts and were available in both hard copy and electronic format.

RESULTS

The study sample consisted of 77 participants with a mean age of 41 years, 45 (58%) of whom were male and predominantly English speaking (74%). The majority of participants (78%) had completed the Comrades Marathon previously with 13% being novices to the ultramarathon distance. The average finishing time for the study participants in the 2017 Comrades Marathon was 10 hours and 16 minutes. Seventy percent reported that they had previously used pain-relieving medication after a race. The majority of participants (86%) documented a history of injury, with 55% reporting a current injury. Only 6% reported currently using chronic pain-relieving medication.

The baseline psychosocial questionnaires revealed that the majority of the participants demonstrated low fear avoidance beliefs (79%), low pain catastrophizing beliefs (88%) and high self-efficacy beliefs (97%). It took five days from the day of the Comrades Marathon for 75% of the runners to score a pain rating of one or lower in the pain logbook and seven days for 75% of the runners to report no pain. There were no correlations between psychosocial factors and pain recovery in this sample of Comrades runners. There was no correlation between finishing times and pain during recovery.

CONCLUSION

In conclusion, this study showed that in this sample of ultramarathon runners pre-race psychosocial factors had no effect on recovery following the 2017 Comrades Marathon. High self-efficacy scores, previous experience, higher pain tolerance and better coping strategies in ultramarathon runners may be contributing factors to these results. Future research needs to explore endurance runners who do not complete the race, assess the profile of the ultramarathon race and assess different recovery markers.

CHAPTER 1: INTRODUCTION AND SCOPE OF DISSERTATION

1.1. INTRODUCTION

It is well established that both elite and recreational athletes are continuously trying to improve their performance and recovery during training and competition (7, 8). With an emphasis on maximising an athlete's performance, research has focused on improving performance by reducing the risk of injury and decreasing recovery time following an injury or competition (7). With this area of research receiving a great deal of attention, a shift in focus is required to continue to find new ways of improving sporting performance and reducing time away from sport (9). Although it is recognised that many factors affecting sporting performance are biomechanical and physiological in nature (10), psychosocial factors have also been found to contribute to athletic performance and risk of injury (11, 12).

An investigation into changes over a 12-week period following ACL reconstruction in athletes found that increased self-efficacy beliefs, decreased pain catastrophizing thoughts and reduced fear avoidance beliefs contributed to improved pain levels in the knee and better knee function (13). This study highlights that by improving self-efficacy beliefs to complete rehabilitation tasks and reducing catastrophizing thoughts and fear avoidance beliefs to improve pain, athletes can return to a pre-injury performance level sooner. This research also recognised fear avoidance beliefs, pain catastrophizing and self-efficacy as inhibitors and predictors of injury recovery following ACL reconstruction. Research linking psychosocial factors with functional outcome in musculoskeletal injuries (13-17), has sparked interest into understanding the effect these psychosocial factors have on recovery in athletes following a race.

The psychosocial constructs within the Fear Avoidance Model (FAM) are of interest to the sporting population (1, 5). The FAM is a biopsychosocial model designed to explain the development of chronic disability following a musculoskeletal injury. The model suggests that when pain is perceived as threatening following a musculoskeletal injury, several psychosocial concepts, such as fear avoidance behaviour, pain catastrophizing and fear of re-injury, are changed, resulting in increased pain levels, disuse and disability (1). By recognising the role of the FAM in the sporting population, the predictive power of these psychosocial factors can be used to explore factors affecting return to performance (recovery) following competition (race).

However, the association between fear avoidance beliefs, pain catastrophizing and self-efficacy, and recovery from pain in athletes after competition has yet to be explored. Recovery is a fundamental part of training among athletes (5, 6) and allows for adaptation (14) and return to pre-race performance levels (14-17). Recovery is an imperative, individualized process which involves both physiological and psychological restoration (14). While a large quantity of research has investigated the physiological recovery in athletes (5, 6, 14), the few studies in ultramarathon runners have not yet investigated the association between psychosocial factors and recovery following an ultramarathon race.

Ultramarathon runners push their bodies beyond normal limits in training and during competition (14). To complete an ultramarathon event, endurance runners need to train for extensive hours each week covering hundreds of kilometres (18). Elite marathon runners cover over 230 km a week in training (18). These extensive training loads need to be carefully monitored to ensure adaptation to training while preventing overtraining syndrome. The build-up of stress from excessive training or competition can result in several days to weeks of recovery to restore performance to its previous level (14, 18, 19). Additionally, during the race these endurance runners manage nociceptive feedback from muscles, tendons and joints as well as overcome excessive fatigue (14, 19). Upon completion of the race, the pain experienced from delayed-onset muscle soreness (DOMS) or exercise-induced muscle damage (EIMD) can delay recovery and return to competition (18). To qualify for an ultramarathon event, endurance runners are required to complete several qualifying races leading up to the main event. This requires quick, effective recovery sessions in between training and qualifying races (18, 19). Thus, the discomfort and fatigue that ultramarathon runners need to overcome to complete a race (14, 18, 19), make for an interesting population to investigate recovery.

The Comrades Marathon serves as an appropriate platform to examine recovery from pain in endurance runners in South Africa (3, 20). The Comrades Marathon is the world's largest and oldest ultramarathon race, which is run annually between Durban and Pietermaritzburg in the KwaZulu-Natal Province of South Africa (20). The 2017 Comrades Marathon is 86.73 km in distance which can change slightly each year depending on the route (3, 20). It alternates between the ‘up’ (Durban to Pietermaritzburg) or ‘down’ run (Pietermaritzburg to Durban) (3, 20). The first Comrades Marathon took place in 1921 with only 34 runners participating. The 92nd Comrades Marathon (4th June 2017) was an ‘up’ run, with a total of 17 031 athletes starting the race and 13 852 (81%) athletes finishing within the twelve-hour cut-off time (3, 20).

The nature of the Comrades Marathon should give rise to the necessary physical, psychological and social stresses required to cause a certain deficit in recovery following the race. This will allow an opportunity to investigate the relationships between pain, psychosocial factors and recovery in endurance runners (14, 15, 21-23). If psychosocial factors can influence recovery from pain, like physical barriers have been found to (14, 15), it will be imperative that these psychosocial factors are identified and addressed early in training. This could prevent a delay in return to competition after a race (7, 24).

1.2. AIMS AND OBJECTIVES

1.2.1. AIMS

The aim of this study was to determine whether there was an association between pain catastrophizing, fear avoidance beliefs and self-efficacy beliefs and athlete pain recovery in a cohort of ultramarathon runners competing in the 2017 Comrades Marathon (86.73 km) road race.

1.2.2. SPECIFIC OBJECTIVES

The specific objectives of this study were to explore whether the psychosocial factors of pain catastrophizing, fear avoidance beliefs and self-efficacy beliefs:

1) Predict pain in ultramarathon runners after competing in the Comrades Marathon; and
2) Affect pain recovery in runners competing in the Comrades Marathon.

1.3. SIGNIFICANCE OF THE DISSERTATION

With the lack of research investigating the role psychosocial factors play in the recovery of athletes, there is a need for further investigation into this area. Identifying the role which psychosocial factors, namely; fear avoidance beliefs, pain catastrophizing and self-efficacy, play in recovery from pain following an ultramarathon race, can allow barriers which hinder return to training to be identified and addressed (15, 25). Information obtained from this dissertation aims to contribute to the limited research on the association between these psychosocial factors and recovery in endurance runners by evaluating the role these psychosocial factors play in pain following the Comrades Marathon. The data reported will provide some insight into pain recovery in endurance runners following the ultramarathon. This may have the potential to facilitate a reduction in time to return to competition (15, 25). The development of psychologically informed training and recovery programs could be used to optimise the duration before returning to performance (15, 26), reduce the potential development of chronic pain (27, 28) and improve performance (16).

1.4. PLAN OF DEVELOPMENT

In preparation for the experimental section of this dissertation, a comprehensive review of the literature pertaining to endurance running as a sport, recovery in endurance running, psychosocial factors and recovery in endurance running, the role of pain in endurance running and fear avoidance beliefs, pain catastrophizing and self-efficacy and endurance runners, will be presented (Chapter 2). This chapter will be followed by a descriptive, longitudinal study that was designed to explore the effects of psychosocial factors, namely pain catastrophizing, fear avoidance beliefs and self-efficacy beliefs, on recovery following an ultramarathon race (Chapter 3). A summary and conclusion chapter will finalise the dissertation (Chapter 4).

CHAPTER 2: LITERATURE REVIEW

2.1. INTRODUCTION

The primary focus of research on athletic recovery following a competition has been on physical factors (2, 6). This is despite the understanding that recovery has both physical and psychosocial influences (16, 29, 30). This is due to the misunderstanding that physical and psychosocial recovery in sport occurs simultaneously; however, physical and psychosocial readiness to return to performance following a race do not always coincide (29, 31). Although the sporting population are believed to have greater conditioned pain modulation than their sedentary counterparts (27, 28), this does not clarify why some athletes have a delayed return to performance following competition or reduced performance even after an injury has healed (14). This suggests that factors, other than physical, may play a role in the recovery process of an athlete.

Pain catastrophizing, fear avoidance beliefs and low self-efficacy scores have been shown to play a key role in sporting performance and recovery following an injury (16, 30-33). However, to date, there has been little evidence recognising the internal or psychosocial factors that contribute to an athlete's perception of pain intensity during recovery. With extensive literature supporting the role psychosocial factors play in recovery following an injury (13-16), there is a need for future research to explore the association between psychosocial factors, pain predictability and recovery in the sporting population.

Therefore, this literature review will appraise the current literature around psychosocial factors affecting sporting performance and recovery, with specific emphasis on pain recovery in endurance runners. This review aims to summarise and critically evaluate the current literature in this area.

Online databases searched included: PubMed, EbscoHost, Science Direct, Medline and Google Scholar. The following keywords and varying combinations of these were used: "*biopsychosocial," "psychosocial," "chronic pain," "pain in sport," "pain in recovery," "ultramarathon running," "marathon running," "ultramarathon runners," "marathon runners," "long distance running," "long distance runners," "endurance sports," "endurance running*," "endurance runners," "*Comrades Marathon," "recovery", "recovery modalities," "fear avoidance beliefs," "self-efficacy," "pain catastrophizing," "fear avoidance questionnaire," "athlete fear avoidance questionnaire,"*

"long distance running," "endurance sports," "endurance running," "pain catastrophizing questionnaire," and *"self-efficacy questionnaire*."

2.2. ENDURANCE RUNNING AS A SPORT

The popularity of endurance running is increasing globally (9), with a surge in new races organised each year (20). It is believed the first marathon was run in 490 B.C. where a soldier Pheidippides ran from Marathon to Athens in Greece announcing victory on the battlefield (34). Subsequently, the number of participants competing in recreational and competitive endurance running has continued to experience massive growth (20, 21). The popularity of running may have to do with the increased awareness of the importance of daily exercise, physical fitness and the many health benefits associated with the sport (35). Physical fitness can be defined as the characteristics that people have or that they develop relating to their capacity to perform physical activity (34). The fascination in testing the body's physical fitness and abilities by long endurance events may explain the considerable increase in both male and female runners attempting ultramarathons (35).

Endurance running has numerous physical and psychological benefits. Unfortunately, with the volume of training required to participate in an ultramarathon; fatigue, exercise-induced muscle damage (EIMD) and delayed-onset muscle soreness (DOMS) are common (14, 18). The next sections will provide a brief overview of the positive effects of endurance running and the potential negative effects of endurance running with training and following competition. The final section will discuss ultramarathon events in South Africa.

2.2.1. POSITIVE EFFECTS ASSOCIATED WITH ENDURANCE RUNNING

Endurance running can result in tissue, organ and mechanical adaptations (35). There are numerous benefits associated with running. Some of these benefits include improved fitness, weight loss, general well-being, reduction in cardiovascular risk factors and enjoyment (9, 35). Additionally, running can be performed in many locations with little to no equipment (35). It is easily accessible enabling many people to participate in the sport (9, 20, 35). Metabolic, cardiovascular, musculoskeletal adaptations and psychological benefits associated with endurance running will now be discussed briefly. A more comprehensive review of the benefits of endurance running is beyond the scope of this review. For additional information on the benefits of endurance running, please refer to Hawley and Spargo (36).

Endurance running largely depends on the aerobic metabolic system (34, 36). This system produces energy via oxidative phosphorylation in the mitochondria of active muscle. Glucose and oxygen enter the Krebs cycle, in the mitochondria, to create adenosine triphosphate (ATP) or energy. The training required to compete in an ultramarathon improves the function of the metabolic system and the muscles oxidative capacity (36). These changes allow a runner to experience less fatigue by using energy more economically. Additionally, blood distribution to the active muscles improves with the increase in the capillary network of the muscle, thereby improving the gas exchange between the muscle and capillary network (34, 36).

Furthermore, endurance running improves the ability of haemoglobin to offload oxygen, increase the number of mitochondrial proteins and the number of Krebs cycles, and consequently increases ATP production (34, 36). In addition, regular endurance training improves the body's ability to metabolise carbohydrate and fat, sparing glycogen stores, enabling endurance runners to burn less energy (34).

With regular endurance running the efficiency of the cardiovascular system improves (34). There is an increase of blood flow through the heart transporting oxygen to active muscles. Additionally, blood volume of the body increases, which enlarges the ventricles' preload and improving oxygen perfusion to muscles. This encourages a greater stroke volume, increasing cardiac output with each heart contraction. Subsequently, the load on the cardiovascular system is reduced decreasing the runner's heart rate and blood pressure at rest and during training (34, 37).

The repetitive mechanical loading involved with ultramarathon training can positively remodel the skeletal muscle resulting in greater strength (38). Exposing the body to resistance training and repeated mechanical loading can cause muscle adaptations. These long-term adaptations can result in muscle hypertrophy resulting in increased running speed and power, imperative to any endurance athlete (34, 38). However, training for an ultramarathon alone is not enough to cause muscle hypertrophy, in fact excessive exposure to repetitive forces or inadequate recovery time may cause overuse injuries in runners (34).

In addition to physical benefits, studies have shown psychological benefits when participating in a marathon (39). To investigate the perceived benefits of running a marathon, 402 endurance runners completed a survey within two weeks of competing in a marathon (39). The survey found that competitive runners had a greater positive attitude towards running and importance to life.

Additionally, recreational runners had a greater general perceived benefit of the sport. The survey showed that female runners also had an improved self-image and life fulfilment, when compared to male runners.

Studies have concluded that regular running decreases symptoms associated with clinical depression and anxiety (39, 40) and improves cognitive function and memory through the increased release of the neurotransmitter catecholamine, associated with the brains learning ability (40). Physical exercise, in the form of running, has also been associated as a buffer against aging of the brain. Brain scans performed on physically active elderly subjects showed a lower rate of brain shrinkage and cognitive decline then their inactive counterparts (38-40). Running has also been linked to improved alertness during the day and improved circadian rhythms, faster sleep onset, a deeper sleep and a decrease in insomnia (36, 38, 40).

2.2.2. POTENTIAL NEGATIVE EFFECTS OF ENDURANCE RUNNING

To become an endurance runner, athletes need to push their bodies to the limit to increase training loads and to maximise running performance (35, 40, 41). This requires a balance between the positive effects of training and the negative effects of training (40-47). The negative effect of endurance running will now be briefly discussed in terms of fatigue, EIMD, DOMS, running related injuries and overtraining. For a more comprehensive review of the potential negative effects of endurance running please refer to Hyldahl and Hubal (48), as further discussion is beyond the scope of this review.

Fatigue is defined as an increase in perceived effort to produce a specific force output to the eventual inability to exert that force output (42). This acutely impairs exercise performance. Muscle fatigue, a “loss of maximum force-generating capacity” (35 p9) in ultramarathon runners, is most closely linked to the intensity and duration of the race. The type of muscle involved, the type of muscle activation and contraction also play a role in muscle fatigue (35).

Muscle fatigue can be subdivided into peripheral and central fatigue (44). Peripheral fatigue is characterized by chemicals affecting the peripheral nervous system (PNS) or the muscles. This can impact muscle strength and power due to the disruption of the muscle’s excitation-contraction coupling. Central fatigue or perceived exertion, is caused by fatigue of the brain. Central fatigue is believed to contribute to muscle fatigue in endurance running and can last for several days after an ultramarathon. Fatigue, like muscle soreness, is subjectively driven by fear, anxiety and anger (44).

Exercise-induced muscle damage, due to unaccustomed intensity or duration that the runner is not used to, can lead to muscle damage and pain (35). Thus, an important indicator of EIMD is muscle soreness. Eccentric loading, or active muscle lengthening under resistance, is a primary factor exacerbating muscle damage. The lengthening of the muscle fibrils results in structural changes leading to symptoms of EIMD. This can lead to muscle soreness or DOMS, muscle swelling, an increase in muscle protein (creatine kinase) in the blood, a loss in muscle strength and motor control deficit in the days following training or a race (27, 45). These symptoms can change the kinematics during running which in turn can negatively influence performance.
The pain associated with EIMD during the recovery period is delayed, appearing 12 hours after training and subsiding within seven to 10 days (46).

The integrated model of muscle damage has been described as having four phases (27, 45). These phases include initial events, autogenic processes, the phagocytic stage and finally the regenerative phase. Initially, after the muscle is damaged, there is an acute inflammatory response, metabolic changes and a significant reduction in homeostasis of the damaged tissue. After leukocytes, pro- and anti-inflammatory cytokines leak into the damaged muscle, the damaged fibres are removed. The regenerative phase promotes muscle repair and growth. Reduced muscle function and DOMS are typical features of EIMD (27, 45, 46).

A symptom of EIMD, DOMS, is a result of inflammation and damage to non-contractile tissues causing pain when the muscle is activated or stretched. Unlike temporary muscle soreness felt at the end of exercise believed to be the result of an accumulation of metabolic waste (45), DOMS can be felt hours after exercise lasting days. Symptoms of DOMS include muscle soreness and stiffness, swelling and reduced function. Although the symptoms of DOMS are similar to EIMD, DOMS does not result in changes in muscle structure or changes in creatine kinase levels (34, 45).

Pain is, therefore, commonly experienced among endurance runners (27, 47). The pain experienced after an ultramarathon can be intense enough to delay return to training, prolong recovery time between races and reduce participation in daily activities (22). Most interestingly, current studies have shown that pain, like thirst or hunger, is an emotional response to reinstate homeostasis and promote recovery in the body (46). Assessing muscle soreness is most commonly done using a questionnaire in which runners are asked to rate their perceived muscle soreness on a fixed ordinal scale, the visual analogue scale (VAS) (45).

It is difficult to determine the precise incidence and prevalence of running injuries as most research relies on retrospective self-reporting questionnaires. This can result in poor recall of information regarding the injuries (34). However, Fredericson and Misra (49) reported a yearly incidence of running-related injuries to be around two-thirds of the running population, with an increase to 90% when training for a marathon. Research in Switzerland found experienced marathon runners to be less likely to be affected by a running-related injury during their training when compared to their novice counterparts (49).

Running mileage (greater than 40 miles or 64 km a week), change in running volume or intensity and history of previous injury are the main predisposing factors to running-related injuries (34, 49). A review of research regarding running related injuries found an incidence of 26% to 92% of injuries in runners, with 80% of injuries occurring at or below the knee joint (50). Common running-related injuries include; patellofemoral pain syndrome, tendinopathies, lower back pain, shin splints, and stress fractures (50).

Over the past few decades, training loads in most sports have greatly increased to improve performance. Consequentially, overtraining syndrome and overreaching are also on the rise (41). Overreaching is considered a build-up of training load that results in performance decrements (41, 51). Overreaching can be subdivided into non-functional and functional overreaching. Functional overreaching is a normal process of training and competition, whereas non-functional overreaching can result in physical and psychological dysfunction. This can take days to weeks to recover (51). However, if overreaching is not addressed with sufficient recovery, overtraining syndrome may occur.

Overtraining syndrome is believed to be due to an imbalance between training and recovery leading to systemic inflammation effecting the central nervous system (CNS) (41). Overtraining syndrome has been associated with increased risk of injury, disturbed sleep, poor performance, irritability and emotional disturbances such as increased anxiety, stress and fear, hormonal changes and central fatigue. Insufficient physical recovery coupled with overtraining can result in maladaptation and reduced performance (41, 51). With 15% to 50% of endurance runners suffering with non-functional overreaching in a season, sufficient recovery is imperative to support increased training loads and competition (34).

2.2.3. ENDURANCE RUNNING EVENTS IN SOUTH AFRICA

South Africa is known for two of the world's most iconic ultramarathon races held every year (3, 20). The Two Oceans Marathon (±11 000 runners per year) is a 56 km ultramarathon race which takes place in Cape Town and the Comrades Marathon (±20 000 runners per year) takes place between Durban and Pietermaritzburg (14). The 2017 Comrades Marathon was an 86.73 km ultramarathon held on Sunday 4 June. The race attracts both international and South African participants, with differing demographics, socioeconomic classes, psychological groups and levels of competitiveness.

The first Comrades Marathon took place in 1921 with 34 runners (14). Currently, this race is run by around 17 000 athletes, with almost 14 000 completing the race (3, 20). Both the young and old (20 to 76 years old for 2017), as well as both males and females (4:1 male to female ratio for 2017) (20) participate.

The Comrades Marathon alternates each year between the 'up' (Durban to Pietermaritzburg) or 'down' run (Pietermaritzburg to Durban) held in the province of Kwa-Zulu Natal (3, 20). The Comrades Marathon has a cut off time of 12 hours with six cut off points along the route. Medals are presented to finishers based on their finishing times. The medals are categorised accordingly; Wally Hayward medal (sub 6 hours), Silver medal (sub 7 hours 30 minutes), Bill Rowan medal (sub 9 hours), Bronze medal (sub 11 hours) and Vic Clapham Copper medal (sub 12 hours).

To qualify for the Comrades Marathon, participants need to complete a standard marathon (42.2 km) in less than five hours in the year leading up to the race. Many participants use the Two Oceans Marathon to qualify for Comrades Marathon (3, 20). Other qualifying races include the Sanlam Marathon, Winelands Marathon and Voet van Afrika Marathon in the Western Cape, the Vaal River City Marathon, Old Mutual Soweto Marathon and the SABS Jacaranda City Challenge in Gauteng, the One City Marathon, NFB Tony Viljoen Masters Marathon and the Legends Ultramarathon in the Eastern Cape and the Bluff Athletic and Sani Stagger Marathon in KwaZulu Natal (20).

The nature of an ultramarathon physically and mentally challenges the human body; hence, recovery is vital (41). Recovery allows for the repair of tissues, restoration of function and retrieval of psychological wellbeing ensuring optimal performance (7, 41). To return to competition (47), quick and effective recovery is imperative, and any factors delaying return to competition need to be identified and addressed.

2.3. RECOVERY IN ENDURANCE RUNNING

Recovery in sport is defined by Kellman and Kallus (19, p96); as an "…*inter-individual and intra-individual multi-level (psychological, physiological, social) process in time for the re-establishment of performance abilities*". Adequate recovery is fundamental to improving performance (41) and an important factor in determining when an athlete may return to competition (42). There is a large variability in recovery time among athletes but the recovery period should be adequate enough that an athlete may return to sport without an increased risk of injury (42).

Inadequate recovery time will prevent necessary adaptation from occurring and possibly result in symptoms of overtraining due to extreme exposure to training loads (41, 42). Because endurance runners require excessive training volumes, it is imperative that the balance between training and recovery is coherent, particularly in those participating in ultramarathons (5, 20, 41).

The next section will include an overview of the physiological factors affecting recovery in endurance running, an overview of recovery modalities used by endurance runners and markers of recovery in endurance running.

2.3.1. PHYSIOLOGICAL FACTORS AFFECTING RECOVERY IN ENDURANCE RUNNING

Ultramarathons are demanding events that deplete energy reserves and can trigger fatigue, EIMD, DOMS, injury and overtraining (49, 50). As discussed, the causes of EIMD and injury are associated with multiple physiological systems (7, 41). Muscle damage can lead to inflammation and oedema (swelling), a reduction in lactate clearance rates and ultimately pain (45, 48). Muscle fatigue, EIMD and DOMS can result in muscle soreness, decreased muscle strength, reduced range of motion and up to 40% to 50% reduced functional capacity immediately after an ultramarathon (34, 45-47). These physical changes may be due to the body having to absorb forces up to three times the body mass of the runner. These forces are exacerbated when running on uneven surfaces or downhill. Eccentric loading of a muscle, which occurs during downhill running, is a primary cause of EIMD and DOMS which may exacerbate muscle damage symptoms (34, 45-48).

The muscles damaged by eccentric loading have a reduction in stored glycogen due to the inflammatory and muscle cells competing for available glucose. The glycogen stores in the muscle can take up to ten days to recover, meaning that any training during this time will further decrease glycogen stores resulting in fatigue. Therefore, it is important that pre-training muscle glycogen levels

are restored (34, 36). Excessive eccentric loading of the muscles also affects the force output of the muscle due to the decrease in muscle pre-activation (34, 45). This is believed to be associated with the change in the contractile properties of the muscle due to the decrease in the pH level from the accumulation of lactic acid. The build-up of lactate and hydrogen ions in the active muscle is related to muscle fatigue. Because of this, it is imperative that all these resources are restored during the recovery process (36, 44).

These physiological factors can result in a longer recovery period and extended time away from training and races (34, 41). The success of recovery is closely associated with returning the athlete to pre-race performance levels in the shortest amount of time with the lowest risk of injuries (41). This includes attaining the body's homeostatic equilibrium, restoring energy resources (blood glucose levels and muscle glycogen stores) and returning the athlete to sport (19, 41).

Recovery should be a carefully planned process to ensure rapid and ideal return to endurance running, while encouraging adaptation to training and preventing overtraining (19, 41, 44, 45). Therefore, the use of recovery modalities is central to enabling endurance runners to return to training and competition sooner. A brief overview of recovery modalities used by endurance runners will now be discussed.

2.3.2. AN OVERVIEW OF RECOVERY MODALITIES USED BY ENDURANCE RUNNERS

Recovery modalities are techniques used to accelerate the recovery process after competition or training (19, 34). Recovery modalities can be described as active or passive. Active recovery includes low intensity aerobic exercise, stretching, massage, cryotherapy, compression garments or water immersion. In contrast, passive recovery includes sedentary rest such as meditation where no physical activity is performed (19, 34, 42). Nutritional recovery is crucial in replenishing glycogen stores in the muscle and blood glucose levels. This can be obtained by consuming carbohydrates, proteins and vitamins (19, 34). Research into the effectiveness of these modalities is limited. Besides active and passive recovery, there is widespread use of nonsteroidal anti-inflammatory drugs (NSAIDs) among endurance runners (5) suggesting that runners experience some sort of pain sensation during recovery. Research shows that 59% of ultramarathon athletes use NSAIDs during training and 61% during recovery from a race and a large percentage (71%) during the event (5). Please refer to Jeffreys (43) for additional information regarding recovery modalities used in elite sport.

2.3.3. MARKERS OF RECOVERY IN ENDURANCE RUNNING

There are a vast range of cardiovascular, physiological, neuromuscular and perceptual markers to monitor recovery in athletes following performance. Biomarkers for endurance runners can include monitoring proteins, metabolites and electrolytes. With continuous advances in technology, biochemical, genetic and haematological testing have been shown to be powerful sources in identifying the balance between training and recovery in endurance runners (52).
However, the majority of these markers are too impractical, costly or invasive to be used by recreational and even some competitive endurance runners. Yet, there is a need to closely assess recovery with markers that can be routinely used at rest causing as little additional fatigue, without disturbing the recovery process and evaluation of competition readiness (44, 52).

Exercise-induced muscle damage is common among endurance runners following competition (35). The damage to the muscles, occurring at a cellular level, is demonstrated by several markers of function. These include; pain, tenderness, inflammation, loss of strength, muscle stiffness and biochemical markers including; creatine kinase, lactate dehydrogenase, and glutamic oxaloacetic transaminase (35, 53). Delayed-onset muscle soreness, peaking after 24 to 48 hours, is one of the main variables when assessing EIMD (53). It is therefore common in research to measure DOMS to assess recovery following an endurance event. To quantify DOMS, a simple numerical measurement tool has been used, the Visual Analogue Scale (VAS). The VAS consists of a 10 cm line whose end points are labelled with “no pain” and “unbearable pain.” As pain is a multidimensional construct including affective, sensory and evaluative aspects, a study (53) compared the VAS, a unidimensional pain instrument, to a multidimensional pain instrument. Results of the study found no significant differences between the pain intensity ratings of the two pain instruments (correlation coefficient of $r = 1.00$). Therefore, to date, the VAS remains the most common perceptual method of assessing DOMS following an ultramarathon event (53).

Nevertheless, as Kellman and Klaus (19) described, recovery is a multilevel process that incorporates physical, psychological and social elements, recovery is not complete when the physiological parameters are met. Additionally, psychosocial factors serve an important indicator for successful recovery (19, 41).

2.4. PSYCHOSOCIAL FACTORS AND RECOVERY IN ENDURANCE RUNNING

Recent work suggests that physical and psychological recovery do not occur simultaneously (41, 54). This suggests that athletes might appear physically ready to return to sporting performance, but not psychologically ready. Even after athletes have recovered physically meeting pre-injury or pre-competition levels in strength, range of motion and flexibility, some athletes still take extended recovery time, are hesitant to return to their sport or never return to their previous level of performance (41, 54-56). With physical factors in recovery all being met, it appears that this delay in return to sport may be associated with psychosocial factors (41, 54).

This section will introduce psychosocial factors with a brief overview then discuss the introduction of psychosocial factors in sport followed by the biopsychosocial model and recovery in sport and the role psychosocial factors play in pain recovery in endurance runners.

2.4.1. PSYCHOSOCIAL FACTORS

Psychosocial factors are defined as a combination of psychological and social constructs affecting an individual (57). Psychological factors refer to individualised thought or behavioural processes which influence an individual's mental state. Social factors are concerned with social processes or social structures surrounding an individual. How an individual understands these social factors may be determined by their psychological state (57). There is an increased recognition of the interaction between psychosocial factors and human biology. Furthermore, psychosocial factors have been shown to play an integral part in disease processes and rehabilitation. In fact, psychology has a biochemical basis emerging into the field currently known as "Health Psychology" (58).

2.4.2. THE INTRODUCTION OF PSYCHOSOCIAL FACTORS IN SPORT

When considering an athletes injury, factors of a biological, psychological and social nature need to be acknowledged. The belief that psychosocial factors play an integral role in injury risk among athletes was first identified in the 1960s (58). Since then it has been accepted that psychosocial factors, which become major stresses in an athlete's life, can negatively impact an athlete's performance by increasing the prevalence and duration of sports-related injuries. Fear, anxiety, stress are all traits that have been shown to delay recovery from an injury (14, 58).

Recently, Nicolas (14) explored the relationship between the perception of stress and anxiety in runners following an ultramarathon event. More specifically, he wanted to investigate the association between perceived stress and recovery in the athlete's physical, emotional and social life. He believed

that the ability to monitor an athlete's perceived stress prior to a race and recovery following a race may aid in preventing the development of the overtraining syndrome. Thus, 14 male participants competing in a 24-hour ultramarathon were recruited for a longitudinal study. The athletes' psychological states were measured at 1, 3, 6, 9, 12, 15, 21 and 30 days following the race (14).

High levels of perceived stress before and during the ultramarathon race were recorded among participants, with those scoring higher in stress and anxiety levels pre- and post-race also having a poorer perceived recovery following the race (14). Additionally, a time frame of two weeks was required for both stress and performance to return to pre-race levels. Sport-related stress levels took at least six days to decrease, while general stress reduced significantly after 15 days. Furthermore, total wellbeing (as measured through self-efficacy, general wellbeing, sleep, social relaxation) took at least 15 days to return to baseline (14, 23).

This study recognised the key role the psychosocial factors; stress and anxiety, play during recovery. In addition, Nicolas (14) suggested a period of at least 10 days for psychosocial factors to recover. As stress and anxiety were only measured once prior to the ultramarathon, these results might reflect a false representation of the runners' general psychological state. This study acknowledged that recovery is an individualised process with each athlete's recovery process being influenced by a complex network of biological, physical, psychological and social factors (14).

With evidence that recovery from a sports-related injury is a complex process involving biological, psychological and social factors (14, 34), it would be interesting to determine if these factors impacted recovery following competition, such as an ultramarathon race. To better understand the psychosocial factors involved in sporting recovery, Wiese-Bjornstal (17) described elements associated with recovery from sport. These elements were adapted from the biopsychosocial model. This model will be discussed in greater detail in Section 2.4.3.

In 2010, Wiese-Bjornstal (17), recognised that recovery in sport was a multilevel process. He determined that athletes processed the pain they felt, after heavy training, competition or injury, differently. Recovery was therefore subdivided into three interrelated elements namely; cognitive, affective and behaviour. Cognition involves the assessment the athlete makes of their own pain for example if an athlete interprets pain as severe, and pain is regarded as an indication of recovery, it is logical for an athlete to have negative cognitions about the pain experience. Affective factors can be

described as the emotional experience of the athlete, including emotions such as fear, depression, anxiety, stress and low self-efficacy (17). Negative cognitions of pain experienced during recovery which arise when the athlete experiences symptoms of EIMD or DOMS may then give rise to negative emotions including fear.

Finally, based on the cognitions and affective factors, behaviours arise such as avoiding the actions and activities that will contribute or increase to their symptoms. Arguably, the most extreme manifestation of these factors, which leads to a delay in recovery or loss of training time and decreased performance, occurs during competition (58). Therefore, the runner's personality traits, currents life events, social situation, response to stress and available coping resources are examples of factors that may predispose the runner to a delay in return to performance following an ultramarathon (58, 59). To achieve successful recovery from competition (after an ultramarathon race), these three factors need to be understood (55, 59). The biopsychosocial model will be used to better understand the role psychosocial factors play in recovery from an ultramarathon race.

2.4.3. THE BIOPSYCHOSOCIAL MODEL AND RECOVERY IN SPORT

The biopsychosocial model, defined as the systemic interaction between biological (physical), psychological (behaviour) and social (cultural) factors, was first applied to the sporting population in 2001 (10), when researchers argued that returning an athlete to sport is a complex process involving many factors (11). The psychological factors were found to have a linking relationship with biological and social factors which in turn affect an athlete's performance (12). It was suggested that exploring the different aspects of the model would indicate how soon athletes can return to sport after a competition (recovery) or after an injury (10-12). If, for example, the athlete is anxious about returning to sport, has poor self-belief or confidence, receives ineffective social support from team-mates or mentors or has a fear of pain or re-injury, this will hinder their return to training (1, 10, 12). It can thus be argued that psychological and social factors play an equally vital role in return to sport and pain recovery (10-12).

However, previous research has only been applied the biopsychosocial model in an athletic population that is returning to sport following an injury (1, 9-12). This model has yet to be implemented in a population of athletes recovering from competition and wanting to return to pre-race level of performance and training. This gap in knowledge has led to an interest in the effects of psychosocial factors on return to performance and recovery.

2.4.4. THE ROLE PSYCHOSOCIAL FACTORS PLAY IN RECOVERY IN ENDURANCE RUNNING

Research into the psychosocial factors affecting an athlete's return to sport suggests that athletes commonly experience difficulties in one or more areas of autonomy (self-authorised behaviour), competency (self-efficacy) and relatedness or sense of belonging in the social world (1, 9, 10). Issues of self-confidence, expectations of the outcome and personal motivation found in social-cognitive theory (35) hold relevance in understanding the transition from training to competition to recovery and back to training. Social-cognitive theory highlights how personal beliefs (self-efficacy), outcome expectations (regarding performance or recovery) and perceived environmental impairments (fear, anxiety and stress) or facilitators (support) can affect a person's wellbeing and motivation (35). Depending on where one is situated on the motivation and self-efficacy continuum will determine one's willingness to recover and return to training (35, 60).

Once an endurance runner has completed an event, there is a high possibility that muscle soreness (pain) will result either from EIMD or DOMS (28, 61). This pain sensation is understood to arise from nociception due to tissue micro trauma and inflammation. Although athletes are perceived as healthy, it has been shown that even healthy participants can experience catastrophic thoughts regarding the pain experienced and focus their attention on the most undesirable consequences of their actions. Furthermore, athletes have been shown to develop a fear of the pain experienced resulting in behaviour to avoid any movements that may evoke the pain (59). Research shows that fear of pain and catastrophic thoughts about pain are psychosocial factors that may have a detrimental effect on recovery (59). However, the association of fear and catastrophizing and return to sport has been primarily researched in athletes following ACL reconstruction (29-31, 33).

Results of a systematic review (62) on return to sport following ACL reconstruction showed that fear was the primary factor for not returning to sport for 19% of the population, despite high rates of successful outcome of knee function. Additionally, a study by Kvist *et al*. (63), found that 43% of participants following ACL reconstruction did not return to sport at the same level as prior to injury. The participants not returning to their pre-injury level of performance scored high in fear of pain and re-injury (63). The association between fear of pain and function during the recovery period in athletes

returning to sport following ACL reconstruction was further investigated by Chmielewski *et al*. (33). Results from the study showed pain as a primary indicator of function across recovery timeframes. As fear of pain decreased, knee function increased and ultimately led to return to competition.

In a study investigating the emotional responses to injury of 30 male athletes over four recovery stages, it was found that 13% of the athletes experienced fear during the rehabilitation phase, with an increase to 40% reporting fear upon returning to sport (64). It is suggested that these fears can remain for years, even after return to sport (65) and be heightened among those with a history of injury (66, 67). Athletes who interpret participation in sport as threatening might try to avoid returning to peak performance as a way of managing their fear (68). Thus, the fear of pain, rather than pain itself, might prevent participation or return to sporting performance (66, 67, 69).

The results from the studies above all support the potential effect of the fear avoidance model (FAM) on athletes following ACL reconstruction and perhaps these psychosocial factors may also be applicable to recovery in endurance runners following an ultramarathon. The FAM was developed to better describe how fear may impact an individual's recovery (7). The model describes the relationship between pain, catastrophizing, fear, avoidance and disability in individuals (7). The FAM will be discussed in greater detail in Section 2.6.1. The next section will discuss the role that pain plays in endurance running.

2.5. THE ROLE OF PAIN IN ENDURANCE RUNNING

Pain is regarded as an unavoidable part of sports participation (28, 59). It can be healthy when the cause is understood (for example, competition, overtraining, DOMS, injury) and the appropriate behavioural response takes place, for example, confrontation, recovery, taper activity, seek medical help (28, 59, 70). However, pain becomes unhelpful when its cause no longer exists, or the athlete adopts an endurance behavioural response which contributes to the development of chronicity (4). To better understand the development of chronicity, the transition from acute to chronic pain will be discussed, followed by a description of the two responses to pain using the Avoidance-Endurance Model and ending this section with the role chronic pain plays in endurance running.

2.5.1. THE DEVELOPMENT OF ACUTE TO CHRONIC PAIN

The mechanisms of chronic pain development are still being understood (2). To appreciate chronic pain, the mechanisms of acute pain must first be addressed. Acute pain is related to actual or potential tissue damage involving an acute nociceptive response (70). Acute pain resolves once the wound or injury is healed.

An increase in pain felt at the injury site, known as primary hyperalgesia, is believed to be mediated by the PNS. However, an increase in pain external to the injury site is mediated by hypersensitivity of the CNS and is known as secondary hyperalgesia (70, 71). The inflammatory stage of an injury is associated with both primary and secondary hyperalgesia that is sustained by nociceptive activation and an acute inflammatory process (70-72). Interestingly, research shows that 20-30% of acute pain injuries continue along the path to chronic pain (71).

Chronic pain is defined as persistent, unhelpful pain lasting more than three months; outlasting the typical healing time (2, 4). Multiple changes have been recorded in the nervous system of people suffering from chronic pain. Some of these changes include structural and functional changes in both the spinal cord and the cortex resulting in amplification of nociception. This pathophysiological state can result in widespread hyperalgesia, allodynia, lowered firing thresholds of peripheral receptors and lowered thresholds in the CNS, known as central sensitisation (4, 70-72). Areas in the brain involved in generating the sensation of pain increase in activity, while other areas can become activated (70-72). Magnetic Resonance Imaging (MRI) studies evaluating chronic pain also show increased activity in the brain not associated with acute pain, such as the dorsolateral prefrontal cortex, parietal cortex and brain stem (4). These neuroplastic changes in the CNS and PNS can explain the transition of acute to chronic pain (71). In addition to CNS sensitisation, chronic pain has been found to prevent the descending pain inhibitory pathways activated during exercise (4, 71).

In normal circumstances, exercise activates the downward inhibitory pathways that release an opioid-mediated analgesic effect. This is responsible for decreasing transmission of nociception during exercise by the release of β-endorphins from the pituitary gland. This results in activation of the μ-opioid receptors peripherally and centrally (4). Thus, exercise results in an increased production of endogenous opioids from the nuclei of the brainstem. However, blockage of these receptors at a central level, as occurs in chronic pain, results in a reduction of analgesia during exercise or training (71, 73) and an increased awareness of pain (71, 72). The combination of lowered pain thresholds, increased responsiveness to nociception in the PNS and CNS and loss of descending inhibition of people with chronic pain, has multiple effects on the functioning of the individual (71-73). Two polar

coping reactions to an individual's pain experience have been proposed. These reactions will now be discussed using the Avoidance-Endurance Model (74).

2.5.2. THE AVOIDANCE-ENDURANCE MODEL

The Avoidance-Endurance Model (74) is used to describe these two possible responses to pain, namely avoidance and confrontation. Both these patterns can increase the risk of failing to recover from an episode of acute pain and lead to the development of chronic pain or in the case of an athlete, impede return to optimal performance (74).

The first response, the fear avoidance response pattern, is based on cognitions that pain is an indicator of danger or tissue damage and evokes avoidance behaviour of activities that could elicit pain, feelings of helplessness and depression (74). This decrease in physical activity may increase the risk of chronic pain development (7, 75). Endurance runners experiencing EIMD or DOMS following an event might interpret muscle soreness (pain) as an indicator of danger, thus changing their interpretation of pain and resulting in a change of behaviour (74, 75).

Carson and Polman (75) identified two avoidance coping strategies in these athletes during recovery, namely behavioural avoidance coping and cognitive avoidance coping. Behavioural avoidance coping is described as the conscious decision of an athlete to remove oneself from a perceived threatening environment, while cognitive avoidance coping is defined as the response of the athlete to either deny or mentally distract oneself from the seriousness of an injury and its consequences related to returning to sport (75, 76).

The second response in the Avoidance-Endurance Model is the endurance-response pattern, which is primarily associated with pain-persistent behaviour involving pushing through pain to complete a set goal (68, 76, 77). This distractive behaviour also increases the risk of developing chronic pain by the overloading of tissue structures. While studies suggest that the fear avoidance response can increase stress levels, the endurance response has a short-term stress-decreasing effect although in the long-term is maladaptive and possibly contributes to overtraining (59, 78, 79).

The Avoidance-Endurance Model was explored in a study (79) of 30 healthy adults with lower back pain (LBP). It was hypothesised that maladaptive fear avoidance response and endurance-response

related to pain would have an impact on pain-induced stress levels. Furthermore, fear avoidance response would be positively associated with stress, while endurance response would be negatively associated with stress. Participants were asked their typical response to pain prior to being exposed to an experimental pain stimulus (cold pressor test).
Stress levels were recorded by comparing the change in salivary cortisol levels (stress hormone) before and after the stimulus. The cortisol levels served to measure physiological stress. Affective, cognitive and behavioural responses were assessed using the Avoidance-Endurance Questionnaire. A positive correlation was found with those scoring high in fear avoidance response having increased stress levels (79).

It could be argued that the results of the above study were a consequence of the participants being made aware of the imminent pain stimulus prior to entering the laboratory. However, those in the endurance response group had lower baseline cortisol levels, supporting the belief that the anticipation of pain in people with this coping strategy results in less stress being experienced. These results suggest that diversion of attention from the anticipated pain stimulus might enable one to successfully manage a painful situation (79). However, these results should be interpreted with caution because, due to a small sample size, there is a lack of data measuring the anticipation of stress.

The findings of this study are similar to findings of the Nicolas study (14), discussed in Section 2.4.2., on pre-race stress levels and recovery following a 24-hour ultramarathon race. If the 24-hour ultramarathon race in the Nicolas study (14) could be perceived as the “pain stimulus” and the pre-race stress and anxiety levels as the “baseline cortisol levels,” it is then suggestive that athletes scoring higher in stress and anxiety levels prior to an ultramarathon, and who (knowingly or unknowingly) possess fear avoidance beliefs, might not have the coping strategies to deal with their pain following the race. This could lead to heightened levels of fear resulting in increased levels of pain experienced. This reduction in pain tolerance in an endurance runner would delay recovery and return to pre-race performance levels (5, 14, 24).

Furthermore, higher stress levels and decreased beliefs in one’s own abilities or lower self-efficacy have been found to affect performance and perception of injury risk (fear) in 196 collegiate athletes suffering from a range of sport related injuries (55). This is the first study of its kind to investigate the effect of psychosocial factors on athletes over a wide range of sports, demonstrating a good generalisation. Although this study established a relationship between fear (of reinjury) and its effect on returning to pre-injury performance levels, it must be noted that the study was carried out under

laboratory conditions that do not produce the same extent of stress and anxiety as competitive sports (55).

In sport, however, fear must not always be regarded as a negative emotion as it allows an athlete to evaluate potential danger. Yet, if fear becomes irrational and inappropriate, affecting the ability of the athlete to return to sport, then it may become unhealthy (80). Both avoidance and confrontational responses to pain may be appropriate at certain points in sporting recovery, however, both may progress into dysfunctional behaviour becoming negatively associated with an athlete's engagement in physical activity (81).

2.5.3. THE EFFECT OF CHRONIC PAIN ON ENDURANCE RUNNERS

As the pain experience is individualised, the interpretation is unique (2). Increased pain demands attention and so can interrupt daily activities (72). Unwarranted attention to pain has been associated with increased pain-related fear. Acute injury results in pain and, to prevent further injury and encourage the necessary care, a certain amount of pain-related fear occurs. This fear is adaptive with withdrawal from activity to allow for healing, the next natural progression. However, when the pain experienced can no longer be explained by tissue damage, fear leading to avoidance of activities becomes dysfunctional and unhelpful (2, 7, 63).

When an individual's life is continuously interrupted by pain they may disengage from their daily routine activities (2, 7). For an endurance runner this would mean avoiding return to training and competition. Such detachment from routine meaningful activity can give rise to catastrophizing thoughts. Pain catastrophizers have difficulty in casting their attention away from painful cues and develop pain in anticipation of an activity as they ruminate on and magnify their symptoms. This can lead to avoidance of an activity to evade pain (72). Additionally, catastrophic thoughts can further encourage this avoidance behaviour and increase descending facilitation, prolonging the central sensitisation process (4).

Although the development of chronic pain among endurance runners is unlikely, unhelpful cognitive and affective factors which change behaviour might affect their ability to return to pre-race performance levels. Endurance runners showing signs of avoidant behaviour and pain-related fear, might not go on to develop chronic pain, but could fall into the Avoidance-Endurance Model. Although

this might not develop into disability among these runners, it might affect recovery and return to performance following a strenuous ultramarathon race (7, 70, 82).

Psychosocial factors have been identified as playing an important role in an individual's pain experience (83). Pain is an accepted consequence of sporting participation; however, it can emerge as a barrier to recovery when it becomes a cause of fear, avoidance behaviour, pain catastrophizing and anxiety. Failing to appropriately interpret pain may result in delayed recovery and return to sporting performance after competition (64). The next section will discuss the role of these psychosocial factors namely; fear avoidance, pain catastrophizing and self-efficacy, play in endurance running.

2.6. FEAR AVOIDANCE, PAIN CATASTROPHIZING AND SELF-EFFICACY AND ENDURANCE RUNNERS

Building upon the knowledge of pain in endurance runners, it can be said that pain has intrinsic threatening components with the threat value varying across different contexts and individuals. Protective behaviour, because of pain-related fear, might be beneficial in the short term, but can result in fear avoidance beliefs and pain catastrophizing in the long term (7, 82). The Fear Avoidance Model (FAM), attempts to explain the development of disability, stress and disuse as a result of avoidance beliefs motivated by fear. The FAM attempts to explain this transition by exploring the interrelating psychosocial factors of fear avoidance beliefs, catastrophic thinking and self-efficacy beliefs (7, 70, 82).

2.6.1. THE FEAR AVOIDANCE MODEL

Initially, the FAM served as a cognitive-behavioural platform to explain the development of chronic pain in acute LBP sufferers. This biopsychosocial model introduces psychological and social factors that contribute to the development of chronic pain. It was used to explain why chronic LBP (CLBP), and its related disability, develops in only a small number of individuals suffering acute LBP (72, 84).

The social-cognitive theory (35) is used to explain the interpretation of pain by individuals and how this can result in one of two behavioural outcomes. If acute pain is perceived as non-threatening, individuals will continue in their activities and the pain will not interfere in their participation (confrontation). This is evident in sport where athletes will continue to participate in training or complete a race, despite being in pain. However, if acute pain is perceived as threatening, as seen in the fear avoidance response pattern, (correctly so in the case of a severe injury, or incorrectly so in

the case of a mild injury), it can result in catastrophic thoughts. These catastrophic interpretations can lead to cognitive avoidance behaviours relating to fear.
This avoidance behaviour can be amplified by further unhelpful cognitive beliefs such as decreased self confidence in one's own abilities, namely low self-efficacy (56, 78). These fears and behaviours might be plausible and adaptive in the acute pain phase during tissue healing or recovering from EIMD. However, if these behaviours continue and become maladaptive, they can lead to long-standing pain beyond normal tissue-healing time, disability and disuse (84).

Fear is described as an emotional response to a situation or perceived threat (cognition) (7, 79). Fear can serve as a protective mechanism to adjust a person's behaviour. The ability to escape this threat reduces one's fear for a short period but has been reported to increase fear in the long term. In contrast, anxiety views the threat as undefinable and without clear focus. It encourages preventative behaviour, as well as avoidance. Thus, fear avoidance behaviour is believed to decrease anxiety and fear in the short term but can have detrimental effects in the long term (7, 71, 79-81, 84, 85). In patients with acute LBP, pain-related fear was linked to decreased participation in activities, increased sick leave and work loss, and poor performance in daily tasks (79). This avoidance behaviour in the acute phase of recovery from injury gives rise to the belief that pain-related fear can contribute to the development of chronic pain and disability. (71, 79-81, 86).

Avoidance behaviour leads those with fear avoidance beliefs to evade activities or perceived threats to prevent an increase in the existing pain (71, 80, 81, 85). Supporting evidence confirms that, in the population with pain-related fear, there are slower walking speeds, weakened muscles and reduced functional performance. Furthermore, poor performance is closely related to fear avoidance beliefs. This is detected in individuals with CLBP who will avoid a perceived threatening situation or perform it at a suboptimal level using safety behaviours (62). Finally, fear avoidance can affect the experience of pain and increase suffering. This can progress into a continuation of pain behaviours. Avoidance behaviour then develops in anticipation of pain, resulting in further anxiety, fear, pain and disability (62).

This avoidance behaviour in endurance runners recovering from an ultramarathon would be unhelpful. The normal pain felt after an ultramarathon, due to the physical demands of the race, may be misinterpreted because of pre-existing fear avoidance beliefs. This could result in delayed recovery or even return to suboptimal performance to avoid any perceived threatening activity (training) that could cause (further) pain.

Although the FAM was designed to describe the transition from acute to chronic pain in the general population, it is not appropriate to evaluate fear avoidance behaviour in the sporting population as the model is not specific enough to athletes (7, 79). Thus, interest in sports participation and return to sport led to the development of the Athlete Fear Avoidance Model (7).

2.6.2. THE ATHLETE FEAR AVOIDANCE MODEL AND ENDURANCE RUNNERS

Due to the nature of sport, athletes experience pain and injury regularly (7). It is therefore understandable that avoidance behaviour in sport is not uncommon**.** Pain-related fear was first identified as contributing to athlete recovery when it was noted that the duration of rehabilitation was inconsistent with the athlete's initial injury (7, 55). This then led to the development of the Athlete Fear Avoidance Model which explains the transition where behaviour and experience develop into an exaggerated perception of pain (72, 84). This heightened perception of pain can result in chronic pain and disability in athletes (7).

A vast amount of research has explored the FAM for the general population. Questionnaires developed in this area have shown good reliability and validity in the general population, however there is a gap in research assessing fear avoidance in the sporting population. The questionnaires available are not specific enough for the athletic population who understandably tolerate pain differently (7, 79). Pain among athletes can be interpreted as an "ally" suggesting that the athlete is working hard and reaching their training goals. Therefore, in sport, pain is an accepted part of their training and performance, and athletes learn to not focus on pain but rather on the sport (79).

Endurance runners train at moderate to high intensities of physical activity over a long distance. Thus, pain is a well-accepted component of ultramarathons (23). Hoffman (28) explored pain perception of 21 ultramarathon runners after competing in the 2005 Western States 100-mile (161 km) marathon. The study examined whether the perception of pain is affected or altered when competing in this marathon.

Hoffman (28) hypothesised that only the fastest or most well-trained athletes would experience exercise-induced hypoalgesia or a reduction in pain intensity. This hypothesis was based on the notion that physical activity levels at a sufficient intensity reduce pain experienced, an opioid analgesic effect (87). This is commonly known as the "runner's high" (11). "Runner's high" is associated with

conditioned pain modulation. This conditioning in runners reduces excitability in the CNS, increases levels of endogenous opioids and serotonin and increases brainstem inhibition (88).
This allows endurance runners, exercising at a certain intensity, to tolerate pain better and continue participating in an ultramarathon (86).

Hoffman (28) used pressure pain threshold tests to the finger, before and after the race, with participants rating their overall pain and pain relating to the pain threshold test. This data was used to assess the functioning of their conditioned pain modulation. Results showed that the runners with the quickest finishing times rated their pain on the pressure pain threshold test lower after the race than before the race, suggesting a change in pain threshold. Remarkably, only the faster runners experienced this exercise-induced hypoalgesia, or "runners high" (28).

When examining the demographics, the faster runners were younger in age and had undergone large amounts of long distance training prior to the race. The excessive amounts of training could have modulated the runner's ability to deal with pain. The more pain the runner experienced in training, and could successfully recover from, the lower the threat value of pain (fear). This decrease in the threat value of pain may have better equipped the runners to cope with the pain felt and dissociate from the pain experienced to perform better (run faster). In addition, marathon runners who are regularly exposed to injury and pain during training may develop higher levels of self-efficacy in the pursuit of their goal, while tolerating the pain and discomfort. Higher self-efficacy beliefs may permit runners to perform better (run faster) in an ultramarathon race due to previous experience in training of achieving personal running goals (11). The small sample size limited Hoffman's (28) ability to detect small changes of pain perception among participants, and the metrics were geared to recognise large differences between the subjects' results. Despite these limitations, the data supports the view that physical activity at a moderate to high intensity results in physiological adaptations in the CNS which may prevent development of fear avoidance beliefs (28).

Sport participation involves continuous strain on the body, which can result in pain. Athletes will continue to compete in training and competition despite pain (endurance response) because of social expectations, personal expectations or poor coping strategies (59). Research has identified how external factors (media, coaches, peers) can influence the attitude an athlete has towards pain, the role psychosocial determinants play in the behavioural response to pain in the sporting population is still being understood (59). The lack of research into the role of the FAM in the athletic population

encouraged Dover (7) to develop and validate an Athlete Fear Avoidance Questionnaire specifically for the athletic population.

The Athlete Fear Avoidance Questionnaire addresses all key areas in fear avoidance; sport injuries, psychology and athletic experience. The goal of the questionnaire is to allow early identification of fear avoidance traits and assist in the development of an effective recovery programme and earlier return to performance (7, 81). Along with fear avoidance beliefs, pain catastrophizing may be an important predictor of pain during recovery and in return to performance (29). Understanding the components of catastrophizing that influence pain may provide information useful for returning an athlete to peak performance as soon as possible. This can be done by identifying areas to target through intervention (16, 29).

2.6.3. PAIN CATASTROPHIZING AND ENDURANCE RUNNERS

The term "pain catastrophizing" was coined in 1962 by Albert Ellis as the process where individuals focus on the most negative consequences of actions (84). Catastrophizing thoughts heighten pain-related fear and thus attention to the painful stimulus increases. The predisposition of an individual to catastrophize pain can result in extended and even inadequate recovery following an injury (79). Pain catastrophizing has been correlated with the development of chronic pain and movement dysfunction (79, 81). Furthermore, pain catastrophizing exaggerates the perceived threat value of pain and one's inability to cope with pain by intensifying the pain experience. In addition to the relationship between catastrophizing and intensified pain, catastrophizing can be related to disability, specifically in CLBP (81).

Initially, pain catastrophizing was identified using non-standardised interviews. However, the interpretation of these interviews was subjective to the assessor and served as a weak measuring tool (89). Additional research focused on self-reporting tools to assess catastrophizing such as The Coping Strategies Questionnaire (90). This questionnaire was then further developed by Sullivan *et al* (91) into the Pain Catastrophizing Scale.

The Pain Catastrophizing Scale was the first of its kind to assess other factors of catastrophizing, namely helplessness, rumination and magnification. This scale has successfully been used across healthy, pain-free individuals (92), chronic-pain individuals (86), across a range of ages (93), in diverse cultures (94), and the sporting population (95).

The Pain Catastrophizing Scale was first introduced into the sports community by Sullivan (59), who wanted to examine the reliability of the scale among athletes. Volunteers included 237 healthy students (19.4 years ±3.6) 97 of whom (41 males, 56 females) were engaging in competitive sport five times a week. The 140 sedentary students and the sports group completed a sports questionnaire and the Pain Catastrophizing Scale. Results showed that in both the sedentary and sporting group's pain catastrophizing consists of three factors: magnification, rumination and helplessness. In other words, participants scoring high on the Pain Catastrophizing Scale tended to amplify the threat value of pain (magnification), excessively focus on pain itself (rumination) and view themselves as incapable of controlling pain intensity (helplessness). The results suggest that the scale is internally consistent across sedentary and the sporting population. Furthermore, the Pain Catastrophizing Scale is a useful tool in athletes who experience pain due to sporting participation (59).

However, when comparing the reliability of magnification across the two groups the reliability coefficients were low. This low internal reliability of the magnification scale between sedentary and the sporting population is further supported in previous work (91). These results may be owing to the small number of items representing magnification and low degree of repetition. Furthermore, those who participate in one form of magnification (remembering other painful experiences), may not participate in other forms, for instance expecting a poor outcome (59, 91). This might affect the reliability value for magnification in the scale (91).

With the understanding that each athlete manages pain differently and that the way athletes manage pain can influence recovery and return to performance, Sullivan *et al* (59) examined the value of the Pain Catastrophizing Scale in pain prediction in the athletic population. Fifty- four sedentary (27 male) and 54 athletes (26 male) attending university participated in the study. It was hypothesised that pain catastrophizing would be a valuable predictor of pain in the sporting population, like the general population, and that pain intensity recorded by athletes could be influenced by pain catastrophizing. Pain was induced by a cold pressor and pain catastrophizing was assessed prior using the Pain Catastrophizing Scale. Participants then submerged their arms in ice water for 1 minute before rating their pain on a scale from 0 to 10 (59).

The results showed that athletes reported less pain than their sedentary counterparts. Additionally, the Pain Catastrophizing Scale was found to be a valuable predictor of pain intensity in the athletic

population. In other words, those athletes scoring high on the Pain Catastrophizing Scale also scored high on the pain scale following the cold presser test.
However, catastrophizing alone could not explain the difference in pain intensity ratings between the athletic and sedentary population. Hence, this study suggested that catastrophizing plays a key role in pain prediction among the athletic population but did not identify the reason for the lack of difference in the perception of pain between sedentary and athletic populations (59, 97, 98).

Further analyses show that the magnification component of the Pain Catastrophizing Scale did not correlate with pain ratings in this study comparing athletes and non-athletes (59). This might in part be related to the nature of the pain produced. The procedure of submerging an athlete's arm in ice water to elicit a pain response is an intervention often used in recovery and therefore might not be experienced as threatening by the athletic population. Fear and stress play a role in pain magnification among athletes. Therefore, the experimentally controlled condition in which pain was induced in this study might not evoke the same fear and stress as an athlete experiences in training or competition and consequently, might not induce the same behavioural response. Future studies should use a more threatening pain stimulus which is not associated with treatment. This might better assess the psychosocial factors or possible pre-existing fear avoidance beliefs associated with the tolerance of pain in athletes (11,12).

Even though this study exposed catastrophizing as a factor related to pain experience, it is not the only relevant psychosocial factor. In addition to fear avoidance beliefs and pain catastrophizing, self-efficacy, goal planning, threat value and hopefulness may also be vital predictors of pain among endurance runners and have a role in recovery (95, 96).

2.6.4. SELF-EFFICACY BELIEFS AND ENDURANCE RUNNERS

Self-efficacy was first described by Bandura (66) as the self-belief one has in one's own abilities to complete a task. Therefore, it does not assess one's skill but self-confidence in one's own skill (99). Bandura proposed that self-efficacy beliefs will impact not only the activity pursued but also the effort put into completing the activity (66). He continues to describe the four main sources related to self-efficacy: what one believes one can accomplish based on past performance; how one sees oneself imitating others; the social persuasion and reinforcement one receives from others; and the physical function one views oneself to have (95).

It has been accepted that high self-efficacy among athletes is imperative to successful rehabilitation following an injury (64, 78, 79). Thomee and colleagues (100), who described self-efficacy as the self-assessment of a person's capability to carry out a task, found a relationship between low optimism, negative mood and increased pain during recovery following an ACL reconstruction. They proposed that the athlete's sense of control of the recovery process and how the athlete felt in relation to the knee's ability to perform were the primary predictors of self-efficacy (100).

One hundred and sixteen athletes (mean age 31.2 years), of whom 45 had ACL deficiencies (49% female) and 71 had ACL reconstruction (34% female), were included in the study. Participants were recruited by an experienced orthopaedic surgeon within one month of injury or assigned surgery. All participants completed a Knee Self-Efficacy Scale (K-SES), which had been previously validated (56), at one month visit and 12 months post injury or reconstruction (100). The most important determinant of self-efficacy, in the above-mentioned athletes, was how they felt about their knee function following recovery, rather than the objective physical findings. Athletes scoring higher on the K-SES prior to rehabilitation returned to sport and pre-injury performance sooner.

These results suggest that a strong correlation exists between high ratings of self-efficacy before reconstruction and a positive recovery outcome. However, it must not be ignored that the participants in the study were young athletes who were physically active prior to the ACL reconstruction. This could have resulted in favourable factors influencing a higher score of self-efficacy. Although an ACL injury has great personal impact for an athlete, these findings can in no way be generalised across all recoveries that follow sport injuries. Injury-related bias can be reduced in future studies by investigating recovery in other injuries that have the same prevalence and severity in an athlete's sporting career, for instance grade three ankle sprain. Yet, within the athletic population this study amplified the key role self-efficacy plays in a positive recovery outcome (100).

The finding that higher self-efficacy scores result in improved recovery following ACL reconstruction has also been supported in further studies. Pre-operative self-efficacy scores predicted athletes' outcomes in terms of return to play, symptoms of the knee, and muscle function (16, 29, 56). It can be recognised that high levels of self-efficacy preoperatively relate to a better outcome following an ACL injury (16, 29). These studies shed light on the fact that if those with low self-efficacy could be identified early in training, recovery might be optimised to allow them to return to sport sooner (16, 29, 56).

As previously discussed, endurance runners experience not only pain but also strong emotions of fear, depression and fatigue before, during and after an ultramarathon competition. Investigation into these aftermath emotions suggests that intense, prolonged exercise, such as an ultramarathon, can result in increased emotional disturbance. However, there are endurance runners that can tolerate and cope well with these emotions as a result of high self-efficacy beliefs and thus improve their running performance (5, 6, 9, 61).

The role of self-efficacy beliefs and catastrophizing as pain mediators was investigated by Johnson (11) in 26 marathon runners. The effects of self-efficacy and coping strategies were explored with regard to pain tolerance using the Cognitive Coping Strategies Inventory, and the Visual Analogue Scale. The study revealed marathon runners had a 40% increase in pain tolerance and pain threshold compared to non-marathon runners. Pain tolerance by marathon runners seems to be improved by an increased level of pain-specific self-efficacy but it is not influenced by general cognitive coping strategies (55, 56, 101). This evidence further supports the argument that psychosocial factors play a role in pain tolerance among marathon runners, with higher levels of self-efficacy permitting marathon runners to tolerate pain better during and after a race (recovery) (56, 101).

Since research supports the early identification of low self-efficacy in injured athletes returning to sport, the obvious next step is to understand the relationship self-efficacy plays in competition and returning to performance. Self-confidence in an athlete's own skills has been recognised as crucial for successful sporting performance (99, 100), therefore, an instrument to determine where an athlete lies on the self-efficacy spectrum would be beneficial.

As the construct of self-efficacy is specific to the situation presented, a wide variety of questionnaires have been developed to assess self-efficacy in different areas (21, 102). The Pain Self-Efficacy Questionnaire (21), the Physical Self-Efficacy Questionnaire (103) and K-SES (56), to name a few, have all been validated in their areas. Given the numerous situations where self-efficacy might be a concern, it is unrealistic to develop countless scales and, therefore, the development of scales for general areas is desirable (23).

However, a higher correlation has been found between self-efficacy and pain when using a task-specific questionnaire than when using a general questionnaire. Furthermore, the use of self-report questionnaires has been shown to be more valid when compared to objective measures (99).

For example, the measure of tennis players' self-belief that they can win a competition is more valuable than the number of successful serves when measuring self-efficacy in performance (99).

Therefore, with the understanding of the imperative role fear avoidance beliefs, pain catastrophizing and self-efficacy beliefs plays in sports performance and pain recovery, it is important that these factors are explored and if necessary addressed during training, before they hinder or slow return to performance (80, 104). Therefore, the timing of assessment of fear avoidance beliefs, pain catastrophizing and self-efficacy is crucial.

Based on this research measuring fear avoidance beliefs, pain catastrophizing and self-efficacy in athletes prior to competition, such as an ultramarathon, it would be beneficial to identify possible factors that could result in prolonged recovery from pain and delayed return to performance. Detecting these psychosocial factors during training could reduce time away from sport following a competition and reduce recovery time (7, 80).

2.7. SUMMARY OF LITERATURE REVIEW

Running is a popular sport worldwide with participation in marathons increasing annually (9, 20). There are many documented benefits of running including; metabolic, cardiovascular, musculoskeletal and psychological (9, 20, 35, 36). However, with the volume of training and intensity required to participate in endurance running, particularly an ultramarathon, there are many negative potential effects (40-45). The primary potential negative consequences include; fatigue, EIMD, DOMS, overtraining and injuries (40-47). Although these negative effects are a normal physiological process of recovery following a marathon, they can result in delayed return to performance and training (40, 41).

Recovery is a fundamental part of endurance running. It allows for physical adaptations to improve performance (41) and is an important indicator of when a runner may return to training and racing (42). Recovery has both physical and psychosocial elements and both elements need to be addressed for recovery to be successful (19). Despite a great deal of research around physical recovery, there is a lack of research into the psychosocial factors affecting recovery (41, 54). Literature has recognised the role stress, fear avoidance beliefs, pain catastrophizing and self-efficacy beliefs play in recovery (14, 16, 29, 58, 105). These psychosocial factors have been found to delay return to sport, prevent return to pre-race performance and increase levels of stress and anxiety in athletes (14, 58).

Yet, with previous research recognising the role psychosocial factors play following an injury, no studies have investigated the role psychosocial factors play in recovery following competition (14, 16, 58), such as an ultramarathon race.

Literature identifies fear avoidance beliefs, pain catastrophizing and self-efficacy beliefs as imperative psychosocial factors in returning an athlete to sport post injury. However, these psychosocial may not solely be a consequence of an injury but may be a pre-existing factor in athletes (7, 80). If these psychosocial factors play a role in delay of recovery following an injury, it is possible that they may play a role in return to competition following a race. Therefore, the aim of this study is to determine the relationship between fear avoidance beliefs, pain catastrophizing and self-efficacy beliefs and recovery following an ultramarathon race. Potentially early recognition of these possible pre-existing psychosocial factors in marathon runners may prevent delay in return to training and earlier return to pre-race performance levels (14, 17).

CHAPTER 3: DO PSYCHOSOCIAL FACTORS PREDICT PAIN AFTER PARTICIPATION IN AN ULTRAMARATHON RACE?

3.1. INTRODUCTION

The popularity of endurance sport is increasing globally (9), with endurance running being undertaken by a wide range of competitive and recreational athletes (20). Ultramarathon races impose severe physical and emotional stress on endurance runners (14-20). Recovery is, therefore, an essential part of endurance running to promote positive adaptations from training and reduce the negative effects of training such as exercise-induced muscle damage (EIMD), delayed-onset muscle soreness (DOMS) and fatigue (41). The recovery process is multidimensional involving physical, psychological, social and emotional aspects. These aspects of recovery do not occur simultaneously (41, 54).

Endurance runners are embedded in a culture that accepts the "no pain, no gain" expression in competition and training (89). Pain is therefore an inevitable part of participating in an ultramarathon (28, 59). However, pain can become obstructive when its cause cannot be explained. If pain is misinterpreted during recovery an endurance runner may adopt unhelpful behaviour which may develop into chronicity (4). The Fear Avoidance Model has been used to better understand how this unhelpful behaviour, driven by fear of pain, can develop into disability and disuse. This model explores the relationship between psychosocial factors of fear avoidance beliefs, catastrophic thinking and self-efficacy beliefs (7, 70, 82). These psychosocial factors may play a significant role in the pain recovery process (105).

Despite the increasing popularity of endurance running and the importance of recovery in endurance running, there is a lack of information from reputable sources about psychosocial factors and their effect on pain recovery in this population (21, 61). The aim of this study was to determine whether there is an association between fear avoidance beliefs, pain catastrophizing and self-efficacy beliefs and athletic pain recovery in a cohort of ultramarathon runners competing in the 2017 86.73 km Comrades Marathon road race.

3.2. METHODS

3.2.1. STUDY DESIGN

This study used a descriptive, longitudinal cohort design. The rationale behind the study design was to establish if there was any association between the baseline pain psychosocial questionnaire scores (Pain Catastrophizing Scale, Athlete Fear Avoidance Questionnaire, Pain Self-Efficacy Questionnaire) and pain recovery following the race. The study consisted of two parts. In the first part, participants completed questionnaires regarding their training history and pain psychosocial questionnaires to establish a baseline. In the second part of the study, daily pain scores of each participant were observed for 10 days following the race to record recovery. Pain was used as a marker for recovery following the ultramarathon (see Section 2.3.3., page 14).

3.2.2. INCLUSION CRITERIA

Healthy ultramarathon runners between the ages of 20 and 60 who had qualified for and were intending to compete in the 2017 Comrades Marathon were included in this study.

3.2.3. EXCLUSION CRITERIA

Participants were excluded if they failed to complete written informed consent (Appendix 1); reported any signs of illness within the two-week period prior to the race; or reported any relevant medical or surgical procedure that would prevent participation in the race. Participants with a diagnosed history of chronic pain, complex regional pain syndrome or other chronic pain conditions or who did not complete the race were also excluded. The information evening and the information sheet (Appendix 2) were used to inform any potential participants diagnosed with a chronic pain condition that they would be excluded from the study.

3.2.4. SAMPLE SIZE DETERMINATION

To determine whether psychosocial factors predict pain during recovery, a multiple regression analysis was conducted to determine sample size using the Daniel Soper statistical calculator (106). The dependent variable used was pain, and the predictor (or independent variables) used were catastrophic thinking, fear avoidance beliefs and self-efficacy. The minimum sample size required based on an effect size of 0.15; a power of 0.8; an alpha level of 0.05 and three (3) predictors was 76. A conservative effect size estimate of 0.15 was selected based on the levels of fear avoidance beliefs exhibited by athletes with and without ankle injuries (106). To allow for loss to follow-up, a minimum sample of 80 participants was required for this study.

3.2.5. PARTICIPANT RECRUITMENT

All participants were runners recruited from Randburg Harriers Running Club and Wanderers Sports Club, the largest (570 members) and second largest (553 members) running clubs in Johannesburg at the time of this study respectively. A convenience sampling method was utilised, as these clubs were selected due to their proximity to the researcher's work and the size of the clubs.

Participants were recruited using advertisements at the running clubs and Randburg Medicross, where the researcher works. Recruitment by advertisement started in April 2017 where participants were made aware of the study and informed of an information session that was going to be held by the researcher at the running clubs. Additionally, the researcher contacted the secretaries of the Randburg Harriers Running Club and Wanderers Sports Club with information regarding the study and the information evening that was going to be held two weeks prior to the 2017 Comrades Marathon. Members who showed interest in the study, required more information or wanted to participate but could not attend the information evening contacted the researcher directly on the email provided by the club secretaries. The information sessions were held at the running clubs two weeks prior to the Comrades Marathon to inform the potential volunteers about the study. At the information session, the consent forms and information sheets were handed out and completed.

The participants were invited to participate in the study with the broad outline of general recovery after the Comrades Marathon and their view of pain, without explicitly telling the participants that psychosocial factors and their possible association to pain recovery was the focus of the study. This was to avoid response bias and subject bias of participants.

3.2.6. MEASUREMENT INSTRUMENTS

3.2.6.1. INFORMED CONSENT FORM

The informed consent form, completed prior to participation, included a description of the significance and procedure of the study, information regarding ethical approval, the possible risks and benefits of the study and the right to withdraw at any stage. Participants were informed that all personal information and data would remain confidential.

3.2.6.2. MEDICAL AND SPORTS HISTORY QUESTIONNAIRE

The Medical and Sports History Questionnaire (Appendix 3), handed out at the information evenings, was either collected and returned at the information evenings or returned within 48 hours of the information evenings via email. This Medical and Sports History Questionnaire was based on the questionnaire that was successfully used in the 2000, 2001, 2006, 2007, and 2014 Two Oceans Marathon and Ironman research studies (35). The questionnaire was developed and validated in a previous study (35) by two experts in endurance exercise. The validators commented on the importance and relevance of the questions and whether the questions were concise, easily understood and clear. In addition, the validators gave input regarding areas not covered in the questionnaire and an updated version was created which was again consolidated by the two experts. Before the questionnaire was used in the above-mentioned study (35), the final version of the training questionnaire was validated across the panel of experts who concurred that all objectives of the questionnaire regarding medical and sports history in endurance athletes were met (35).

The questionnaire was used to obtain information regarding the participant's; demographics, training history, competition history, medical history and injury history. Past injuries were recorded as any injury experienced during the participants running career. These current injuries would have been present at the time the Medical and Sports History Questionnaire were completed, two weeks prior to the Comrades Marathon. Details of the current injuries reported included anatomical area, structure, injury severity on a scale of 1 to 4, how the injury had been treated to date (rest, surgery physiotherapy, exercises and medication) and the specific year or month the participant first became aware of the injury.

The injury severity scale was graded 1 to 4 with grade 1 representing: “I only experience symptoms after exercise,” grade 2: “I experience symptoms during exercise, but it does not interfere with exercise,” grade 3: “I experience symptoms during exercise that may interfere with my training/competition,” and grade 4: “I am so painful that I may not be able to train or compete.”

Previously used pain-relieving medication after completion of a running race was recorded with no specific timeframe of use. Over the counter pain-relieving medication were listed with an option of participants adding additional medication used in a section under “other.”

3.2.6.3. THE PSYCHOSOCIAL QUESTIONNAIRES

The three psychosocial questionnaires utilised in this study have been widely used and validated in pain management and research (7, 70, 73, 81). The Pain Catastrophizing Scale (Appendix 4) was used to explore whether a correlation exists between inconsistent pain recovery and catastrophizing thoughts. The Athlete Fear Avoidance Questionnaire (Appendix 5) was used to assess the athlete’s fears and thoughts about returning to performance and pain-related fear. The Pain Self-Efficacy Questionnaire (Appendix 6) was used to assess the participant’s confidence in their ability to cope with pain. All questionnaires were made available in Afrikaans and isiZulu. The three baseline psychosocial questionnaires will now be discussed in greater detail.

3.2.6.4. THE PAIN CATASTROPHIZING SCALE

The Pain Catastrophizing Scale is used to assess the components of catastrophizing: rumination (four items), helplessness (three items) and magnification (six items). The questionnaire consists of a five-point scale of 13 items measuring different thought processes of individuals that might be experiencing pain. The points range from a score of zero to four where zero represents “no worry at all” and four represents “worrying all the time” or increased levels of catastrophizing (79). The cut-off score for the questionnaire is 30 (indicating unhelpful pain catastrophizing). The cut-off scores for rumination, helplessness and magnification are 11, five and 13 respectively (95, 96). Research suggests the scale is the only one of its kind to successfully identify the level of catastrophizing in the general population. It has also been successfully used and tested in the South African context (94). The Pain Catastrophizing Scale was translated into English, Afrikaans and Xhosa to adapt the scale across South African cultures. The adapted scale showed excellent test-retest reliability (0.90, 0.91, 0.89 for English, Afrikaans, Xhosa) and internal consistency across all three languages.

This scale is therefore a valid and reliable tool to assess catastrophizing within the South African context. Additionally, the scale has been effectively used in the sporting population (59).

3.2.6.5. THE ATHLETE FEAR AVOIDANCE QUESTIONNAIRE

The Athlete Fear Avoidance Questionnaire consists of 10 items where five represents strong agreement to the question and one represents strong disagreement (7). Content validity was established through a cross-sectional study in which the questionnaire was validated by a board of eight experts. Their expertise was in the field of sport, fear avoidance, psychology and sport therapy. Concurrent validity was established in a sample of 99 athletes attending university across a variety of sports. The 99 athletes completed the Athlete Fear Avoidance Questionnaire, the Fear Avoidance Beliefs Questionnaire and the Pain Catastrophizing Scale. Results showed significant associations between these questionnaires. This ensures the questionnaire is measuring fear in athletes and no other confounding variables. A Cronbach α of 0.805 supports high internal consistency of the questionnaire (7).

Currently, the Athlete Fear Avoidance Questionnaire is the only questionnaire of its kind to specifically detect fear avoidance beliefs that could hinder return to performance in the athletic population. It can be used to detect possible psychosocial barriers to recovery and rehabilitation in athletes (7). Although the questionnaire is complex, with evidence of good internal validity and consistency, the sex and age of athletes were not considered and might obscure the results (7). Further testing in this area across a range of ages and between male and female athletes is therefore needed.

3.2.6.6. THE PAIN SELF-EFFICACY QUESTIONNAIRE

The Pain Self-Efficacy Questionnaire was developed in the 1980s to assess the self-confidence one has in completing a task despite pain. It consists of 10 items. The total score ranges from 10 to 60, with a cut-off score of 30. Those scoring below this mark are scored as having low self-efficacy (12). A study investigated the validity and reliability of the Pain Self-Efficacy Questionnaire and Pain Catastrophizing Scale in 103 participants aged between 18 and 60 years. The participants' diagnoses ranged from fibromyalgia to CLBP. Data was gathered at the initial assessment and three months later. The Pain Catastrophizing Scale showed high reliability (0.93) and validity (0.87). The Pain Self-Efficacy Questionnaire also demonstrated high validity (0.67-0.84) and reliability (0.92) (21).

The use of the Pain Self-Efficacy Questionnaire within the South African context has yet to be validated, however, the Coping Self-Efficacy Scale (CSE) was validated across a multicultural sample in South Africa (n=2214). The cross-sectional survey design indicated good alpha reliability coefficient of 0.87. Furthermore, substantial correlations were reported between the CSE and other self-efficacy measures, concluding that the English version of the CSE had good reliability and validity within the South African context (104).

The most acceptable assessment tool to assess self-efficacy and pain (recovery) in the sporting population is the Pain Self-Efficacy Questionnaire (38, 83) because recovery from sport is most effectively measured by subjective pain intensity ratings (83). There is a lack of research assessing self-efficacy after competition, during recovery and when returning to performance. Although he K-SES is the only questionnaire of its kind to assess self-efficacy in the sporting population, it has only been validated in athletes with an ACL injury (56). To assess performance in athletes, task-specific self-efficacy measures correlate most strongly when compared with general self-efficacy assessment measures (56, 103). This suggests that to measure, for example, recovery in sport, a specific self-efficacy questionnaire must be used.

3.2.6.7. THE PAIN LOG BOOK

The Pain Logbook (Appendix 7) is a 10-day brief pain inventory (BPI) logbook (101) commencing on the evening of the Comrades. It was filled out before bed every night to allow for standardization. This logbook was used to generate a Pain Severity Score out of 10. Research shows that the BPI is valid and reliable in different populations, including athletes, with a good test-retest reliability (94). The Pain Severity Score is generated from four questions which explore the severity of the participant's pain (93). These four questions measure pain variability over time: pain at its "worst," "least", "average" and "now" (current pain). Numerical scores ranging from zero to 10, zero representing "no pain", five representing "moderate pain" and 10 representing "worst pain you can possibly imagine." The mean of the four scores gives the Pain Severity Score (93, 94). This gave an average of the participant's pain severity over 24-hours. In this study, the Pain Severity Score and the BPI were used to monitor pain during recovery from the Comrades Marathon.

3.2.7. STUDY PROCEDURE

Ethical approval (Appendix 8) was obtained from the Human Research Ethics Committee of the UCT Faculty of Health Science prior to recruitment (HREC REF: 045/2017). The 2017 Comrades Marathon was to be held on Sunday, 4 June 2017. Therefore, participants were recruited from April 2017, prior to the 2017 Comrades Marathon, via advertisements at the running clubs, at Randburg Medicross and through word of mouth. In addition, the secretaries of Randburg Harriers Running Club and Wanderers Sports Club were contacted by the researcher. These advertisements were then forwarded by the secretary to the email addresses of all members of the participating running clubs who were running the 2017 Comrades Marathon. The researcher's email address was provided by the secretary for runners who required further information, would like to participate in the study or were unable to attend the information evening. Information evenings were held two weeks prior to the 2017 Comrades Marathon, towards the middle of May, at the running clubs, to allow the researcher to present and explain the current study to all potential participants. Recruitment was on a voluntary basis.

3.2.7.1. DATA COLLECTION

The data collection procedure is illustrated in Figure 1. Consent forms and information forms were handed out on the information evening to all interested participants. Those who signed the informed consent received a Medical and Sports History Questionnaire to complete and hand in that night or to return via email within 48 hours. Those who were unable to attend the information evening received the informed consent forms and Medical and Sports History Questionnaire by email. These participants had previously contacted the researcher via email after receiving information from their club secretary regarding the study. The psychosocial questionnaires and the pain logbook were handed out in hard copy at the information evening or sent as a downloadable electronic copy via email to the participants once consent was obtained. All psychosocial questionnaires were made available in English, Afrikaans and isiZulu. These forms had already been translated into English, Afrikaans and isiZulu, but interestingly, all participants requested the English questionnaire, so there were no transcultural issues raised in the analysis of the data.

Participants were asked to complete the psychosocial questionnaires (Pain Catastrophizing Scale; Athlete Fear Avoidance Questionnaire and Pain Self-Efficacy Questionnaire) 48 hours prior to the race as the pre-race baseline measures.

Research suggests that measuring baseline levels of fear of pain and catastrophizing 48 hours prior to an event is a good indicator for the development of disability and prediction of peak pain (69). Furthermore, measuring fear of pain prior to an injury has shown the greatest construct for predicting future pain intensity (69).

3.2.7.2. PAIN LOGBOOK COMPLETION

The pain logbook was commenced on the night of the race (Day 1) and completed for nine days following the race, giving a total of 10 entries. SMSs and phone calls were used on the day of the Comrades Marathon and for nine days following the race to remind participants to complete the pain logbook before bed. Participants were asked to record any pain-relieving medication and dosage that they were taking from a comprehensive list attached to the pain logbook (Appendix 7). The list only provided the brand name and generic name of all the pain-relieving medication available in South Africa. No additional information of the pain-relieving medication was provided, for example dosage, interactions and contraindications. This was to ensure that the study did not interfere with the participants' usual practice of over the counter medication use post-race. Any information, regarding pain-relieving medication, given prior to the study, could have affected the participants' rating of their pain or changed how they typically took pain-relieving medication during the recovery post-race. However, as a precaution, the harmful effects of non-steroidal anti-inflammatory drugs (NSAIDs) were discussed as part of the presentation at the information evening.

The official race time of each participant was recorded from the race website by the researcher after the race. Finishing times were then categorised according to the medal times which are listed in Section 2.2.3 (page 11). All completed data were collected from the running clubs, directly from individual participants or were emailed to the researcher. The data were captured manually and stored under password protection with a copy on an external hard drive. The external hard drive was kept at the Randburg Medicross physiotherapy practice in a locked safe. All hard copies of the questionnaires and pain logbooks were filed and kept with the external hard drive in the safe at the Randburg Medicross. Only the researcher and owner of the practice had access to the key. The electronic data was only accessible to the primary researcher and student researcher and will be kept until 2023.

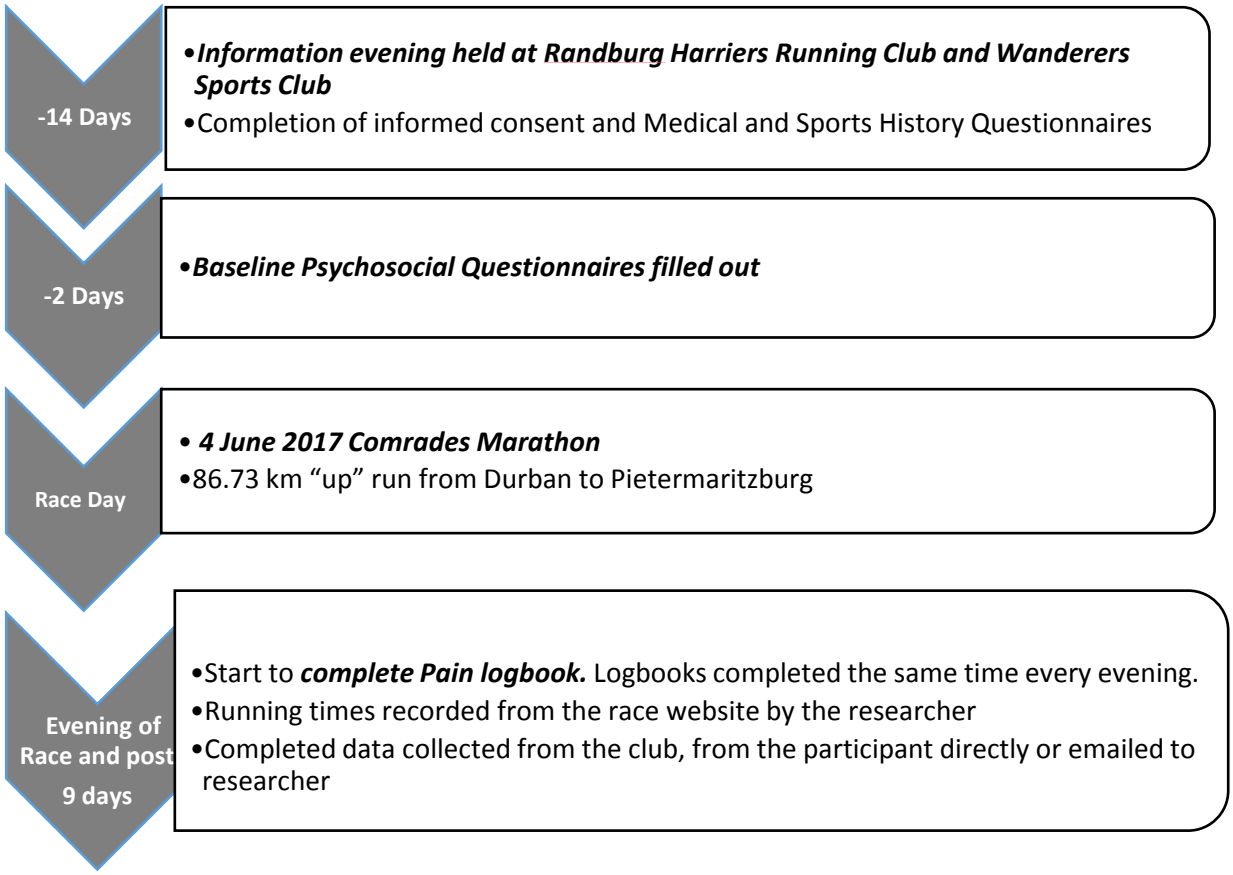

Figure 1: Summary of the data collection procedure from completion of the baseline psychosocial questionnaires until completion of the pain logbook

3.2.8. STATISTICAL ANALYSES

Data were captured into Excel. Statistical analyses were performed using Statistica software (Data analysis software system, version 13, www.statsoft.com). The Kolmogorov-Smirnov test was used to assess normality of pain as the primary outcome measure. As the pain data from day 1 had normal distribution, means and standard deviations were used to summarise the demographic and training history of the participants.

Participants' scores on the Pain Catastrophizing Scale, Athlete Fear Avoidance Questionnaire and Pain Self-Efficacy Questionnaire were summarised (mean and standard deviation). Cut off scores for the Pain Catastrophizing Scale and Pain Self-Efficacy Questionnaire were used to categorize participants into two groups for each questionnaire.

As no information regarding the cut off score for the Athlete Fear Avoidance Questionnaire was found the author of the questionnaire was contacted directly via email. The author of the instrument recommended that the scores be analysed as continuous data to avoid generating subgroups, therefore no cut off scores were created for the Athlete Fear Avoidance Questionnaire (107).

Using the cut-off score for the Pain Catastrophizing Scale (31), participants were categorized as having catastrophizing thoughts or not catastrophizing. In addition, participants were categorized according to the subgroups of catastrophizing for rumination, magnification and helplessness. In addition, for the Pain Self-Efficacy Questionnaire, participants were categorized as having high or low self-efficacy based on the cut point of 40 (86, 87). As the group sizes for both catastrophizing (n=9) and non-catastrophizing (n=68) and high self-efficacy (n=75) and low self-efficacy (n=2) were skewed, non-parametric analysis (Friedman's test) was used to explore relationships between catastrophizing and pain, and self-efficacy and pain during the recovery period.

Changes in pain severity scores over time were summarised using a box and whisker plot. Although the data on day 1 were normally distributed, the data were not normally distributed each day after that. Therefore, non-parametric analyses were performed using the Friedman's test. To explore relationships between pain catastrophizing and self-efficacy with pain, Friedman's test was conducted to compare recovery in catastrophizers versus non-catastrophizers and comparing participants with low self-efficacy vs. high self-efficacy.

To explore relationships between fear avoidance beliefs and pain, Spearman's correlation analyses were conducted to determine if there was a relationship between pain on each day of recovery and the scores on the AFAQ. In addition, Pearson's correlations were conducted to explore relationships between scores on the Pain Catastrophizing Scale, Athlete Fear Avoidance Questionnaire and Pain Self-Efficacy Questionnaire and pain on days 1 to 10. Significance was accepted as $p<0.05$.

Finishing times of participants captured from the Comrades website by the researcher were entered into Excel. Data was categorised according to the five medal times (listed in section 2.2.3., pg 11) that participants in the study achieved. Due to the small numbers in some of the categories and the non-parametric nature of the data, a Spearmans rank order correlation was performed to determine if there was a difference in scores on the Pain Catastrophizing Scale, Athlete Fear Avoidance Questionnaire and Pain Self-Efficacy Questionnaire according to finishing categories.

3.2.9. ETHICAL CONSIDERATIONS

The study proposal was submitted to the University of Cape Town, Faculty of Health Sciences Human Research Ethics Committee. Ethical approval was obtained prior to study commencement (UCT HREC REF: 045/2017). The study was carried out in accordance with the Declaration of Helsinki (108). To protect justice, all participants were selected without bias or prejudice. Those wanting to participate and meeting the inclusion/exclusion criteria were required to complete an informed consent. The consent form included all relevant information regarding the procedure of the study, any possible risks and benefits and confidentiality of the results. The opportunity to withdraw from the study without any consequences was also outlined. In addition, consent was discussed in detail at the information evening held at the running clubs where participants were given the opportunity to ask questions and interact with the researcher. Participants were not compensated for their participation in the study.

The researcher did not have any affiliation to the clubs and did not give or receive any monetary compensation. There were no potential conflicts of interest in this study.

3.2.9.1. RISKS OF THE STUDY TO PARTICIPANTS

There were no risks associated with filling out the questionnaires or completing the pain logbook. There might have been risks associated with participating in the Comrades Marathon, due to the distance of the race and strenuous component of the sport. However, all participants had qualified for the race by previously completing a marathon and were entered to participate in the Comrades Marathon before recruitment into the current study. The detailed medical history section of the questionnaire, as well as any flu-like symptoms two weeks prior to the race were grounds for exclusion from the study. Dealing with participants' safety was always a key concern and focus in the current study.

3.2.9.2. BENEFITS OF THE STUDY TO PARTICIPANTS

On completion of the dissertation, the included participants will receive their individual psychosocial questionnaire results. The research results will be presented at the running clubs to those who indicate an interest in receiving this information. This might improve participants understanding of the development of chronic pain and how it could affect their running recovery. This will be completed after submission of this dissertation.

3.3. RESULTS

3.3.1. DESCRIPTIVE CHARACTERISTICS

Of the 83 participants who were recruited for this study, data from 77 participants were included for analysis (Figure 2). Six participants were excluded from the study, with three not finishing the Comrades Marathon, two being lost to follow up after not handing in their pain logbooks and not responding to the reminder emails and one withdrawing from the study prior to participating in the Comrades Marathon due to other commitments. The majority of the runners were male (n=45) with an average age of 41 years (±9), height 172 cm (±8.2), weight 65 kg (±9.6). The group were predominantly English speaking (n=57) with the majority of participants running for Randburg Harriers running club (n=26) (Table 1).

Figure 2: Flowchart showing participant recruitment process

Table 1: Descriptive characteristics of participants (n=77). Data are expressed as number and percentage (%) or mean ± standard deviation (SD)

	Number (%) or mean ± SD
Language	
English	57 (74%)
Afrikaans	15 (19,5%)
Setswana	2(2.6%)
isiZulu	1(1.3%)
isiXhosa	1(1.3%)
Venda	1(1.3%)
Running Club	
Randburg	26(33.8%)
Wanderers	22(28.6%)
Born2run	12(15.6%)
Jeppe	6(7.8%)
Pirates	5(6.4%)
Florida	3(3.9%)
Fourways	3(3.9%)
Previous ultramarathons completed	
Two Oceans Marathon	53(68.8%)
Comrades Marathon	60(78%)
No previous ultramarathons completed	13(10%)
The number of Comrades Races completed per participant who previously completed a Comrades Marathon	5.3± 6
Comrades Personal Best (PB) race time	583 minutes ±90.8
2017 Comrades Race Time	623 minutes ±80.9
% Time of 2017 Comrades Marathon race vs PB	95(12%)
Participants reporting a previous running-related injury	66(85.7%)
Number of participants with current injuries at baseline*	42(54.5%)
Number of current injuries	54
Grade of current injury(s)	
Grade 1	6
Grade 2	23
Grade 3	20
Grade 4	5
Previously used pain-relieving medication after a race	54
Type of pain-alleviating medication previously used after a race (or in combination) to treat an injury or pain**	
NSAIDS	39
Anti- inflammatory gel	18
Paracetomal	10
Codeine	3
Cortisone injection	1
Currently taking chronic medication for pain management**	5(6.5%)
Type of chronic medication currently used for pain management (or in combination)**	
NSAIDS	3
Cortisone	1
Paracetomal	1
Antiretroviral Therapy	1

Participants (n=42) reported more than 1 injury, therefore total injuries n=54.

****Current use of pain- relieving medication taken chronically***

*****Participants reported the use of more than 1 medication***

3.3.2. COMPLETION AND INJURY HISTORY

The majority, 78% (n=60), of the participants had completed a Comrade's Marathon race previously, with 69% (n=53) finishing a Two Oceans (56 km) ultramarathon (Table 1). Thirteen percent (n=10) of participants were novices to the ultramarathon distance. The average finishing time of the participants was 623 minutes (10hrs 23min), with the average personal best finishing time of those participants who had previously completed a Comrades Marathon was 583 minutes (9hrs 43min). Participants ran the 2017 Comrades Marathon at an average of 95% of their speed when compared to the participants previous Comrades Marathon personal best times.

Seventy percent (n=54) of the participants recorded that they had previously used pain-relieving medication after a race with oral NSAIDs being the most popular choice (n=32). Of the 77 runners, 85.7% (n=66) documented a history of injury, with 54.5% (n=42) reporting a current injury. Of the 42 with injuries, 14% reported suffering with a grade 1 injury (n=6), 55% grade 2 (n=23), 48% grade 3 (n=20) and 12 % grade 4 (n=5). Only 6% (n=5) of the runners reported current use of chronic pain-relieving medication (Table 1)**.**

3.3.3. FINISHING TIMES FOR 2017 COMRADES MARATHON

Two participants received Silver medals, 14 participants received Bill Rowan medals, 31 participants received Bronze medals and 30 participants received Copper medals.

3.3.4. BASELINE QUESTIONNAIRES: PAIN CATASTROPHIZING, FEAR AVOIDANCE BELIEFS AND SELF-EFFICACY

Baseline descriptive scores for the Pain Catastrophizing Scale are presented in Table 2. The baseline Pain Catastrophizing Scale revealed that the participants generally had low pain catastrophizing scores (15 ±10.2). In addition, the runners scored low on rumination and helplessness (5.9±4 and 5.7±5 respectively) with magnification being scored the lowest (3.4±2.4).

Table 2: Baseline scores of the sample (n=77): Pain Catastrophizing Scale, Athlete Fear Avoidance Questionnaire and Pain Self-Efficacy Questionnaire

Baseline Questionnaire	Mean Score (SD)
Pain Catastrophizing Scale (PCS) – Total (x/52)	14.99 (10.15)
PCS - Rumination (x/16)	5.88 (3.96)
PCS - Magnification (x/12)	3.39 (2.37)
PCS – Helplessness (x/24)	5.70 (4.91)
Athlete Fear Avoidance Questionnaire (x/50)	20.12 (5.96)
Pain Self-Efficacy Questionnaire (x/60)	53.36 (8.13)

(x/x) represents the mean score of each questionnaire or sub-section

At a cut off score of 30 (67), only 12% of the participants (n=9) were categorised as having unhelpful pain catastrophizing thoughts (Appendix 9). In the sample of 77, 17% (n=13) scored high in rumination, 33% (n=25) scored high in magnification and 12% (n=9) scored high in helplessness. Interestingly, 8 of the 9 participants scoring high on magnification also scored above the cut-point of 30 for the total instrument, indicating catastrophic thinking about pain. The two participants scoring highest in magnification on the Pain Catastrophizing Scale were novice runners with a history of only completing one Comrades Marathon race previously (in 2016).

Baseline descriptive scores for the Athlete Fear Avoidance Questionnaire are presented in Table 2. Sixty-one participants scored low on the Athlete Fear Avoidance Questionnaire (mean of 20 out of a total score of 50), suggesting that this sample group had low fear avoidance beliefs.

Baseline descriptive scores for the Pain Self-Efficacy Questionnaire (Table 2) generally showed a high self-efficacy score (mean of 53.4±8.1 out of 60). Only 2 of the 77 runners scored below the cut-point (below 40) on the questionnaire (Appendix 10). Both these runners were novice runners with history of only three completed Comrades Marathons between them (Appendix 14). The participant with the lowest Pain Self-Efficacy Questionnaire score (25 out of 60) had only completed one Comrades Marathon which was in 2016. As the Comrades Marathon alternates between an “up” to “down” race each year, the 2017 Comrades Marathon would have been this runner’s first “up” race. The age of the above mentioned participants, 29 and 31 years (Appendix 14), fall below the mean age (41y±9) of the sample.

3.3.5. PAIN SEVERITY SCORES AND RECOVERY

As shown in Figure 3, 50% of the participants scored moderate pain ratings (93) on the Pain Severity Scale the evening following completion of the Comrades (Day 1). It took up to five days from the day of Comrades Marathon for 75% of the runners to score a rating of 1 or lower. Seven days into recovery, 75% of the runners reported no pain.

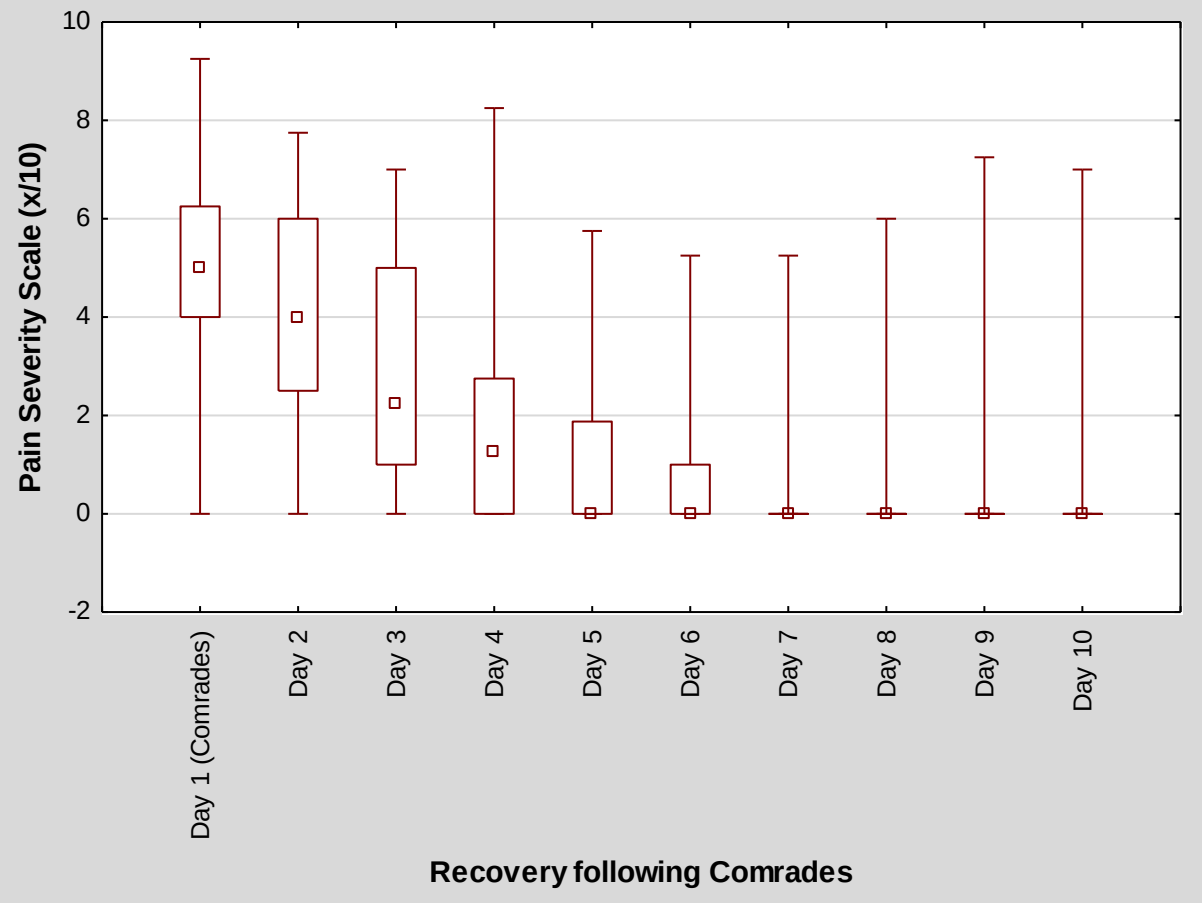

Figure 3: Median Pain Severity Scale scores for 10 days of Recovery following the Comrades Marathon (n=77)

3.3.6. ASSOCIATIONS BETWEEN PAIN SEVERITY SCORES AND PAIN CATASTROPHIZING, FEAR AVOIDANCE AND SELF-EFFICACY

When comparing catastrophizers (PCS≥30; n=9) to non-catastrophizers (PCS<30, n=68) there were no significant differences between groups in Pain Severity Scores over the 10-day recovery period (Figure 4). Pearson correlations (Figure 5) showed a weak positive correlation between Pain Severity Score on Day 1 and Pain Catastrophizing Scale (χ^2=0.27; p<0.05). There was no correlation between Pain Severity Score and Pain Catastrophizing Scale on any of the other days of recovery (Appendix 11).

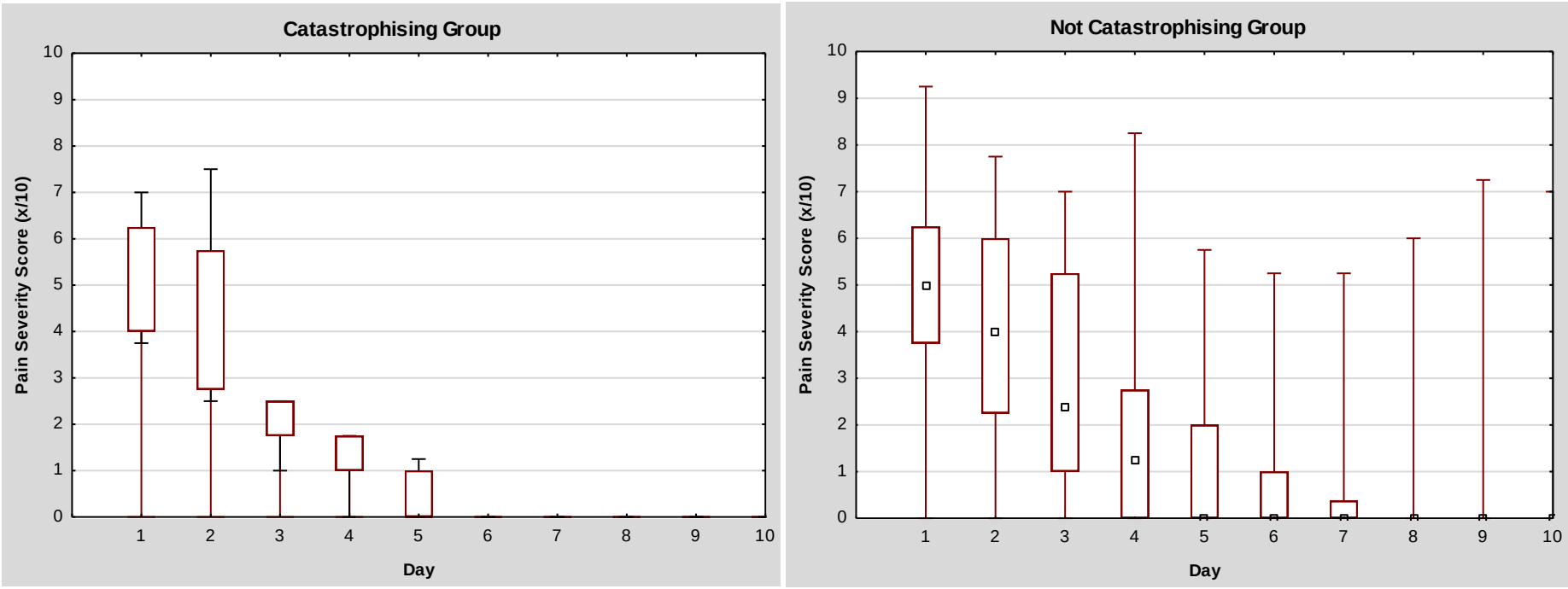

Figure 4: Change in pain scores over time in runners who had high scores on the Pain Catastrophizing Scale (PCS≥30; n=9) vs. those who scored low on the Pain Catastrophizing Scale (PCS<30; n=68)

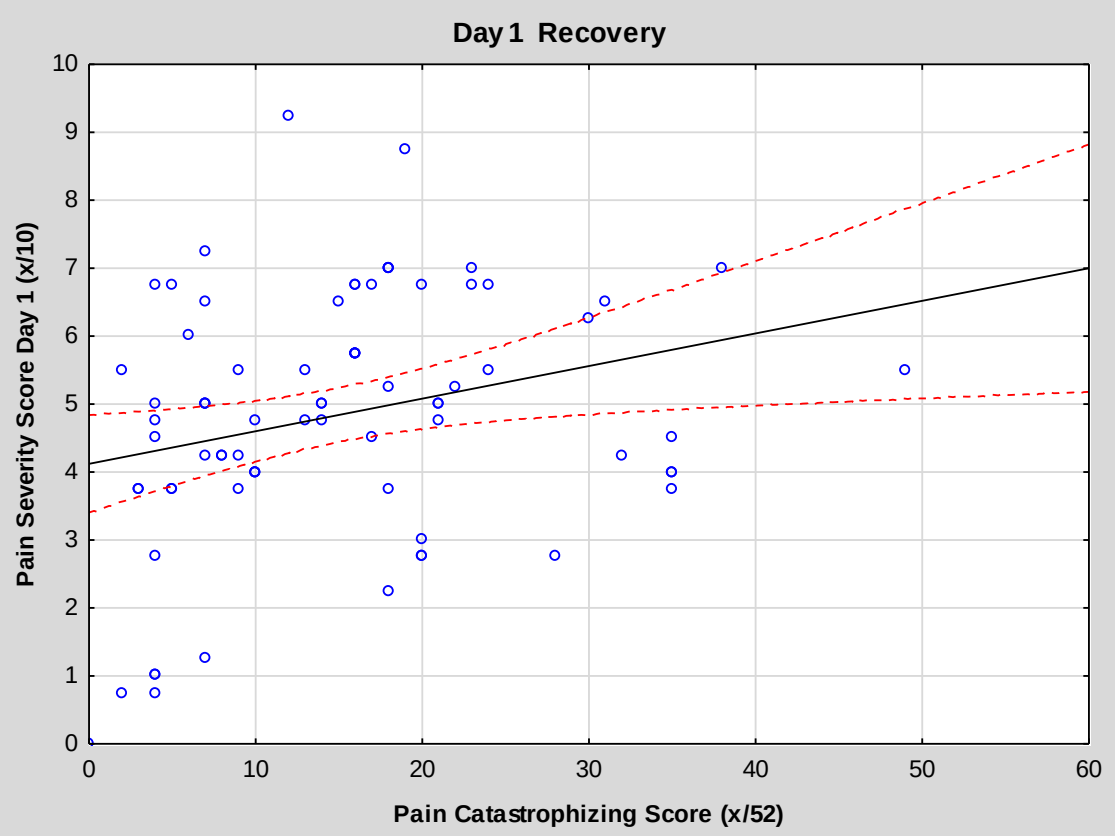

Figure 5: Correlation between the Pain Severity Score (PSS) on Day 1 (race day) and the Pain Catastrophizing Scale (χ^2=0.27; p<0.05)

There were no correlations between Athlete Fear Avoidance Questionnaire scores and Pain Severity Scores on days one to 10 as seen in Table 3.

Table 3: Pearson correlations between Athlete Fear Avoidance Questionnaire (AFAQ) that showed no correlation to Pain Severity Scores (PSS) over the 10 days of recovery

	p-value	r-value
PSS Day 1 and AFAQ	0.502	0.07
PSS Day 2 and AFAQ	0.551	0.07
PSS Day 3 and AFAQ	0.630	0.06
PSS Day 4 and AFAQ	0.086	0.2
PSS Day 5 and AFAQ	0.107	0.19
PSS Day 6 and AFAQ	0.185	0.15
PSS Day 7 and AFAQ	0.158	0.16
PSS Day 8 and AFAQ	0.197	0.15
PSS Day 9 and AFAQ	0.193	0.12
PSS Day 10 and AFAQ	0.381	0.10

When comparing the low self-efficacy group (<40, n=2) and high self-efficacy group (≥40, n=75) there were no significant differences in pain severity scores between the two groups over the 10-day recovery period (Figure 6).

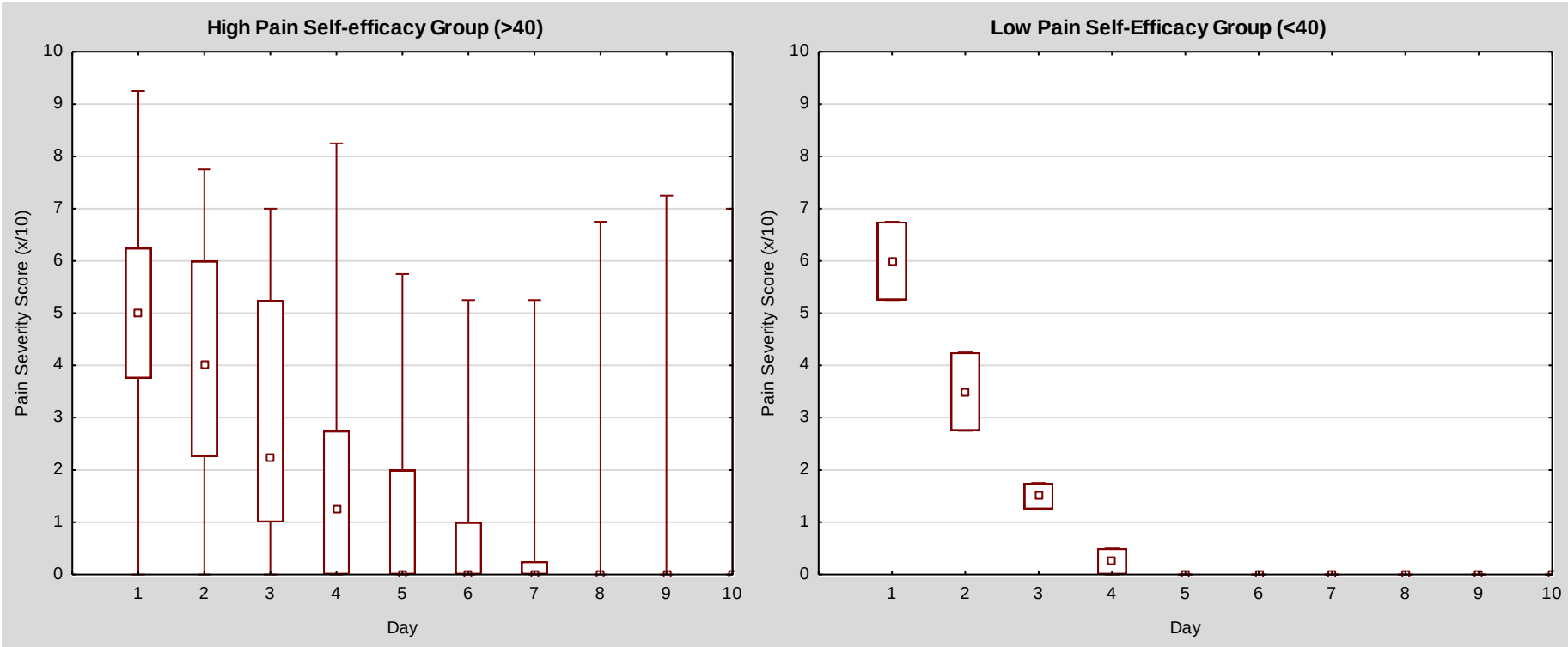

Figure 6: Change in pain scores over time in runners who had high scores on the Pain Self-Efficacy Questionnaire (≥40; n=75) vs. those who scored low on the Pain Self-Efficacy Questionnaire (<40; n=2)

3.3.7. ANALYSES OF COMRADES FINISHING TIMES OF PARTICIPANTS

The two participants in the low self-efficacy group fell in the Bronze medal category, while the nine participants in the high catastrophizing group fell into either the Bill Rowan Medal, Bronze medal and Copper medal group (Figure 4). Interestingly, the two participants who received silver medals scored high in the Pain Self-Efficacy Questionnaire (59 and 60), low in the Pain Catastrophizing Scale (5 and 14) and low on the Athlete Fear Avoidance Questionnaire (19 and 28), having one Athlete Fear Avoidance Questionnaire score higher than the mean (20) of the sample. There were no differences in the Pain Catastrophizing Scale, Athlete Fear Avoidance Questionnaire or Pain Self-Efficacy Questionnaire scores for participants completing the race in the different categories (Table 4). There were no correlations found between finishing times and pain during recovery.

Table 4: Spearman's correlation matrix between finishing categories that showed no correlation to Pain Catastrophizing Scale (p=0.79), Athlete Fear Avoidance Questionnaire (p=0.68) and Pain Self-Efficacy Questionnaire (p=0.14). Data are expressed as mean and standard deviation (SD)

Finishing category	Number of runners (n=77)	Pain Catastrophizing Scale p=0.79	Athlete Fear Avoidance Questionnaire p=0.68	Pain Self-Efficacy Questionnaire p=0.14
Silver (6-7.5hrs)	2	9.5 (6.36)	23.5 (6.36)	59.5 (0.71)
Bill Rowan (<9hrs)	14	13.21 (8.27)	20.21 (7.15)	54.57 (6.79)
Bronze (<11hrs)	31	13.74 (9.69)	18.94 (4.46)	54.03 (8.97)
Copper (<12hrs)	30	17.47 (11.36)	21.07 (6.71)	51.7 (7.92)

3.3.8. SUMMARY OF RESULTS

The sample of this study comprised of 77 participants (aged 41 years ±9), 45 being male and mainly English speaking. Majority of participants (78%) had completed a Comrades Marathon race previously with 13% being novices to the ultramarathon distance. The average 2017 Comrades Marathon finishing time for participants was just over 10 hours. Seventy-percent of participants had previously used pain-relieving medication after a race while the majority of participants (86%) documented a history of injury, with 55% reporting a current injury. Only 6% reported to be currently using chronic pain-relieving medication.

The baseline psychosocial questionnaires revealed that majority of the participants demonstrated low fear avoidance beliefs (79%), low pain catastrophizing beliefs (88%) and high self-efficacy beliefs (97%). It took five days from the day of the 2017 Comrades Marathon for 75% of participants to score a pain rating of one or lower in the pain logbook and seven days for 75% of participants to report no pain. There were no correlations between psychosocial factors and pain recovery in this sample of Comrades runners. There was also no correlation between finishing times and pain during recovery.

3.4. DISCUSSION

This study investigated associations between pain catastrophizing, fear avoidance beliefs and self-efficacy beliefs and pain during recovery in ultramarathon runners competing in the 2017 Comrades Marathon. No correlations were found in the 10 days of recovery between pain and pain catastrophizing, pain and fear avoidance beliefs, and pain and self-efficacy beliefs in the sample of runners who successfully completed the race. The findings will be discussed in more detail and will conclude with a section on study limitations.

3.4.1. PARTICIPANTS

Data from 77 participants were included for analysis in this study. This was just above the minimum sample size of 76 required for a statistical power of 95%. The baseline questionnaires completed in the two weeks leading up to the Comrades Marathon were made available in English, Afrikaans and isiZulu as a hard copy and electronic copy. This allowed participants to have easy access to the forms and complete them in their home language, if preferred. However, participants who were recruited via email and who did not attend the information evening at the running clubs were at a disadvantage as there was no direct communication. Although participants were instructed to complete the baseline psychosocial questionnaires 48 hours prior to the race, this was impossible to control. If the baseline psychosocial questionnaires were not completed two days preceding the race, a time when the enormity of the race was more real, the scores on the baseline psychosocial questionnaires may have been affected. To control the timing of questionnaire completion, future studies should look at recruiting participants during registration, held a few days prior to the race.

When comparing the demographics of the sample of the dissertation to the population of Comrades runners competing in the 2017 marathon they matched for average age with 41 years and 42 years respectively (20). There were more male to female runners (4:1) competing in the population of Comrades Marathon when compared to the sample (3:1) (Appendix 12). The number of previous Comrade Marathon races completed per participant was higher in the sample (5.3) in comparison to the population (4.95) (3, 20). The average finishing time of the population was faster at 09:50:05 (3, 20) in comparision to the sample whose average finishing time was 10:23:00 (Table 1).

The study design and strategy of recruiting participants both at the information evening and by email from the club secretaries makes it impossible to determine the response rate for the study. The loss to follow up of three of the participants (two lost to follow up and one withdrawal) may have been because of the length of the baseline questionnaires. Future studies might target a specific psychosocial factor, while keeping questionnaires short. However, due to the nature of this study being the first of its kind, it was necessary to include a range of psychosocial factors.

Although participants were recruited from the two largest running clubs in Johannesburg, the sample was based on geographical convenience to the researcher. This limits variability in the sample as majority of participants were English speaking (n=57) and male (n=45).
Participants with limited access to email and internet would also be at a disadvantage in participating in the study. This reduces the generalisability of the results. Recommendations are discussed under study limitations in this section.

The majority (78%) of the participants had previously completed a Comrades Marathon. The mean number of Comrades Marathons completed per participant was five (Table 1). Novice runners have been classified as completing less than three marathons (34). Therefore, according to this definition, the participants in this sample were mainly experienced. Only 13% of the sample were novices to the ultramarathon distance. The fact that most participants were classed as experienced runners may have influenced the psychosocial baseline scores. Knowledge of what to expect during and after the race may have played a role in the low fear avoidance and pain catastrophizing scores reported prior to the race (20, 29). This will be discussed in further detail.

When analysing running pace, the participants ran the 2017 Comrades Marathon at 95% when compared to their recorded personal best times. This means the participants completed the 2017 Comrades Marathon at a 5% slower pace than their personal best times. However, as the data only recorded personal best times of previously completed Comrades Marathons, those runners who were novices to the ultramarathon distance were excluded from this data analysis. Future studies should compare Comrades Marathon pace to qualifying marathon pace. This would ensure Comrades novices were included in the comparison.

Research suggests a yearly incidence of running-related injuries to be around two-thirds of the running population, with an increase to 90% when training for a marathon (49). Although there were a high number of past injuries recorded among the participants (86%), the number of participants reporting a current injury was significantly lower (55%) than the literature. The higher number of previous injuries reported by this sample may have predisposed the participants to the current injury reported (34, 49). It was impossible to determine if the current injuries had any influence on the pain severity score reported during recovery due to missing data.

In addition, the current study did not record any issues (injuries, illnesses) experienced by the participants during the Comrades Marathon that may have affected their performance and subsequent pain recovery. Therefore, future longitudinal studies might determine if current injuries, based on definition of a current injury and grading of injury severity, have any effect on performance and pain recovery following the race.
Furthermore, a more detailed definition of a "past" and "current" injury may need to be defined in the Medical and Injury History Questionnaire to avoid misinterpretation.

An increasing number of endurance runners are using pain-alleviating medication during training and recovery (5), despite the known negative side effects. Across all sports, but especially in ultramarathon events, pain-alleviating medications are the most commonly used medication not only to treat pain but also as a prophylactic intervention in the anticipation of pain. Non-steroidal anti-inflammatory drugs (NSAIDS) are used as a prophylactic not only during the ultramarathon event but also to enhance recovery (5). In the current study, 70% of the participants reported using pain-alleviating medication after a race, with 64% using oral NSAIDs and 33% using anti-inflammatory gel, both with similar absorption rates (5). This may suggest that the sample of Comrades Marathon runners associate recovery with a painful experience and use pain-alleviating medication to not only treat actual pain but potential pain that might be experienced.

3.4.2. PAIN CATASTROPHIZING

With only 12% of the sample scoring above the cut point on the Pain Catastrophizing Scale (PCS), it is apparent that the majority of this sample population did not have catastrophic thoughts about pain prior to competing in the race. Research shows a strong correlation between low catastrophic thoughts and a better toleration of pain (109). Athletes are believed to tolerate increased levels of pain during a race or competition. This is thought to be due to good cognitive coping strategies.

As discussed in Section 2, this resilience to pain is believed to be related to several factors including: experience (learnt over time), greater intensity of performance (release of endorphins and opioid mechanism) and motivation to succeed (for example, beat a personal best time, win a medal). With 78% of the sample having previously completed the Comrades Marathon race, experience might have played a key role in the low pain catastrophizing scores (15 ±10.2) of this sample (20, 29). Furthermore, all the participants of this sample completed the race which may suggest that there was a high motivation to succeed.

Yet, research shows that athletes suffering from an injury have higher catastrophic thinking related to greater emotional distress (anxiety, depression) than the general population (97, 105). This is believed to be associated with perceived external (coach, media) or internal (athlete identity) pressures (105) which may affect the ability of a runner to complete a race (97).

As injuries can bring about harmful psychological responses, especially in competitive athletes (97), it might be beneficial for future studies to explore the effect of psychosocial factors on pain recovery in endurance runners who do not finish the race. Future studies should compare a population of long distance runners, who are matched with injury and severity (if any) and separate them according to PCS scores. Those above the cut off score of 30 on the PCS are high and those below 30 are low. Future research needs to investigate if there is any correlation between injured runners scoring above 30 on the PCS (having catastrophizing beliefs) who do not complete the ultramarathon race and a prolonged recovery time.

Examining the three components of catastrophizing: rumination, magnification and helplessness, might have relevance to athletes who are in pain (29) and might give greater insight into potential targets of intervention. Neither rumination (where athletes cannot stop thinking about pain) nor helplessness (where athletes believe nothing will decrease their pain intensity) (109), appeared to have any significance in the findings of this study. However, a correlation was found between participants who scored high in magnification also scoring above the cut point of 30 on the PCS. This suggests that these participants magnify the distress they feel during a painful experience (29) or worry that something serious might occur (109). These participants might be recalling a high number of previous painful experiences or injuries (16, 105).

As discussed in Section 2, the psychological response to a sports injury involves emotional, cognitive and behavioural factors, all of which can directly impact physical and psychosocial recovery (17). Likewise, the biopsychosocial model of sports recovery suggests cognitive and affective factors can influence return to competition outcomes, with indirect relation mediated by pain (65). This suggests that psychological implications of (past) injuries could result in runners recollecting the high number of physically painful experiences associated with injuries and possibly result in a higher pain catastrophizing score.

The ability of a runner to complete a race and recover efficiently, despite pain from an injury, EIMD or DOMS, may be explained using the biopsychosocial model (17), as discussed in Section 2. Out of the two potential pathways; namely the endurance reaction and avoidance cycle (74, 77), endurance runners often fit into the endurance model in response to pain during recovery. This pain persistent coping strategy encourages pain experienced during recovery to be viewed as temporary (17).

Long training sessions prior to the Comrades Marathon as well as the ability to recover from races timeously to qualify for Comrades, may reduce the threat value of a runner's pain as a result of learnt past experiences. In other words, the behavioural and cognitive efforts of an endurance runner to manage the demands of recovery may have been a result of adaptive responses learnt from the familiarity of previous recovery sessions (17, 29). So, even if an endurance runner scores high on the PCS prior to a marathon, the coping response during recovery may distract from the pain experienced (29). This may enable the runner to confront their pain, lower the threat value of the pain and possibly return to running sooner (17, 74, 77).

Additionally, these cognitive coping strategies may be motivated by self-confidence and self-determination (29), thereby higher self-efficacy beliefs in runners could contribute to evading the avoidance cycle. The avoidance cycle would prevent endurance runners from returning to training or effectively adapting to their pain during recovery. The effects self-efficacy may have on recovery, following the Comrades Marathon, will be discussed in detail later in section 3.4.4. (pg 68).

As mentioned, past experiences may have played a role in the low pain catastrophizing scores of this sample. This may suggest why two out of the nine participants with high pain catastrophizing scores scored high in magnification. With both participants categorized as novices to the Comrades Marathon, competing in the unknown, with a lack of previous knowledge regarding the outcome, catastrophizing thoughts in these two runners could have been amplified before the race started, possibly explaining the higher magnification score in the PCS.

With only two out of the nine participants with high pain catastrophizing scores scoring high in magnification, the low internal reliability of the magnification scale, as mentioned in Section 2, must be recognised. The low number of runners in this study scoring high in magnification (2), may be owing to the small number of items representing magnification with low degree of repetition, participants who engage in one form of magnification (remembering painful experiences), may not engage in other forms (expecting a poor result). Future studies, which choose to explore the relationship between pain catastrophizing and recovery from pain in the sporting population and utilise the total score of the PCS, must be aware that this may mask the distinctive role of each of its components; namely rumination, helplessness and magnification.

3.4.3. FEAR AVOIDANCE

Seventy-nine percent of the participants in this study scored a low mean score on the Athlete Fear Avoidance Questionnaire (AFAQ) suggesting this sample had low fear avoidance beliefs prior to the Comrades Marathon. Fear avoidance may serve as a psychological barrier during pain recovery resulting in athletes scoring high on the AFAQ (7). The results from this study, however, suggest the opposite.

There are multiple possible explanations why a large proportion of this sample scored low on the AFAQ, although over half (55%) reported a current injury. The physical and physiological differences between ultramarathon runners and recreational runners has been appreciated in research, however, the psychological differences between these two groups may help to explain the results from the AFAQ. It is acknowledged that endurance runners push their bodies' abilities past what might be regarded as the ordinary limits during training and competition (14). To qualify for the Comrades Marathon, the participants in this study had to complete a standard marathon (42. 2 km) in under five hours (3). The successful completion of a race, particularly completing within a set time, involves both mental and physical capabilities (14).

Research has found ultramarathon runners to have high levels of stability and low levels of anxiety (12, 110). As previously mentioned, anxiety has been closely linked with fear. Therefore, the psychological profile that defines an ultramarathon runner may already predispose them to low levels of fear (10-12).

Additionally, ultramarathon runners represent a population that has exceptional capacity to push through the physical pain of a race and recover (86). Ultramarathon runners' resilience towards pain, compared to the general population, might explain the low fear avoidance scores of this study. Like pain catastrophizing, the cognitive strategies adopted by ultramarathon runners to overcome any feelings of anxiety and fear (12) to finish an ultramarathon, may be what separates them from a recreational runner. This attitude may also encourage them to better manage and push through their pain to complete their goal (12). Furthermore, their less negative responses to pain perception, lower pain perception and increased self-confidence in their own abilities to achieve a goal might have predisposed them to become ultramarathon runners in the first place (10-12, 20).

Therefore, an ultramarathon runner's psychological profile as well as their ability to cope with fear to complete an ultramarathon may have to do with their goal directed behaviour (20, 105, 111). Runners are more likely to engage in ultramarathon running if they believe they will be successful (111).
Self-confidence plays a key role in their ability to push themselves through a painful ultramarathon to finish the race and to quickly return to performance following the race (105). Self-efficacy is therefore a vital component for success in ultramarathon running.

3.4.4. SELF-EFFICACY BELIEFS

It is known that competing in sport improves physical well-being as well as positive self-beliefs (8, 11, 98). It is important for endurance runners to be able to cope with pain as well as deal with setbacks to complete an ultramarathon. Therefore, a high level of self-efficacy beliefs is crucial to succeed in a strenuous event, like the Comrades Marathon (111). Of the 77 participants in this study, only two scored below the cut point of 40 on the Pain Self-Efficacy Questionnaire (PSEQ). This represents a high level of self-efficacy among the sample of endurance runners (21).

A high level of self-efficacy beliefs in marathon runners have been shown to effect pain tolerance, affective states, reactions to stress and stamina (66, 111). Endurance runners cognitively interpret their physical state to form self-efficacy judgements about whether they can complete a marathon.

In preparation for the Comrades Marathon, participants would have spent considerable time and effort in increasing running intensity, duration and distance (20).

To qualify for a Comrades Marathon and to successfully complete the race, participants would have to persevere through challenges and learn to cope with pain to reach goals set in training. Essentially, this training would result in improvements in running endurance and tolerance to pain (35, 111), improving both physical and mental skills. Furthermore, self-efficacy beliefs have been inversely related to pain perception. In other words, endurance runners with higher self-efficacy beliefs may be able to cope with pain experienced during and after a marathon better to pursue their goal. This goal may be completing a marathon or earlier return to training after completing a marathon. Endurance runners with lower self-efficacy beliefs are more likely to give up when faced with challenges, like completing an ultramarathon race (111).

When investigating the driving force behind why endurance runners compete in marathon and ultramarathon events, the appeal to achieve a goal was found as a primary motivator (112). Literature specifically investigating self-efficacy in endurance runners has focused mainly on the effects of self-efficacy on running performance, there is minimal research exploring the influence of self-efficacy beliefs on recovery (111).

In Australia, male Olympic-level endurance runners (111) scoring high in self-efficacy placed higher in events, set more difficult goals and ran at a faster pace than runners with lower running self-efficacy. A more recent study in 2008 following a sample of endurance runners training for a marathon found that improvement in running ability related to increased self-efficacy levels (113). In addition, it was also noted that variations in running abilities were related to changes in self-efficacy levels.

A study exploring the change in self-efficacy over 15 weeks of training for a marathon found that of the 39 Caucasian, college runners (11 males), self-efficacy significantly increased from pre-training to post-race (111). The students were asked to complete self-efficacy, affect and training volume questionnaires weekly during training. The final set of questionnaires were completed after the marathon race. Results showed that self-efficacy beliefs pre-training were quite high with a mean of 80%; but post-race results showed a significant increase with self-efficacy scores reaching a mean of 97%. However, finishing times were not recorded, so there was no way to determine if self-efficacy had any effect on running performance (111).

Future studies might want to replicate this study and explore the effects of self-efficacy on performance, in addition, a larger and more cross-cultural sample is needed. The high self-efficacy scores prior to training in the above-mentioned study may suggest that individuals who choose to partake in marathon races may already have pre-existing high self-efficacy beliefs (11,103,112).

In addition to the training, completing a challenge successfully in sport, like finishing an ultramarathon race, is associated with increased self-efficacy (98, 99). A significant increase in self-efficacy from pre-race to post-race was also found in the study mentioned above (111). Therefore, these college runners had more confidence in their abilities to tackle challenges after the race, such as recovery and returning to running. Individuals that choose to participate in ultramarathons are willing to expose themselves to pain and stress to follow strict training programmes (20, 111). This is supported by marathon and ultramarathon runners having higher self-efficacy scores than the general population (98, 102).

The results of these studies give greater insight into the associations between self-efficacy beliefs and endurance runners, an increased level of self-efficacy is imperative for success in ultramarathons.
Therefore, this sample of marathon runners in the current study, may not be a suitable sample to explore the associations between psychosocial factors and pain recovery.
With 97% of the sample in the current study scoring above the cut-point on the PSEQ, this sample may not be appropriate to determine if there is any relation between psychosocial factors and pain during recovery in sport. Future studies might explore the effect of psychosocial factors on pain recovery in different sporting populations.

Past performances, such as previously completing a marathon, serve as a strong source of self-efficacy. Of the 77 participants in the current study, 60 had previously completed the Comrades Marathon with 53 completing the Two Oceans Marathon. Only 13% reported that they were novice runners to the ultramarathon distance. Successful past performances in running are based on a runner's own mastery experience of completing an ultramarathon (20, 111). Experienced marathon runners who can reflect on successful past achievements in running are able to self-appraise their performance, which will affect the way they assess future races. Endurance runners, who view their previous races as successful, will unknowingly increase their self-efficacy beliefs (98, 103).

An average of five Comrade Marathon races were completed per runner of the 60 participants who had previously completed the Comrades Marathon prior to 2017, an average of five Comrades Marathon races were completed per runner (Table 1). The experience of having successfully completed a Comrades Marathon race may have increased the perception that the participant can complete another ultramarathon successfully.

Previous performance and success tend to provide the greatest amount of reliable material upon which to base a runner's pain self-efficacy. Successful previous performances, such as training and races (qualifying events), will raise efficacy expectations in the runners. However, if training sessions, races and qualifying events are deemed failures by the runners this lowers efficacy expectation (111,114). This may highlight an area that needs further investigation in the future. Runners who do not complete the Comrades Marathon would make an interesting sample. This will be discussed further under study limitations.

As mentioned, both participants scoring below the cut off score on the PSEQ were novice runners, with the participant scoring the lowest on the PSEQ only having completed one Comrades Marathon the year before. As the 2017 Comrades Marathon would have been this runners' first "up" race, with no previous experience upon to make expectation, this may have lowered the runner's pain self-efficacy prior to the race. Feelings of anxiety as one races the unfamiliar could potentially lower self-efficacy beliefs. However, experience cannot be viewed as the only factor potentially effecting self-efficacy before a race. A multitude of factors exist that can possibly facilitate or hinder the successful completion of a race and its influence on self-efficacy beliefs.

These potential factors include social support at the time of the race and throughout training, resources available to the runner during training such as access to qualifying races and the circumstances around which training, the race and recovery are completed. This includes family, finance and personal health, all of which can encourage or hinder an endurance runners performance and recovery (110, 111, 114).

Closely related to running experience, is the effect age may have on the self-efficacy of endurance runners. The age of the participants scoring below the cut point on the PSEQ fell below the mean age (41 years) of the sample, as seen in Section 3.3.1 (Table 1). There is little research on the effects of age on self-efficacy in sports; however, older endurance runners may have competed in the sport for a longer period and as a result have greater experience in participating in ultramarathons (111).

There is no evidence to suggest that age influences self-efficacy beliefs, yet as shown, past running experience does improve self-efficacy beliefs (20, 111). Nevertheless, age should be considered in future designs measuring self-efficacy in athletes.

In addition to running experience, social support plays a vital role in increasing self-efficacy in endurance runners during training, the race and recovery (110, 111, 114). All the participants of the current study were members of running clubs. Verbal persuasion and modelling from peers, coaches and friends has been shown to enhance self-efficacy beliefs in runners. Verbal persuasion or encouragment from others can positively influence a runner's behaviour and performance by improving the perception they have of themselves (17). The encouragement (or discouragement) from fellow running club members, peers or coaches, especially those that are highly respected, can influence a runner's self-confidence (66, 111). Yet, verbal persuasion has a limited influence and can only impact a runner's self-confidence if the feedback is somewhat realistic to the runner (111).

Being a member of a running club exposes runners to others who have successfully completed ultramarathons. It is possible that observation of other runners, who have successfully completed the Comrades Marathon, may have contributed to increased beliefs that one too can achieve this goal. Modelling behaviour has been found to enhance self-efficacy in a wide variety of sports, including running (17). The social support, encouragement and modelling of behaviour that a runner receives when being part of a running club may serve as a factor to further enhance self-efficacy beliefs prior to competing in the Comrades Marathon race.

However, as verbal persuasion, observation and socialiastion were not measured in the current study, it must be recognised that any social support, encouragement and modelling behaviour one may receive from being part of a running club is only an assumption.

Considering the above research, it is not surprising that participants of this study had high self-efficacy scores (mean score of 53.36 out of 60) before running the Comrades Marathon. Although research suggests both verbal persuasion and modelling hold a place in increasing self-efficacy, successful past performances are still shown to be the most influential source of self-efficacy in endurance runners (20, 111). Of the 77 participants, only 13% of the sample were novice to the ultramarathon distance and therefore the majority of participants were experienced in completing an ultramarathon race.

Consequently, this study was subject to a ceiling effect as a large percentage of the participants scored very high on the PSEQ, thereby making it difficult to discriminate among the participants at the top of the scale. The ceiling effect may be because of the positive self-image the runners had prior to the Comrades. This positive self-image could be owing to the large volume of training and previous ultramarathons that the participants had completed to qualify for the Comrades Marathon (98). This may have resulted in a higher reported self-efficacy score (only 48 hours prior to Comrades) than if the participant were to complete the PSEQ at the beginning of, or mid training. It would, therefore, be beneficial to identify how endurance runners attribute success and failure along with available strategies to enhance self-efficacy beliefs in this population.

3.4.5. PAIN SEVERITY SCORES AND RECOVERY

It is well-known that pain can impede recovery following a sporting event or injury (109). However, there is a lack of aligned research exploring recovery following a marathon (42, 105, 109), with large variability reported in individual recovery periods (42). The general trend of research suggests the discomfort experienced with DOMS reduces within seven to 10 days of a marathon race (46). As discussed EIMD, DOMS, fatigue and running training history all play a role in the recovery period (49, 50), with research reporting a positive correlation between marathon running experience and improved pain recovery time (114, 115).

In the current study over three-quarters of the sample (78%) had previously completed a Comrades Marathon. This data may explain why 75% of participants reported one out of 10 or less by day five on the Pain Severity Scale. Further investigation into pain recovery following an ultramarathon should explore a novice group of endurance runners. This may attempt to eliminate the role experience in running can play in recovery.

Fear avoidance beliefs and pain catastrophizing have a considerable influence on the pain recovery process (105). However, there were no correlations between PCS scores and pain scores or AFAQ scores and pain scores over the 10 days of recovery. As mentioned, psychological traits have been shown to influence pain perception. Ultramarathon runners do not view pain as a threat but rather an “ally” during training (79). As the intensity and volume of training increases, pain-related fear is reduced, and pain is interpreted as a sign of accomplishing a set goal (79). Therefore, not only does pain tolerance increase with training and experience in running, but the view on the pain experience changes (69).

These unique traits, either inherent or learnt over time, encourage long distance runners to draw their attention away from pain either during an ultramarathon race or during recovery from a race. As discussed, goal setting and achievement, training for an ultramarathon and successful past performances go hand in hand with increased self-efficacy beliefs (12). Runners with higher self-efficacy scores can manage their pain better during performance and recovery (104). This may explain the Pain Severity Scores over the 10-day recovery, with 75% of participants reporting one out of 10 or less by day five.

Perhaps these findings can be carried over into the general sporting population. Ultramarathon runners learn to reduce their awareness and attention to pain during training, improving pain tolerance and encouraging quicker recovery and return to performance (12, 20, 28). This behaviour can be encouraged in other sports by health professionals, sports physiotherapists and coaches. Strategies of increasing pain tolerance by enhancing self-efficacy beliefs will be discussed under Section 3.4.5.1.

The results of this study showed little correlation between finishing times and psychosocial factors, and no correlation between finishing times and pain catastrophizing, fear avoidance beliefs and self-efficacy beliefs. However, research suggests that self-efficacy plays a role in improving and predicting performance in runners following a marathon (20, 92, 102). Perhaps the results of the current study differed to previous studies because of the sample used. This study is the first of its kind to explore psychosocial factors affecting recovery in ultramarathon runners.

As mentioned, the psychological character traits of ultramarathon runners, namely; better pain tolerance, higher self-efficacy beliefs and improved mental coping strategies, may be associated factors in the recovery observed in the sample following the 2017 Comrades Marathon (14, 47). The perception of these participants that they could compete successfully in the Comrades Marathon whether it be from experience, modelling behaviour or verbal persuasion (87, 88, 114, 115), may have played a role in the successful completion of the race. However, due to the ceiling effect in the current study, future studies should develop a more sensitive instrument to measure self-efficacy in athletes.

It is evident from existing literature that high self-efficacy beliefs play an important role in a runner's performance and may potentially play a role in an athlete's ability to recover from a race (111, 114). Additionally, runners with high self-efficacy beliefs can tolerate pain better during performance and recovery (84). With 75 of the 77 participants of the current study scoring high on the PSEQ prior to the Comrades Marathon, self-efficacy may have contributed to their successful recovery.

In addition, 75% of participants reporting one out of 10 or less by day five of their recovery. It is suggested that self-efficacy beliefs are motivated by four principal sources: positive self-talk, instruction and drills, modelling confidence and verbal persuasion (66, 88) which will now be discussed in more detail.

3.4.5.1. IMPROVING SELF-EFFICACY BELIEFS IN ATHLETES

Gradually exposing athletes to activities which they view as threatening (graded exposure) is recognised as an effective strategy to reduce fear avoidance beliefs and pain catastrophizing (99, 104). Though graded exposure seems to be effective in reducing fear avoidance beliefs and pain catastrophizing, strategies for addressing low self-efficacy among athletes are also necessary. Self-confidence and high self-efficacy have proven to be crucial factors in competitive, successful performance in athletes (66) and may play a role in recovery.

Positive self-talk is highly effective in promoting self-efficacy in athletes, with national Olympic coaches in the USA identifying this strategy as being the most effective and most widely used in enhancing self-confidence in their teams (88). Bandura (66) believed that completing a task successfully is the most important means of enhancing self-efficacy. By qualifying for the Comrades Marathon, runners would have already increased self-efficacy beliefs with successful completion of a marathon in order to qualify.

Furthermore, setting SMART (specific, measurable, attainable, relevant, timely) goals and achieving them, such as participating in time trials, improving finishing times, completing longer training runs and qualifying for races, may further increase self-efficacy in Comrade runners (10, 114).

As mentioned, being part of a running club and being surrounded by experienced runners who have successfully completed a Comrades Marathon may potentially be associated with modelling confidence in novice runners (87). Likewise, research suggests verbal persuasion or encouragement from coaches, fellow runners from running clubs and health professionals has been proven to enhance self-efficacy in athletes (111). However, the influence of running clubs on improving self-efficacy was not investigated in the current study. Therefore, any verbal persuasion or modelling behaviour associated with being a member of a runnng club can only be seen as an assumption. Further limitations to the current study will now be discussed.

3.4.6. STUDY LIMITATIONS

A primary limitation of this study, which is characteristic of correlational research, is reporting bias. In addition, data were collected from only two running clubs in Johannesburg with participants mainly being male and English speaking. This convenient and purposive population limits generalisability. A wider group of participants are required with a greater variability in demographics. Future studies should include a greater number of running clubs representing a greater range of demographics across South Africa.

The Comrades Marathon race alternates each year between an “up” and “down” race. The “up” race starts in Durban at an altitude just above sea-level. At 20 km it reaches an altitide of 450 m with a steep incline to the 40 km mark reaching an altitude just below 750 m. The “up” race then plateaus slightly with rolling hills ranging between 700 m and 750 m above sea level. It reaches its highest point of 810 m above sea level at the 70 km point before finishing in Pietermaritzburg with a gradual decline to 700 m above sea level. The “down” race is the reverse starting in Pietermaritzburg and ending in Durban. The symptoms associated with EIMD and DOMS are significantly exacerbated when running downhill compared to uphill (22, 45, 46). The 2017 Comrades Marathon was an “up” race which may have influenced the pain experienced during recovery compared to if the race was a “down” race. Future studies should explore the effects of psychosocial factors and pain recovery on ultramarathon runners competing in a race with a profile that is mainly downhill where the extent of EIMD and DOMS is significantly higher.

As there were no significant correlations found between pain recovery and pain catastrophizing, fear avoidance beliefs and self-efficacy beliefs (three independent variables), a multiple regression analysis could not be performed. However, if future studies find correlations between pain recovery and these psychosocial factors based on the suggestions above, a multiple regression analysis is recommended.

Further pain recovery was the only marker used to assess recovery following the Comrades Marathon. Pain, however, is poorly correlated with biomechanical and functional markers of recovery (116). Future research mightassess different recovery markers, such as fatigue. By exploring different recovery markers, additional psychosocial factors influencing recovery may be identified.

Despite these limitations, this study provides insight into the importance of self-efficacy in athletes and the role it plays in success in running. Therefore, athletes demonstrating lower self-efficacy beliefs may benefit from employing strategies which not only address fear and pain catastrophizing but increase self-efficacy (81).

CHAPTER 4: SUMMARY AND CONCLUSION

There is a wealth of literature that supports the negative impact that psychosocial factors can have on an athlete's performance, coping strategies and recovery from injury (7, 13, 26). Fear avoidance beliefs and pain catastrophizing can delay recovery from an injury or sporting event and delay return to sport (29, 69). If athletes are not mindful of this, fear avoidance beliefs and pain catastrophizing have the potential to contribute to the development of persistent pain and/or reduced performance (7, 9). Consequently, the longer the exposure to these negative psychosocial stressors, the greater the impact and possible disability and development of chronic pain (7).

Self-efficacy has proven to play a key role in an athlete's success. Increased self-belief in one's own abilities has shown to improve an athlete's tolerance to pain. This will allow an endurance runner to not only complete an ultramarathon but also better cope with pain afterwards, allowing for a quicker return to performance. Past experiences (training, qualifying for an ultramarathon, previously completing an ultramarathon), goal setting and achieving, social support from peers and running clubs have all been shown to increase self-efficacy belief in endurance runners (67, 99, 101).

Thus, the purpose of this dissertation was to explore potential associations between pain catastrophizing, fear avoidance beliefs and self-efficacy beliefs and pain recovery in a cohort of ultramarathon runners competing in the 2017 Comrades Marathon. The study applied a quantitative approach to investigate the relationship between these three mentioned psychosocial factors and pain recovery for 10 days after the Comrades Marathon. Results from this study showed no correlation between each of the psychosocial factors and pain over the 10 days of recovery following the 2017 Comrades Marathon.

The results of this study might be explained by the sample group used. Research has shown that ultramarathon runners have a higher tolerance to pain felt during and after a race and better coping strategies to deal with stress and fatigue to complete a goal. Higher self-efficacy beliefs are believed to be an associated factor to this psychological trait. Running experience, such as previously completing a Comrades marathon, qualifying for the Comrades Marathon and successful training, plays a vital role in improving self-efficacy among runners.

Regardless of the limitations of the current study, high self-efficacy scores, previous experience, higher pain tolerance and better coping strategies in ultramarathon runners may be contributing factors to the success in recovery from pain. Therefore, health professionals need to be aware that athletes in pain are potentially emotionally vulnerable. With fear avoidance beliefs, pain catastrophizing and self-efficacy beliefs all possibly influencing pain experienced during recovery, it is the role of the physiotherapist, sports physician and coach to ensure the athlete is both physically and psychologically ready to return to performance (55, 56).

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CHAPTER 6: APPENDICES

APPENDIX 1: INFORMED CONSENT FORM

Study: Do psychosocial factors predict pain after participation in an ultramarathon race?

Dear Participant,

The University of Cape Town and Masters of philosophy student in sports physiotherapy, Jessica Rabbitte, will be conducting a study to investigate the following:

- To predict whether psychosocial factors predict pain in ultramarathon runners after competing in the Comrades ultramarathon
- To assess the effect of psychosocial factors on recovery in runners competing in the Comrades ultramarathon.

The study will help us to understand whether there are other underlying factors that contribute to pain and essentially recovery in ultramarathon runners and to what extent. The findings of this study might allow us to identify and treat these factors early in training to reduce the time taken to recover from an endurance sporting event.

Researcher's Contact information:

Investigator	**Contact number**	**Email Address**
Jessica Rabbitte	0829256220	jessrabbitte@gmail.com

Please answer all the following questions by ticking the appropriate block. Once all the questions have been answered please print your name and sign the form in the space provided.

Consent Form

Have you read the study information sheet?	**Yes**	**No**
Have you had an opportunity to ask questions and discuss the study?	**Yes**	**No**
Have you received satisfactory answer to all your questions?	**Yes**	**No**
Have you received enough information about the study?	**Yes**	**No**

Do you agree that your participation in the study is voluntary and that you are free to withdraw at any stage?	**Yes**	**No**
Do you understand that the study has received ethical clearance from the University of Cape Town Ethics Committee	**Yes**	**No**
Do you understand who will have access to your personal data, how the data will be stored, and what will happen to the data at the end of the research project	**Yes**	**No**
Do you agree to take part in the study?	**Yes**	**No**

Participant: (Please print name):

Signature: _____ **Date: _____**

Witnessed Consent (Please print name):

Signature: _____ **Date: _____**

**The UCT's Faculty of Health Sciences Human Research Ethics Committee can be contacted on 021 406 6338 in case you have any ethical concerns or questions about your rights or welfare as a participant on this research study

APPENDIX 2: INFORMATION SHEET

Study: Do psychosocial factors predict pain after participation in an ultramarathon race?

Dear Participant,

My name is Jessica Rabbitte, I am a qualified physiotherapist completing a Sports Physiotherapy master's degree at the University of Cape Town and I'm currently researching the effects of psychosocial factors on pain and recovery in ultramarathon runners.

Why is this study being done?

It is important to any sportsperson to become a better athlete. This can be done by improving performance and reducing recovery time after a race. Reduced recovery time means that athletes will be able to return earlier to their sport. A lot of factors can affect returning to sport after a big race including stiffness, pain and injuries. However, there is little information on the effects of psychosocial factors on recovery. But what are psychosocial factors? Psychosocial factors are the psychological and social behaviours that affect a person's well-being and health. These factors can include stress, anxiety, relationships with family and friends, support structures, culture etc. Psychosocial factors can also include fear of injuring one's self or fear of re-injury.

A lot of research has looked at how "physical factors" can affect an athlete's recovery but there is little information on how these "psychosocial factors" affect sporting recovery. This lack of information has motivated me to look at whether these psychosocial factors influence recovery after the Comrades marathon. The Comrades marathon has been chosen as it is a physically challenging race that requires a good recovery after the race. I am hoping that this study will help us to improve recovery in runners after they compete in an ultramarathon race. I am hoping that this study can identify any factors other than physical ones that can slow down an athlete's recovery and return to sport.

Are you eligible to take part in the study?

In order to compete in this study, you must be already qualified to participate in the Comrades Marathon 2017. For your own safety, any flu-like symptoms two weeks prior to the race will result in exclusion from the study and you will be encouraged to see a doctor for further assessment in this situation.

What will happen if you wish to take part in the study?

Should you choose to take part in the study, you will be asked to complete the attached questionnaires today: **Medical and Sports History questionnaire and sign the informed consent** (it will take you no longer than 20 minutes). These will need to be handed to the researcher today. The scales are also available in Afrikaans and isiZulu from the researcher.

You will also receive a **second pack of questionnaires** (pack two) containing:

(1) Pain Catastrophizing Scale,

2) The Athlete Fear Avoidance Questionnaire

3) Pain Self-Efficacy Scale

These questionnaires are to assess different psychosocial components of pain. Each questionnaire will include questions that you need to answer that will give the researcher a better understanding on how you, think, feel and deal with pain when training and competing in sport. There are no right or wrong answers for these questionnaires and it is important that these questionnaires are answered truthfully.

After the race I will also need access to your marathon running times which I will get from the comrade's marathon website using your race numbers. These times will remain confidential and the information will be used to work out your running performance.

How long will the study take?

You will be asked to complete the 3 questionnaires (above) in pack two **48 hours before the Comrades race.** This will take you approximately 10 minutes.

Attached to this pack will be a pain logbook. You will be asked to **start the logbook the night of the Comrades and the next 9 evenings** (with a total of 10 entries). It is encouraged that the logbook be **completed around the same time every night** before bed.

What if you forget?

An SMS or email will be sent to you 48 hours before the race to remind you to complete the questionnaires in pack two. An SMS or email will also be sent to you every day for the 10 days after the Comrades to remind you to fill out your pain logbook. If you miss a day of completing the logbook please continue to complete the next night's logbook the following day. This ensures that the logbook will be fully completed 9 days after the race.

What do you do with the completed questionnaires and pain logbook?

These questionnaires and logbook will be collected from the running club, you directly or handed into the researcher at the Richard Feher Physiotherapy practice at Randburg Medicross.

What are the risks of the study?

There are no risks associated with filling out these questionnaires or completing the pain logbook.

What are the benefits of the study?

You will receive the results of your individual questionnaires after the study is completed. The results of the study will be presented one evening after the study is finished to those who are interested. There will be no remuneration for taking part in the study.

Who will see the information which is collected from the study?

Only the researcher and research assistants will have access to your personal information. Your information and completed questionnaires will be kept in a locked safe at the Randburg Medicross physiotherapy practice. The results will be saved on an external hard drive that will be password protected and locked in the safe at the practice. Only the researcher and research assistants will have access to the safe key. The study will only make use of your answers from the questionnaires. There will be no personal details used in the study itself. When the results of the study are presented, all information will be anonymous. You will have access to your individual results after the study is completed.

What happens at the end of the study?

On completion of the study your findings will be made available to you. An evening will be held at you running club to discuss the results of the study if you would like to attend. This is not compulsory. The study will be published in a peer reviewed journal. However, all your personal information will remain confidential.

What other choices do you have?

You may wish not to participate in this study. There will be no penalty if you choose not to participate. You are also free to pull out of the study at any time without any penalty or explanation needed.

I appreciate your willingness to participate in the study.

Kind regards,

Jessica Rabbitte
BSc Physiotherapy (UCT)

Who do I speak to if I have any further questions about the study?

Investigator contact details	**Supervisor:**	**Supervisor:**
Jessica Rabbitte Richard Feher Physiotherapy and Associates Randburg Medicross Corner of Malibongwe and Rabie Road Robindale Johannesburg 0829256220 jessrabbitte@gmail.com	**A/Prof Romy Parker** Division of Physiotherapy Department of Health and Rehabilitation Sciences University of Cape Town Groote Schuur Hospital Anzio Road Observatory 7725 021 406 6431 Romy.parker@uct.ac.za	**Dr Theresa Burgess** Division of Physiotherapy Department of Health and Rehabilitation Sciences University of Cape Town Groote Schuur Hospital Anzio Road Observatory 7725 021 406 6171 Theresa.burgess@uct.ac.za

APPENDIX 3: MEDICAL AND SPORTS HISTORY QUESTIONNAIRE

MEDICAL AND SPORTS HISTORY QUESTIONNAIRE

Thank you for taking the time to complete this questionnaire, which will take 10 minutes of your valuable time to complete. The completion of the questionnaire is voluntary, and all the information will be kept confidential. The information collected will only be used for research purposes.

Instructions:

Please complete Sections A, B, C, D, E, F

Section A:	Personal Details
Section B:	Racing and Training history
Section C:	General Medical History
Section D:	Specific Medical History
Section E:	Specific Medical History- Medications
Section F:	Specific Injury History

Section A: Personal Details			
2017 Comrades Race Number			
Surname			
First Name			
Language			
Postal Address		Postal/ Zip Code	
E-mail address		Phone (day time)	code number
Date of birth	yyyy-mm-dd	Cell	
Height	cm	Gender	Male: Female:
Weight	kg		
Running club		Age	

Section B: Racing and Training History	
What is your predicted time for the 2017 Comrades Marathon?	____Hrs ____Min

Type of Event	**Two Oceans Marathon**	**Comrades Marathon**
Which Races have you participated in?	Yes ☐ No ☐	Yes ☐ No ☐
Year of first event		
How many events have you participated in?		
Personal best time	_____ hrs:min	_____ hrs:min

Section C: General medical history	
1.In the past **6 weeks** did you suffer from any **symptoms of flu** (fever, sore throat, blocked or runny nose, cough, wheeze, muscle aches and pains)? **If you answer "yes", please complete the additional questions in Section D.**	Yes ☐ No ☐
2.Have you **ever** in your running career **suffered from an injury?**	Yes ☐ No ☐
3.Have you **ever** in your running career **used medicines to treat injuries or pain** in the week **before, during or after a race** – including anti-inflammatory drugs, cortisone (pills, or injection), or pain killers? **If you answer "yes", please complete the additional questions in Section E.**	Yes ☐ No ☐
4.Please tick in which anatomical area you ever had **surgery** performed.	☐ Head ☐ Finger ☐ Neck ☐ Lower back ☐ Face ☐ Hip ☐ Front chest ☐ Thigh ☐ Back chest ☐ Knee ☐ Shoulder ☐ Lower leg ☐ Upper arm ☐ Achilles ☐ Elbow ☐ Ankle ☐ Forearm ☐ Foot ☐ Wrist ☐ Abdomen ☐ Other (Specify: _____) ☐ NO SURGERY TO DATE
5.Do you **currently** suffer from any **symptoms of injury** in the muscles, tendons, bones, ligaments or joints? **If you answer "yes", please complete the additional questions in Section F. If "no" continue with the rest of the questionnaire leaving out Section F.**	Yes ☐ No ☐

6.**Neurological Conditions** Do you currently present with any neurological conditions?	☐ Yes ☐N0 (Please Specify: _____ _____ _____)

Section D: Specific Medical History	
1. Flu symptoms in the last 6 weeks	
(1a) Please tick which of these flu symptoms you suffered from **in the last 6 weeks**.	☐ Fever ☐ Cough ☐ Joint pains ☐ Blocked nose ☐ Wheezing ☐ Runny nose ☐ Muscle aches ☐ Any other flu symptoms (Specify: _____)
(1b) Please tick which of these flu symptoms you suffered from **in the last 7 days**.	☐ Fever ☐ Cough ☐ Joint pains ☐ Blocked nose ☐ Wheezing ☐ Runny nose ☐ Muscle aches ☐ Any other flu symptoms (Specify: _____)

Section E: Specific Medical History - Medications	
2. Use of medicines to treat an injury or pain before or during participation in Comrades	
(2a) Which of the following medicines have you used in the past to treat an injury or pain **in the week just before** a race?	☐ Paracetamol (e.g. Panado, Tylenol) ☐ Non-steroidal anti-inflammatories (e.g. Voltaren, Cataflam) ☐ Cortisone (pills) ☐ Cortisone injection ☐ Codeine ☐ Anti-inflammatory gels/creams/patches ☐ Any other pain killers (Specify: _____)
(2b) Which of the following medicines have you used in the past to treat an injury or pain **during a race**?	☐ Paracetamol (e.g. Panado, Tylenol) ☐ Non-steroidal anti-inflammatories (e.g. Voltaren, Cataflam) ☐ Cortisone (pills) ☐ Cortisone injection ☐ Codeine ☐ Anti-inflammatory gels/creams/patches

	☐ Any other pain killers (Specify: _____)
(2c) Which of the following medicines have you used in the past to treat an injury or pain **after a race**?	☐ Paracetamol (e.g. Panado, Tylenol) ☐ Non-steroidal anti-inflammatories (e.g. Voltaren, Cataflam) ☐ Cortisone (pills) ☐ Cortisone injection ☐ Codeine ☐ Anti-inflammatory gels/creams/patches ☐ Any other pain killers (Specify: _____)
3. Current use of Chronic Medication for Pain or Neuropsychiatric Conditions	
(3a) Are you currently taking any chronic medication for pain management?	☐ Yes ☐N0 ☐ Oral Cortisone ☐ Other (Please Specify: _____ _____ _____ _____ _____)
(3b) Are you currently taking any chronic medication for neuropsychological conditions?	☐ Yes ☐N0 (Please Specify: _____ _____ _____ _____ _____)

Section F: Specific Injury History	
1. History of any <u>current injury</u> that you suffer from	
Injury 1	
(1a) What was the approximate date when you first became aware of the injury?	Month Year
(1b) Please indicate which side of your body is injured. (if applicable)	☐ Right ☐ Left
(1c) Please indicate which anatomical area is currently injured	☐ Head ☐ Elbow ☐ Hamstring ☐ Neck ☐ Forearm ☐ Quadriceps ☐ Face ☐ Wrist ☐ Knee ☐ Front chest ☐ Finger ☐ Shin ☐ Back chest ☐ Lower back ☐ Achilles ☐ Shoulder ☐ Hip ☐ Ankle ☐ Upper arm ☐ Thigh ☐ Foot Other (Specify: _____)
(1d) Please indicate the type of structure that was injured	☐ Muscle ☐ Ligament ☐ Tendon ☐ Joint ☐ Bone Other (Specify: _____)
(1e) Please indicate the severity of the injury. Please only tick one box.	☐ I only experience symptoms after exercise - Grade 1 ☐ I experience symptoms during exercise, but it does not interfere with exercise - Grade 2 ☐ I experience symptoms during exercise that may interfere with my training/competition - Grade 3 ☐ I am so painful that I may not be able to train or compete - Grade 4
(1f) Please indicate how your injury was treated to date. You can tick more than one box.	☐ Rest ☐ Tablets ☐ Stretches ☐ Cortisone injection ☐ Physiotherapy ☐ Other injection ☐ Surgery ☐ Orthotics ☐ Strengthening exercises ☐ Equipment change Other (Specify: _____)

Injury 2	
(2a) What was the approximate date when you first became aware of the injury?	Month Year
(2b) Please indicate which side of your body is injured. (if applicable)	☐ Right ☐ Left
(2c) Please indicate which anatomical area is currently injured.	☐ Head ☐ Elbow ☐ Hamstring ☐ Neck ☐ Forearm ☐ Quadriceps ☐ Face ☐ Wrist ☐ Knee ☐ Front chest ☐ Finger ☐ Shin ☐ Back chest ☐ Lower back ☐ Achilles ☐ Shoulder ☐ Hip ☐ Ankle ☐ Upper arm ☐ Thigh ☐ Foot Other (Specify: _____)
(2d) Please indicate the type of structure that was injured.	☐ Muscle ☐ Ligament ☐ Tendon ☐ Joint ☐ Bone Other (Specify: _____)
(2e) Please indicate the severity of the injury. Please only tick one box.	☐ I only experience symptoms after exercise - Grade 1 ☐ I experience symptoms during exercise, but it does not interfere with exercise - Grade 2 ☐ I experience symptoms during exercise that may interfere with my training/ competition - Grade 3 ☐ I am so painful that I may not be able to train or compete - Grade 4

(2f) Please indicate how your injury was treated to date. You can tick more than one box.	☐ Rest ☐ Tablets ☐ Stretches ☐ Cortisone injection ☐ Physiotherapy ☐ Other injection ☐ Surgery ☐ Orthotics ☐ Strengthening exercises ☐ Equipment change Other (Specify: _____)

APPENDIX 4: PAIN CATASTROPHIZING SCALE

PCS

Client No.: _____ Age: _____ Sex: M(__) F(__) Date: _____

Everyone experiences painful situations at some point in their lives. Such experiences may include headaches, tooth pain, joint or muscle pain. People are often exposed to situations that may cause pain such as illness, injury, dental procedures or surgery.

We are interested in the types of thoughts and feelings that you have when you are in pain. Listed below are thirteen statements describing different thoughts and feelings that may be associated with pain. Using the following scale, please indicate the degree to which you have these thoughts and feelings when you are experiencing pain.

0 – not at all **1** – to a slight degree **2** – to a moderate degree **3** – to a great degree **4** – all the time

When I'm in pain …

1. ☐ I worry all the time about whether the pain will end.
2. ☐ I feel I can't go on.
3. ☐ It's terrible and I think it's never going to get any better.
4. ☐ It's awful and I feel that it overwhelms me.
5. ☐ I feel I can't stand it anymore.
6. ☐ I become afraid that the pain will get worse.
7. ☐ I keep thinking of other painful events.
8. ☐ I anxiously want the pain to go away.
9. ☐ I can't seem to keep it out of my mind.
10. ☐ I keep thinking about how much it hurts.
11. ☐ I keep thinking about how badly I want the pain to stop.
12. ☐ There's nothing I can do to reduce the intensity of the pain.
13. ☐ I wonder whether something serious may happen.

… Total

APPENDIX 5: ATHLETE FEAR AVOIDANCE QUESTIONNAIRE

UNIVERSITÉ Concordia UNIVERSITY

Name: **Sport:** **Date:**

Athletic Fear Avoidance Questionnaire (AFAQ)

Instructions: We are interested in your feelings or thoughts when in pain as a result of a sport injury. Using the following scale, please indicate the degree to which you have these thoughts and feelings when you are in pain due to a sports injury.

Rating	1	2	3	4	5
Meaning	Not at all	To a slight degree	To a moderate degree	To a great degree	Completely agree

Statement	Rating
1. I will never be able to play as I did before my injury	
2. I am worried about my role with the team changing	
3. I am worried about what other people will think of me if I don't perform at the same level	
4. I am not sure what my injury is	
5. I believe that my current injury has jeopardized my future athletic abilities	
6. I am not comfortable going back to play until I am 100%	
7. People don't understand how serious my injury is	
8. I don't know if I am ready to play	
9. I worry if I go back to play too soon I will make my injury worse	
10. When my pain is intense, I worry that my injury is a very serious one	

APPENDIX 6: PAIN SELF-EFFICACY QUESTIONNAIRE

PAIN SELF EFFICACY QUESTIONNAIRE (PSEQ)

M.K.Nicholas (1989)

NAME: _____ DATE: _____

Please rate how **confident** you are that you can do the following things at present, **despite the pain**. To indicate your answer circle **one** of the numbers on the scale under each item, where 0 = not at all confident and 6 = completely confident.

For example:

0	1	2	3	4	5	6
Not at all Confident						**Completely confident**

Remember, this questionnaire is **not** asking whether of not you have been doing these things, but rather **how confident you are that you can do them at present, despite the pain.**

---

1. I can enjoy things, despite the pain.

0	1	2	3	4	5	6
Not at all Confident						**Completely confident**

2. I can do most of the household chores (e.g. tidying-up, washing dishes, etc.), despite the pain.

0	1	2	3	4	5	6
Not at all Confident						**Completely confident**

3. I can socialise with my friends or family members as often as I used to do, despite the pain.

0	1	2	3	4	5	6
Not at all Confident						**Completely confident**

4. I can cope with my pain in most situations.

0	1	2	3	4	5	6
Not at all Confident						**Completely confident**

5. **I can do some form of work, despite the pain. ("work" includes housework, paid and unpaid work).**

0	1	2	3	4	5	6
Not at all Confident						Completely confident

6. **I can still do many of the things I enjoy doing, such as hobbies or leisure activity, despite pain.**

0	1	2	3	4	5	6
Not at all Confident						Completely confident

7. **I can cope with my pain without medication.**

0	1	2	3	4	5	6
Not at all Confident						Completely confident

8. **I can still accomplish most of my goals in life, despite the pain.**

0	1	2	3	4	5	6
Not at all Confident						Completely confident

9. **I can live a normal lifestyle, despite the pain.**

0	1	2	3	4	5	6
Not at all Confident						Completely confident

10. **I can gradually become more active, despite the pain.**

0	1	2	3	4	5	6
Not at all Confident						Completely confident

APPENDIX 7: PAIN LOGBOOK

Participant Pain Logbook

Participant race number: _____

Please complete the following logbook for a total of 10 days. Please start the logbook on the **evening of completing the Comrades**. Continue to complete the logbook for every successive day at the same time in the evening (before bed).

If you have any queries, please contact Jessica Rabbitte using the details below. Thank you for taking time to participate in this study and completing the form.

Jessica Rabbitte

BSc Physiotherapy (UCT)

Cell: 0829256220

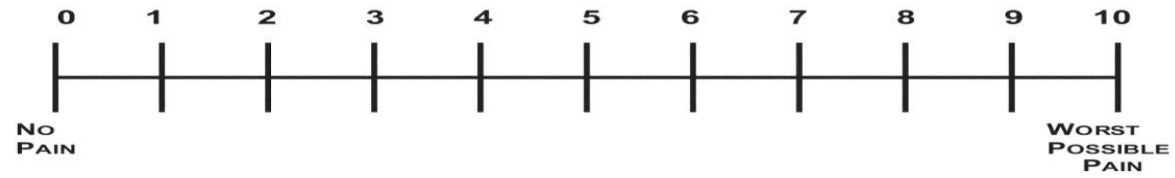
Email: jessrabbitte@gmail.com

PAIN LOGBOOK DAY 1: (Night of the Comrades)

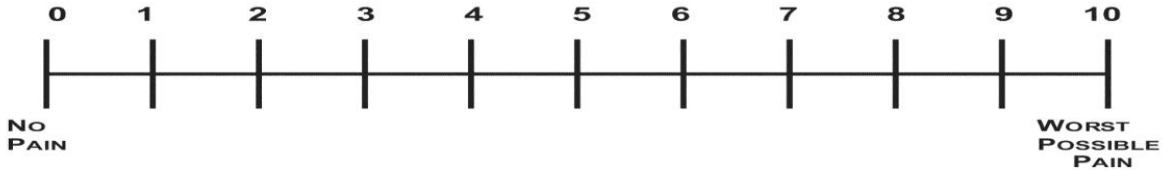
Please complete the pain logbook before you go to bed every evening. Write down the time you complete the form and mark your pain on the visual analogue scale out of 10.

Time: _____

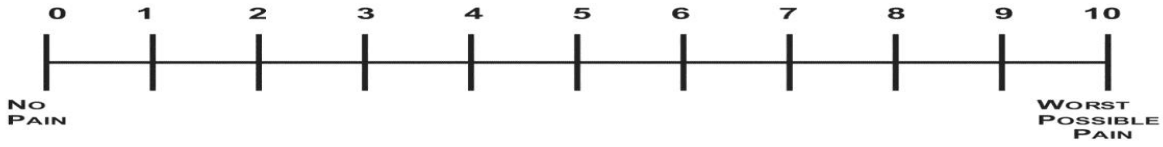
Visual Analogue Scale: How bad has your pain been today on average?



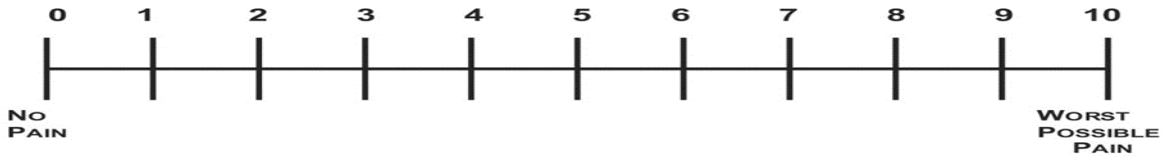
Visual Analogue Scale: What was your pain at its worst today?



Visual Analogue Scale: What was your pain at its least today?



Visual Analogue Scale: What was your pain right now



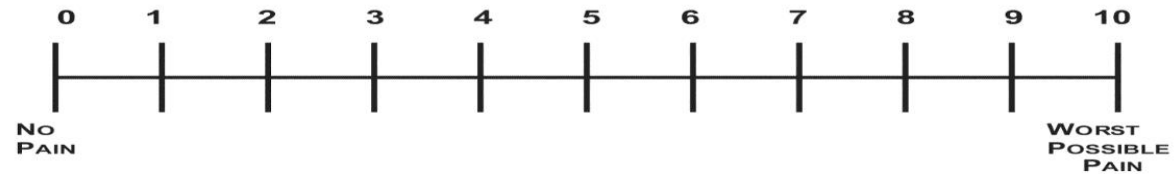
Medication taken today for pain:	
Time taken:	
Name of medication and dosage (eg. Panado, 500mg)	

PAIN LOGBOOK DAY 2:

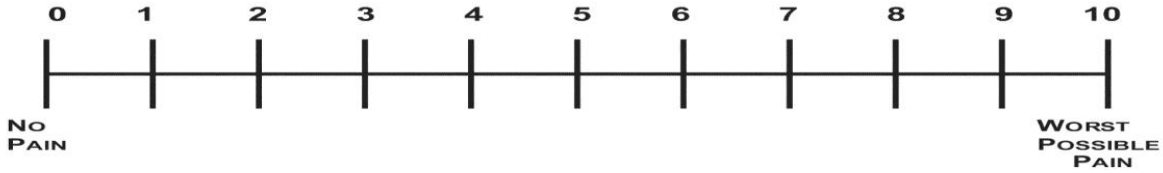
Please complete the pain logbook before you go to bed every evening. Write down the time you complete the form and mark your pain on the visual analogue scale out of 10.

Time: _____

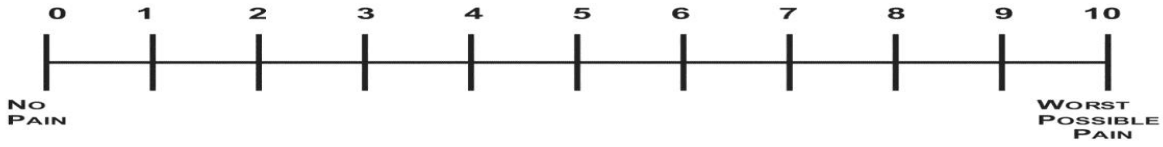
Visual Analogue Scale: How bad has your pain been today on average?



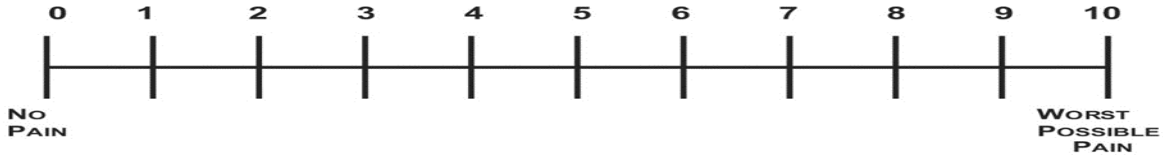
Visual Analogue Scale: What was your pain at its worst today?



Visual Analogue Scale: What was your pain at its least today?



Visual Analogue Scale: What was your pain right now?



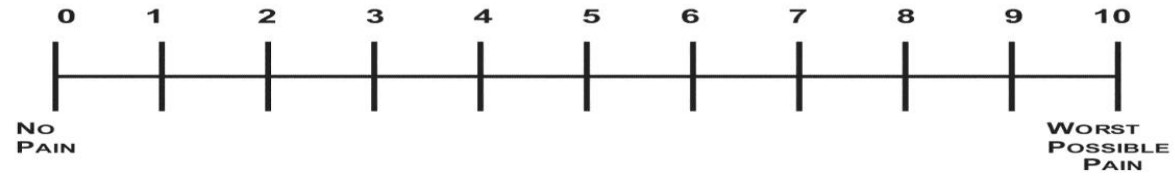
Medication taken today for pain:	
Time taken:	
Name of medication and dosage (eg. Panado, 500mg)	

PAIN LOGBOOK DAY 3:

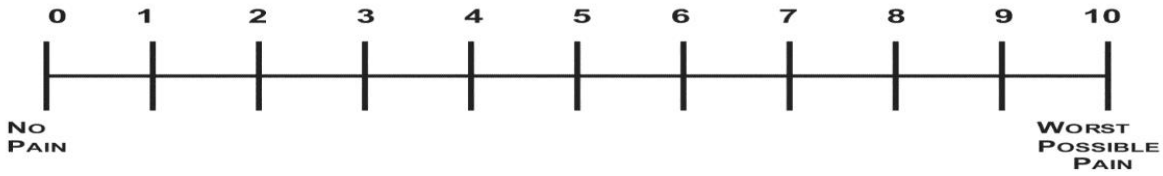
Please complete the pain logbook before you go to bed every evening. Write down the time you complete the form and mark your pain on the visual analogue scale out of 10.

Time: _____

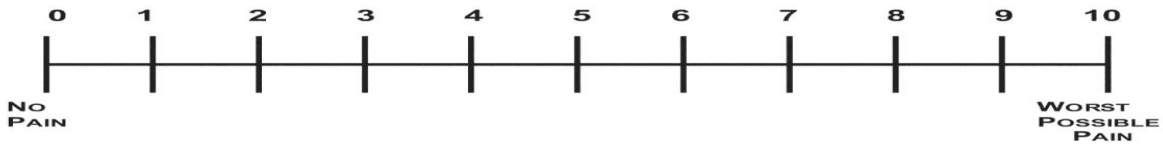
Visual Analogue Scale: How bad has your pain been today on average?



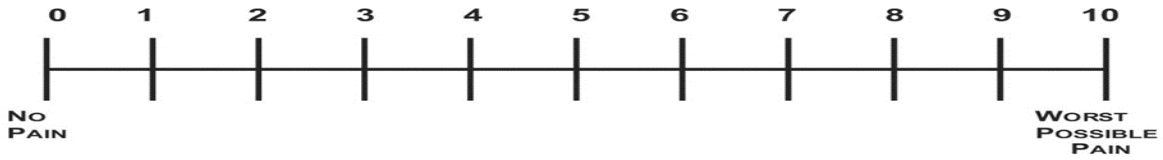
Visual Analogue Scale: What was your pain at its worst today?



Visual Analogue Scale: What was your pain at its least today?



Visual Analogue Scale: What was your pain right now?



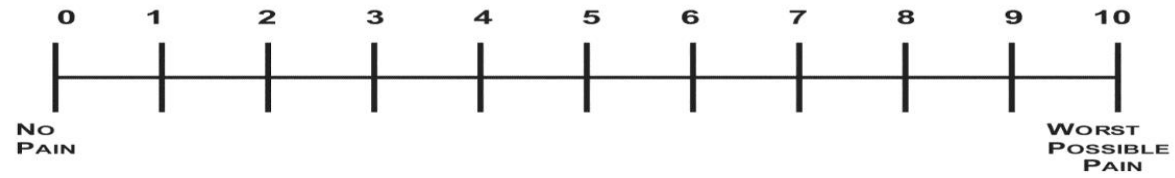
Medication taken today for pain:	
Time taken:	
Name of medication and dosage (eg. Panado, 500mg)	

PAIN LOGBOOK DAY 4:

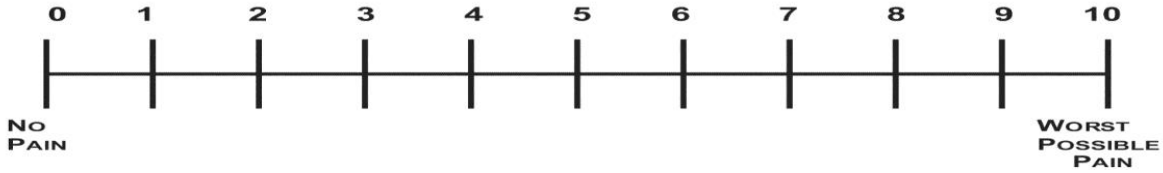
Please complete the pain logbook before you go to bed every evening. Write down the time you complete the form and mark your pain on the visual analogue scale out of 10.

Time: _____

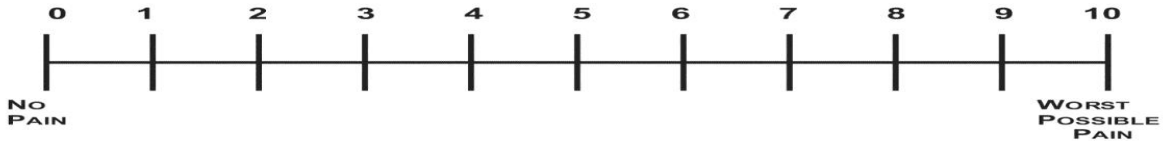
Visual Analogue Scale: How bad has your pain been today on average?



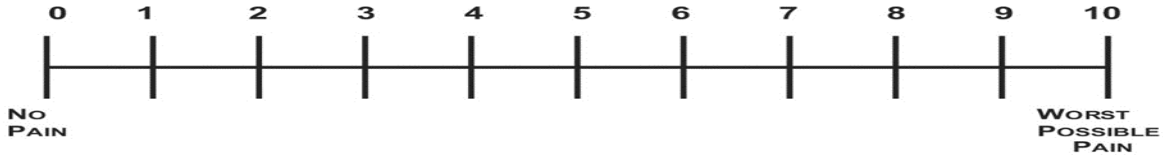
Visual Analogue Scale: What was your pain at its worst today?



Visual Analogue Scale: What was your pain at its least today?



Visual Analogue Scale: What was your pain right now?



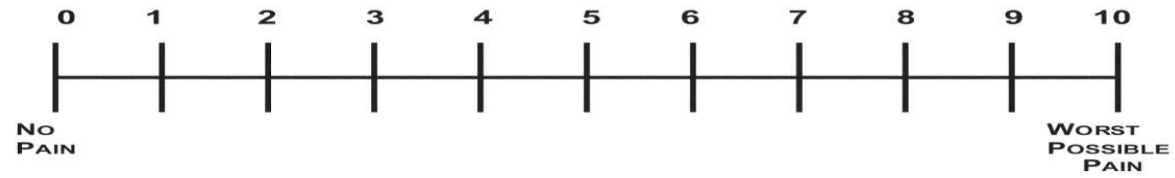
Medication taken today for pain:	
Time taken:	
Name of medication and dosage (eg. Panado, 500mg)	

PAIN LOGBOOK DAY 5:

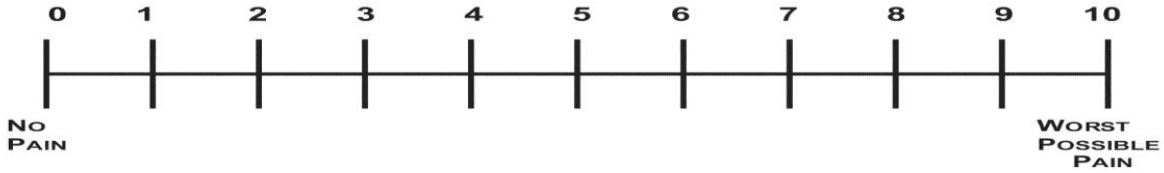
Please complete the pain logbook before you go to bed every evening. Write down the time you complete the form and mark your pain on the visual analogue scale out of 10.

Time: _____

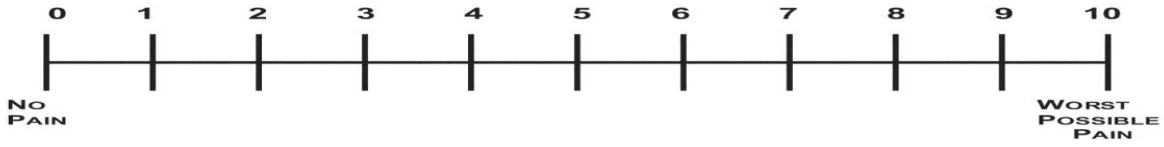
Visual Analogue Scale: How bad has your pain been today on average?



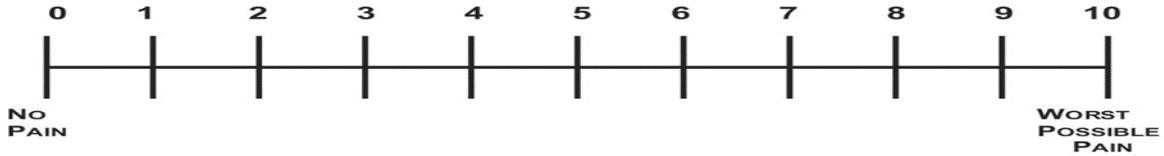
Visual Analogue Scale: What was your pain at its worst today?



Visual Analogue Scale: What was your pain at its least today?



Visual Analogue Scale: What was your pain right now?



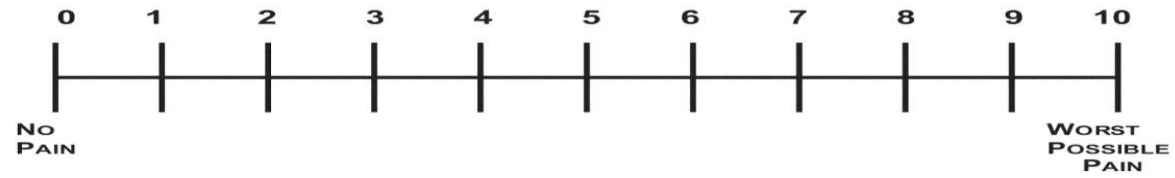
Medication taken today for pain:	
Time taken:	
Name of medication and dosage (eg. Panado, 500mg)	

PAIN LOGBOOK DAY 6:

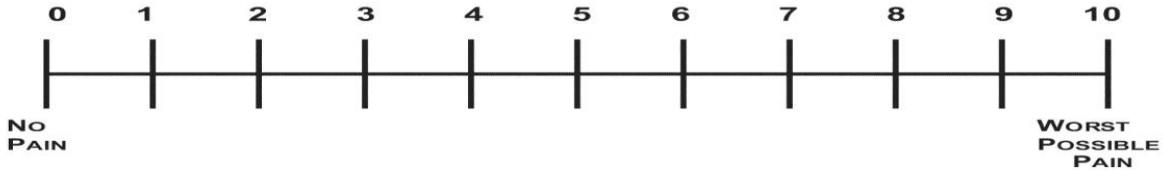
Please complete the pain logbook before you go to bed every evening. Write down the time you complete the form and mark your pain on the visual analogue scale out of 10.

Time: _____

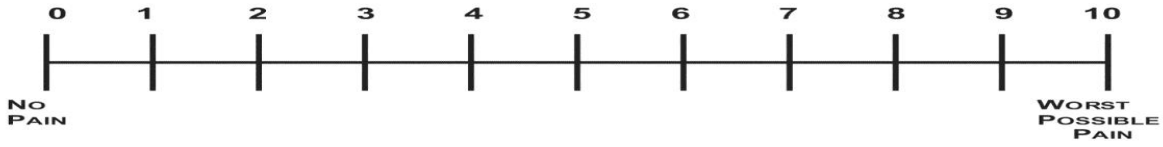
Visual Analogue Scale: How bad has your pain been today on average?



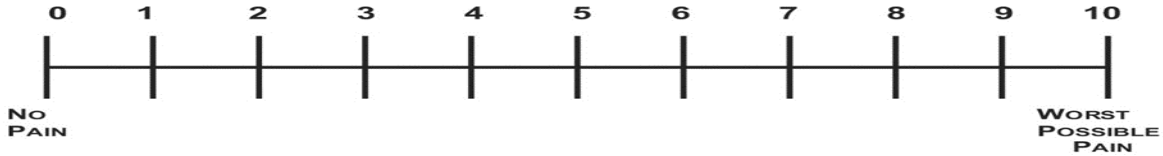
Visual Analogue Scale: What was your pain at its worst today?



Visual Analogue Scale: What was your pain at its least today?



Visual Analogue Scale: What was your pain right now?



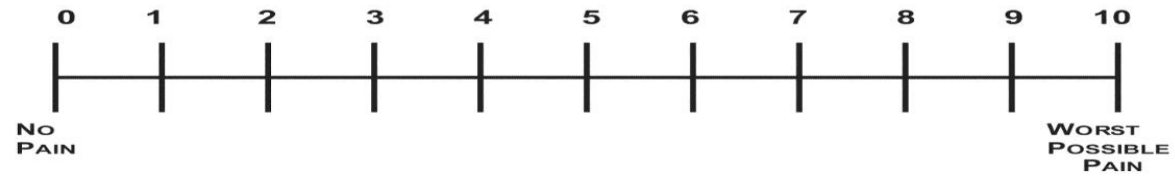
Medication taken today for pain:	
Time taken:	
Name of medication and dosage (eg. Panado, 500mg)	

PAIN LOGBOOK DAY 7:

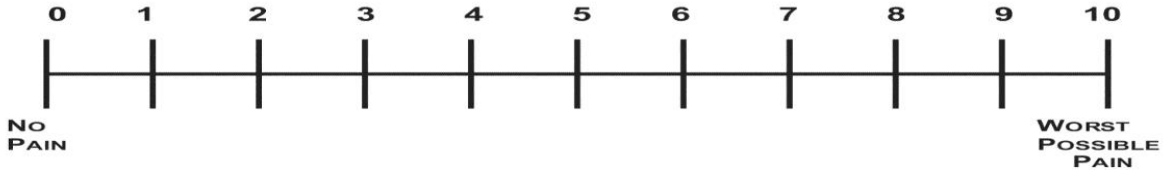
Please complete the pain logbook before you go to bed every evening. Write down the time you complete the form and mark your pain on the visual analogue scale out of 10.

Time: _____

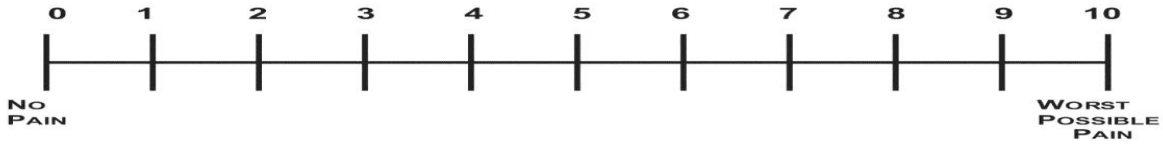
Visual Analogue Scale: How bad has your pain been today on average?



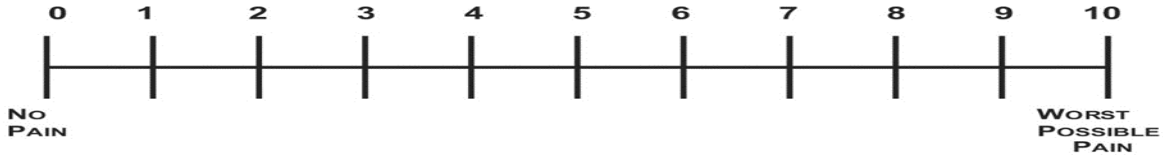
Visual Analogue Scale: What was your pain at its worst today?



Visual Analogue Scale: What was your pain at its least today?



Visual Analogue Scale: What was your pain right now?



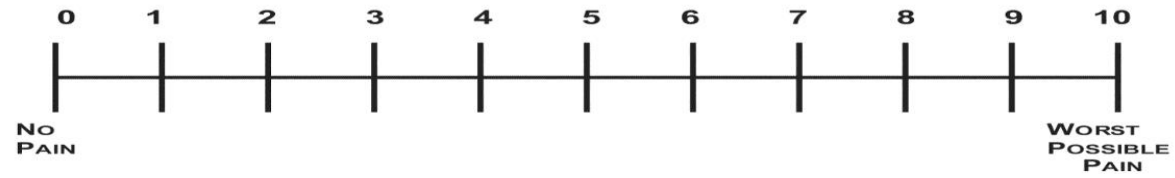
Medication taken today for pain:	
Time taken:	
Name of medication and dosage (eg. Panado, 500mg)	

PAIN LOGBOOK DAY 8:

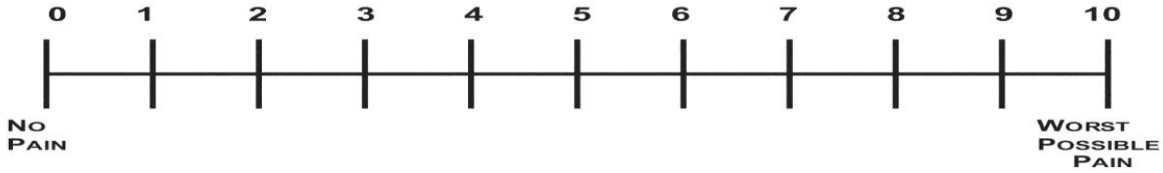
Please complete the pain logbook before you go to bed every evening. Write down the time you complete the form and mark your pain on the visual analogue scale out of 10.

Time: _____

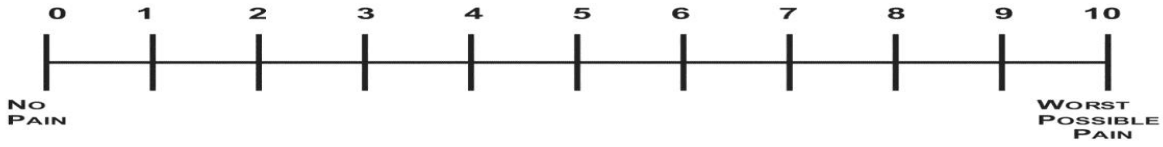
Visual Analogue Scale: How bad has your pain been today on average?



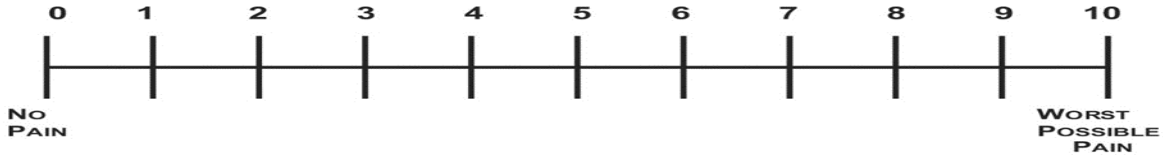
Visual Analogue Scale: What was your pain at its worst today?



Visual Analogue Scale: What was your pain at its least today?



Visual Analogue Scale: What was your pain right now?



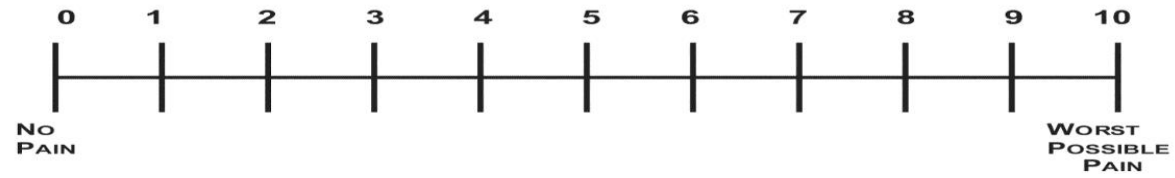
Medication taken today for pain:	
Time taken:	
Name of medication and dosage (eg. Panado, 500mg)	

PAIN LOGBOOK DAY 9:

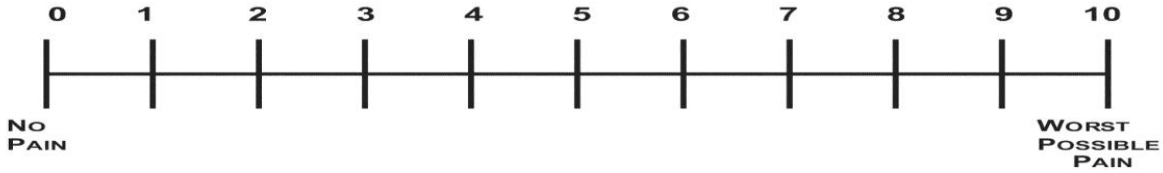
Please complete the pain logbook before you go to bed every evening. Write down the time you complete the form and mark your pain on the visual analogue scale out of 10.

Time: _____

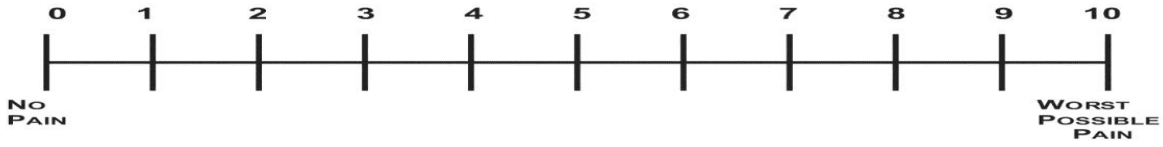
Visual Analogue Scale: How bad has your pain been today on average?



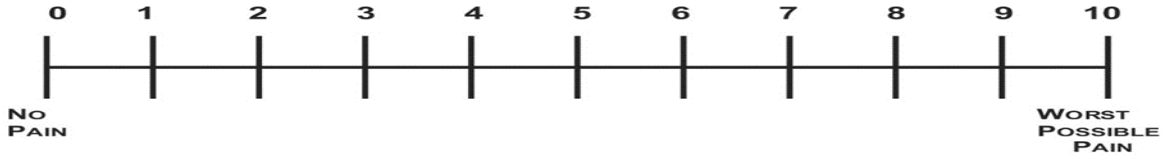
Visual Analogue Scale: What was your pain at its worst today?



Visual Analogue Scale: What was your pain at its least today?



Visual Analogue Scale: What was your pain right now?



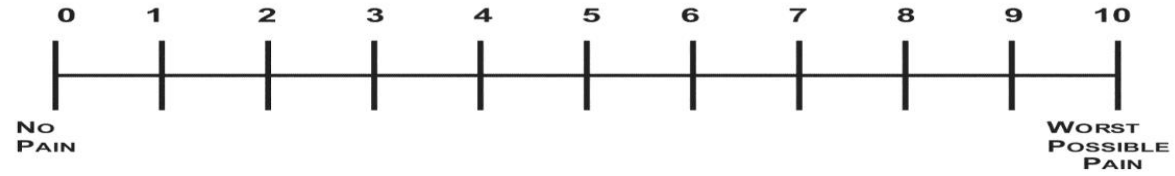
Medication taken today for pain:	
Time taken:	
Name of medication and dosage (eg. Panado, 500mg)	

PAIN LOGBOOK DAY 10: (Final Form)

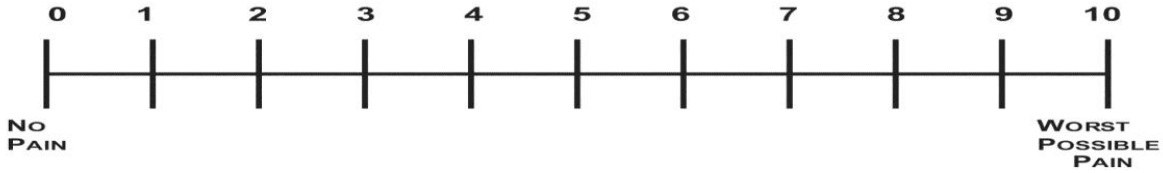
Please complete the pain logbook before you go to bed every evening. Write down the time you complete the form and mark your pain on the visual analogue scale out of 10.

Time: _____

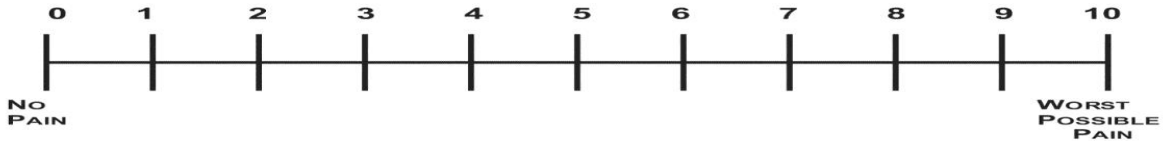
Visual Analogue Scale: How bad has your pain been today on average?



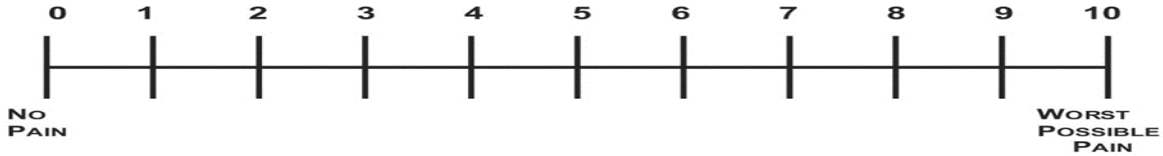
Visual Analogue Scale: What was your pain at its worst today?



Visual Analogue Scale: What was your pain at its least today?



Visual Analogue Scale: What was your pain right now?



Medication taken today for pain:	
Time taken:	
Name of medication and dosage (eg. Panado, 500mg)	

Pain killer drugs: Checklist

Dear participant,

Below is a list of pain medications available in South Africa. Should you use any pain medications after the race, please refer to the list to ensure correct recording of the medication that you use. Please feel free to record the brand or generic name in your pain diary if you are taking any pain medication.

Non-Narcotic Analgesics

Generic	Brand Name
Acetaminophen	Tylenol

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)

Generic	Brand Name
Bromfenac	Prolensa, Bromday
Diclofenac	Cataflam, Voltaren, Zipsor
Diflunisal	Dolobid
Etodolac	Lodine, Lodine XL
Fenoprofen	Nalfon
Flurbiprofen	Ansaid
Ibuprofen	Advil, Cramp End, Dolgesic, Excedrin IB, Genpril, Haltran, Ibren, Ibu, Ibuprin, Ibuprohm, Ibu-Tab, Medipren, Midol IB, Motrin, Nuprin, Pamprin-IB, Q-Profen, Rufen, Trendar
Indomethacin	Indocin, Indocin SR, Tivorbex
Ketoprofen	Actron, Orudis, Oruvail
Ketorolac	Toradol, Sprix
Meclofenamate	Meclomen
Mefenamic Acid	Ponstel

Meloxicam	Mobic, Vivlodex
Nabumetone	Relafen
Naproxen	Aleve, Anaprox, Anaprox DS, EC-Naprosyn, Naprelan, Naprosyn
Nepafenac	Nevanac
Oxaprozin	Daypro
Phenylbutazone	Cotylbutazone
Piroxicam	Feldene
Sulindac	Clinoril
Tolmetin	Tolectin, Tolectin DS

COX-2 Inhibitors

Generic	Brand Name
Celecoxib	Celebrex, Arcoxia, Rayzon

Narcotic Pain Medications (Painkillers)

Generic	Brand Name
Buprenorphine	Buprenex, Butrans transdermal patch
Butorphanol	Stadol
Codeine	
Hydrocodone	
Hydromorphone	Dilaudid, Dilaudid-5, Dilaudid-HP, Hydrostat IR, Exalgo ER
Levorphanol	Levo-Dromoran

Meperidine	Demerol
Methadone	Dolophine, Methadose
Morphine	Astramorph PF, AVINZA, Duramorph, Kadian, M S Contin, MSIR, Oramorph SR, Rescudose, Roxanol
Nalbuphine	Nubain
Oxycodone	OxyContin, Roxicodone, Oxecta
Oxymorphone	Numorphan
Pentazocine	Talwin
Propoxyphene	Cotanal-65, Darvon
Tapentadol	Nucynta

Central Analgesics

Generic	Brand Name
Tramadol	Ultram
Tramadol and Acetaminophen	Ultracet

Combinations

Generic	Brand Name
Butalbital, Acetaminophen, and Caffeine	Femcet, Fioricet, Esgic, Esgic-Plus
Butalbital, Aspirin, and Caffeine	Fiorinal
Butalbital, acetaminophen, caffeine, and codeine	Fioricet with Codeine
Hydrocodone and Ibuprofen	Hydrostal IR, Vicoprofen
Morphine/Naltrexone	Embeda

Oxycodone/Naltrexone	Troxyca ER
Pentazocine/Naloxone	Talwin NX
Narcotic Analgesics and Acetaminophen	
Acetaminophen and Codeine	Capital with Codeine, Margesic #3, Phenaphen with Codeine, Tylenol with Codeine
Dihydrocodeine, Acetaminophen, and Caffeine	DHCplus
Hydrocodone and Acetaminophen	Allay, Anexsia 5/500, Anexsia 7.5/650, Dolacet, Dolagesic, Duocet, Hycomed, Hydrocet, Hydrogesic, HY-PHEN, Lorcet 10/650, Lorcet-HD, Lortab, Panacet 5/500, Panlor, Stagesic, T-Gesic, Ugesic, Vicodin, Zydone
Oxycodone and Acetaminophen	Endocet, Percocet, Roxicet, Roxilox, Tylox; Xartemis XR
Pentazocine and Acetaminophen	Talacen
Propoxyphene and Acetaminophen	Darvocet-N 50, Darvocet-N 100, E-Lor, Propacet 100
Narcotic Analgesics and Aspirin	
Aspirin, Caffeine, and Dihydrocodeine	Synalgos-DC
Aspirin and Codeine	Empirin with Codeine
Hydrocodone and Aspirin	Damason-P, Lortab ASA, Panasal 5/500
Oxycodone and Aspirin	Endodan, Percodan, Percodan-Demi, Roxiprin
Pentazocine and Aspirin	Talwin Compound
Propoxyphene, Aspirin, and Caffeine	Darvon Compound-65, PC-Cap, Propoxyphene Compound-65

Topical Analgesics

Generic	**Brand Name**

Capsaicin	ArthriCare, ARTH-RX, Axsain, Capsagel, Dura-Patch, Methacin, Qutenza, Zotrix, Zotrix-HP

Topical Anesthetics

Generic	Brand Name
Benzocaine	Americaine, Endocaine, Lagol
Benzocaine / Menthol	Benzocol, Butyl Aminobenzoate, Dermoplast
Dibucaine	Cinchocaine, Nupercainal Cream, Nupercainal Oinment
Lidocaine	LidaMantle, Lidoderm, Lignocainem, Xylocaine
Lidocaine/ Prilocaine	EMLA

Adapted from: http://www.emedexpert.com/lists/pain-meds.shtml

https://www.sapj.co.za/index.php/SAPJ/article/viewFile/1005/1161

APPENDIX 8: ETHICAL APPROVAL LETTER (HREC Ref: 045/2017)

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E53-48 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: sumayah.achelles@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

19 April 2017

HREC REF: 045/2017

A/Prof R Parker
Division of Physiotherapy
Department of Health & Rehab Sciences
OMB

Dear A/Prof Parker

PROJECT TITLE: DO PSYCHOSOCIAL FACTORS PREDICT PAIN AFTER PARTICIPATION IN AN ULTRAMARATHON RACE? (Master's candidate J Rabbitte)

Thank you for your response letter dated 05 April 2017, addressing the issues raised by the Human Research Ethics Committee (HREC).

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 April 2018.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

We acknowledge that the student, J Rabbitte will also be involved in this study.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval before the research may occur.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637,
Institutional Review Board (IRB) number: IRB00001938

HREC 045/2017

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

FHS016: Annual Progress Report / Renewal

HREC office use only (FWA00001637; IRB00001938) This serves as notification of annual approval, including any documentation described below.			
☑ Approved	Annual progress report	Approved until/next renewal date	30.4.2019
☐ Not approved	See attached comments		
Signature Chairperson of the HREC		Date Signed	11/4/2018

Comments to PI from the HREC

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	04/04/2018		
HREC REF Number	045/2017	Current Ethics Approval was granted until	30/4/18
Protocol title	Do psychosocial factors predict pain after participation in an ultramarathon race?		
Protocol number (if applicable)			
Are there any sub-studies linked to this study?		☐ Yes x No	
If yes, could you please provide the HREC Ref's for all sub-studies? Note: A separate FHS016 must be submitted for each sub-study.			
Principal Investigator	Prof Romy Parker		
Department / Office Internal Mail Address	D23 Dept Anaesthesia ~~Division of Physiotherapy, Department of Health and Rehab, Old Main Building,~~ Groote Schuur Hospital, Observatory, 7925		

(Note: Please complete the Closure form (FHS010) if the study is completed within the approval period)

APPENDIX 9: BASELINE MEASURES: FREQUENCY TABLE OF CATASTROPHIZERS VS. NON-CATASTROPHIZERS

Table 5: Baseline measures: frequency table of catastrophisers (cut off score of 30 out of 52)

Category	Frequency table: Catastrophising Yes/no (Background information in Results final)			
	Count	Cumulative Count	Percent (%)	Cumulative Percent (%)
No	68	68	88.31	88.31
Yes	9	77	11.69	100
Missing	0	77	0	100

Table 6: Baseline measures: frequency table of rumination (cut off score of 11)

Category	Frequency table: Rumination yes/no (Background information in Results final)			
	Count	Cumulative Count	Percent (%)	Cumulative Percent (%)
No	64	64	83.12	83.12
Yes	13	77	16.88	100
Missing	0	77	0	100

Table 7: Baseline measures: frequency table of magnification (cut off score of 5)

Category	Frequency table: Magnification Yes/No (Background information in Results final)			
	Count	Cumulative Count	Percent (%)	Cumulative Percent (%)
No	52	52	67.53	67.53
Yes	25	77	32.47	100
Missing	0	77	0	100

Table 8: Baseline measures: frequency table of helplessness (cut off score of 13)

Category	Frequency table: Helplessness Yes/no (Background information in Results final)			
	Count	Cumulative Count	Percent (%)	Cumulative Percent (%)
No	68	68	88.31	88.31
Yes	9	77	11.69	100
Missing	0	77	0	100

APPENDIX 10: BASELINE MEASURES: FREQUENCY TABLE OF HIGH SELF-EFFICACY BELIEFS VS. LOW SELF-EFFICACY BELIEFS

Table 9: Baseline measures: frequency table of self-efficacy (cut off score of 40)

Category	Frequency table: PSEQ High/low (Background information in Results final)			
	Count	Cumulative Count	Percent (%)	Cumulative Percent (%)
Low	2	2	2.60	2.60
High	75	77	97.40	100
Missing	0	77	0	100

APPENDIX 11: PAIN SEVERITY SCORES OVER 10 DAYS OF RECOVERY BETWEEN CATASTROPHIZERS VS NON- CATASTROPHIZERS

Table 10: Mann- Whitney U Test showing Pain Severity Scores (PSS) over 10 days of recovery between catastrophizers (n=9) and non- catastrophizers (n=68)

10 Days of Recovery	z-value	p-value
Day 1- Pain Severity Score (PSS)	-0.10	0.92
Day 2 PSS	-0.44	0.66
Day 3- PSS	0.11	0.91
Day 4- PSS	-0.47	0.64
Day 5- PSS	0.67	0.50
Day 6- PSS	1.29	0.20
Day 7- PSS	0.72	0.47
Day 8- PSS	0.55	0.58
Day 9- PSS	0.16	0.87
Day 10- PSS	0.56	0.57

APPENDIX 12: DATA CAPTURED FROM MEDICAL AND SPORTS HISTORY QUESTIONNAIRE, PAIN CATASTROPHIZING QUESTIONNAIRE, ATHLETE FEAR AVOIDANCE QUESTIONNAIRE, PAIN SELF-EFFICACY QUESTIONNAIRE AND PAIN LOGBOOK

Table 11: Excel spreadsheet: data captured from Medical and Sports History Questionnaire, PCQ, AFAQ, PSEQ and pain logbook for comrades runners (n=77) over 10 days of recovery

Participant	Language	DOB	Gender	Height (cm)	Weight (kg)	Running Club	Age	Predicted time (min)
1	afrikaans	23/12/1975	female	172	59	klerksdorp marathon club	41	630
2	english	10/04/1958	female	157	56	pirates running club	59	690
3	english	24/05/1968	female	150	48	fitness from africa	49	710
4	english	19/09/1976	female	160	60	pinelands ac	40	658
5	english	10/08/1987	male		72	born2run	30	525
6	english	17/02/1988	female	165	64	randburg harriers	29	630
7	english	12/05/1974	female	163	64	born2run	43	690
8	english	18/08/1963	female	159	56	jeppe	53	675
9	english		male	187	80	florida	53	600
10	afrikaans	26/07/1977	male	184	76	mpha centurion	39	570
11	english	27/07/1980	male	184	82	wanderers AC	36	445
12	english	18/08/1976	male	180	68	wanderers AC	40	530
13	venda/english		male	158	60	wanderers AC	34	450
14	english	3/6/1984	male	168	57	jeppe	32	510
15	english	22/07/1991	male	185	75	wanderers AC	25	630
16	english	10/03/1966	male	185	83	randburg harriers	51	600
17	english	22/11/1969	male	176	71	randburg harriers	47	530
18	afrikaans	29/08/1984	female	176	59	wanderers AC	32	659
19	afrikaans	24/05/1979	male	179	90	magnolia running club	38	705
20	english	24/04/1954	female	170	60	born2run	63	690
21	english	24/07/1987	male	173	77	faku chiefs	29	645

Participant	Language	DOB	Gender	Height (cm)	Weight (kg)	Running Club	Age	Predicted time (min)
22	english	10/11/1966	female	167	53	pinetown and districts athletic	50	540
23	english	25/09/1958	female	173	60	born2run	58	630
24	english	29/08/1975	male			old eds	41	588
25	english	23/05/1956	male	177	87	jeppe	61	690
26	english	15/08/1964	male	173	89	pirates running club	52	659
27	isizula	09/08/1982	male	170	65	wanderers AC	35	520
28	english	06/05/1972	male	177	73	florida	45	659
29	afrikaans	14/05/1979	male	177	72	fourways road runners	38	440
30	english		male	183	75	pirates running club	35	440
31	english		male	169	78	panorama running club	34	630
32	isixhosa	21/05/1978	female		64	team vitality	39	600
33	english	26/04/1972	male	164	70	jeppe	45	630
34	english	29/12/1981	male	175	66	randburg harriers	35	630
35	english	09/10/1983	female	172	62	born2run	33	560
36	english	06/05/1966	female	170	57	jeppe	51	640
37	english	27/05/1971	male	176	66	fourways road runners	46	385
38	english	26/12/1985	male	181	71	wanderers AC	31	525
39	afrikaans	07/09/1979	female	166	64	pretoria marathon club	37	710
40	english	04/01/1974	male	170	63	pretoria marathon club	41	539
41	english	05/07/1979	female	163	67	roodepoort	38	710
42	afrikaans	05/06/1984	female	168	60	pentagon pistols	32	705
43	english	13/08/1967	male	175	66	panorama running club	49	630
44	english	11/12/1968	female			howick athletic club	48	680
45	english	04/11/1985	male		77	born2run	31	570
46	english		male	177	69		48	540
47	english	20/02/1988	male	165	65	faku chiefs	29	600
48	afrikaans	09/10/1981	female	170	68	randburg harriers	35	600
49	english	15/04/1986	male	175	67	wanderers AC	31	510

Participant	Language	DOB	Gender	Height (cm)	Weight (kg)	Running Club	Age	Predicted time (min)
50	english		male	176	68	wanderers AC		675
51	afrikaans	10/02/1966	male	183	80	acrw	51	650
52	afrikaans	17/10/1985	female	176	57	germiston callies harriers	31	690
53	english		female	169	54	rand road warriors	39	504
54	english	19/11/1982	female	175	61	randburg harriers	34	580
55	english	28/07/1971	male	172	70	vitality ac	45	650
56	english	03/02/1988	female	166	54	howick athletic club	29	590
57	afrikaans	27/02/1975	female	173	62	wanderers AC	42	630
58	english	16/02/1971	female	167	57	born2run	46	665
59	english	31/05/1976	female	163	62	born2run	40	690
60	setswana		male	168	56	randburg harriers	36	430
61	english	14/03/1988	male	177	80	nedbank	29	660
62	english	13/03/1973	male	187	80	randburg harriers	44	599
63	english	04/07/1977	male	195	77	born2run	39	630
64	afrikaans	21/09/1986	male	188	83	randburg harriers	30	615
65	english	23/10/1974	female	152	48	randburg harriers	42	660
66	english	02/03/1957	male	176	71	alberton	60	630
67	english	03/03/1982	female	176	58	randburg harriers	35	482
68	setswana	04/05/1985	male	172	70	team butterfly athletics club	32	660
69	english	03/08/1988	male	173	71	westville athletic club	28	680
70	afrikaans	24/01/1985	male	168	55	kumba irone	31	550
71	english	15/12/1971	female	153	60	florida	44	730
72	afrikaans	12/08/1983	female	176	59	randburg harriers	32	600
73	english	03/03/1969	male	168	57	alpha centurion runners and w	46	700
74	english	17/01/1964	male	172	71	team vitality	52	540
75	afrikaans	04/05/1981	male	180	72	benoni northerns athletics club	35	720
76	english	1966	female	169	55	jeppe	49	600
77	english		female			wanderers AC	47	620

Participant	Two oceans	#2o	Yr of first 2o	20PB (min)	Comrades	#Com	Yr of first Com	Com PB (min)
1	yes	1	2015	379	yes	6	2000	648
2	yes	6	1988	329	yes	24	1988	557
3	yes	3	2014	390	yes	2	2015	714
4	yes	4	2014	390	yes	2	2015	672
5	yes	2	2016	288	yes	1	2016	593
6	yes	1	2016	410	no			
7	yes	2	2014	350	yes	2	2014	640
8	yes	2	2015	660	yes	2	2015	681
9	yes	26	1992	295	yes	2	2014	616
10	no				no			
11	yes	4	2013	264	yes	6	2011	471
12	yes	8	2008	284	yes	3	2010	523
13	yes	1	2016	434	yes	1	2016	471
14	yes	3	2013	278	yes	3	2013	478
15	no							
16	yes	4	2014	330	yes	3	2014	570
17	yes	1	2013	333	yes	3	2011	535
18	yes	1	2015	360	no			
19	yes	2	2015	405	yes	4	2012	692
20	yes	1	2016	403	no			
21	yes	1	2015	340	yes	1	2016	643
22	yes	1	2016	354	yes	2	2015	536
23	yes	1	1998	322	yes	15	1989	558
24	yes	2	2016	348	yes	9	2008	577

Participant	Two oceans	#2o	Yr of first 2o	20PB (min)	Comrades	#Com	Yr of first Com	Com PB (min)
25	yes	11	2001	369	yes	11	1999	633
26	yes	4	2012	402	yes	3	2014	696
27	yes	1	2016	285	yes	1	2015	549
28	no				yes	4	2010	659
29	yes	2	2012	283	yes	2	2014	518
30	yes	1	2011	302	yes	1	2013	453
31	no				yes	2	2015	593
32	yes	2	2016	370	no			
33	yes	6	1998	231	yes	18	1997	418
34	yes	2	2016	369	no			
35	yes	4	2011	325	yes	4	2014	595
36	yes	25	1990	287	yes	27	1988	491
37	yes	3		226	yes	9	2008	377
38	yes	1	2013	304	yes	1	2016	592
39	no				yes	1	2016	646
40	yes	2	2013	360	yes	17	2000	432
41	no				no			
42	no				no			
43	no				yes	1	2016	718
44	no				yes	1	2016	695
45	yes	2	2008	325	yes	2	2015	595
46	no				no			
47	yes	1	2015	350	yes	1	2016	644
48	no				yes	1	2016	626
49	yes	1	2014	410	no			
50	yes	13	1988	307	yes	24	1988	496

Participant	Two oceans	#2o	Yr of first 2o	20PB (min)	Comrades	#Com	Yr of first Com	Com PB (min)
51	yes	3	1998	322	yes	4	1998	563
52	no				no			
53	yes	1	2016	350	yes	5	2011	567
54	no				yes	1	2016	527
55	yes	3	2011	338	yes	6	2010	640
56	yes	1	2017	340	yes	2	2015	589
57	yes	4	2006	347	yes	5	2006	588
58	no				no			
59	yes	2	2016	401	yes	1	2016	708
60	yes	8	2010	237	yes	7	2010	446
61	yes	2	2010	346	no			
62	yes	1	2014	365	yes	3	2014	592
63	no				no			
64	yes	1	2016	331	yes	2	2012	625
65	no				yes	5	2012	574
66	yes	15	2001	316	yes	17	2000	610
67	no				yes	5	2011	482
68	no				yes	4	2013	647
69	no				yes	1	2016	649
70	no				no			
71	no				yes	1	2016	706
72	yes	1	2015	350	yes	4	2013	653
73	no				yes	3	2014	716
74	yes	3	2012	240	yes	5	2012	501
75	no				no			
76	yes	5	2001	308	yes	19	1998	584
77	no				yes	1	2016	588

Participant	Pace of Com PB (km/h	Com time 2017 (min)	Pace of Com time 2017	% time of 2017 race vs I	Hx meds after a race
1	7.28	634	7.19	101	yes
2	6.25	690	7.57	83	yes
3	8.14	719	8.17	100	no
4	7.45	688	7.56	99	no
5	6.05	492	5.4	112	no
6		650	7.3		yes
7	7.23	647	7.28	99	yes
8	7.51	625	7.12	105	no
9	7.06	601	6.56	108	yes
10		574	6.37		yes
11	5.26	477	5.3	99	yes
12	6.02	536	6.11	99	no
13	5.26	514	5.56	95	no
14	5.31	532	6.08	87	yes
15		625	7.12	99	no
16	6.34	623	7.11	89	no
17	6.1	705	8.08	75	yes
18		671	7.44	104	no
19	7.59	694	8	107	yes
20		698	8.03	95	yes
21	7.25	613	7.04	103	yes
22	6.11	551	6.21	98	yes
23	6.26	654	7.32	86	yes
24	6.39	712	8.13	79	yes

Participant	Pace of Com PB (km/h	Com time 2017 (min)	Pace of Com time 2017	% time of 2017 race vs	Hx meds after a race
25	7.18	710	8.11	89	yes
26	8.01	716	8.15	98	no
27	6.2	529	6.06	102	no
28	7.36	711	8.12	91	yes
29	5.58	505	5.49	102	yes
30	5.13	400	4.37	117	no
31	6.5	655	7.33	89	yes
32		714	8.14	82	yes
33	4.49	703	8.06	56	yes
34		698	8.03		yes
35	6.52	583	6.43	101	no
36	4.17	693	7.59	55	yes
37	4.21	392	4.31	98	yes
38	6.5	529	6.06	107	no
39	7.27	708	8.1	90	no
40	4.59	529	6.06	76	yes
41		709	8.1		yes
42		710	8.11		no
43	8.17	712	8.13	100	yes
44	8.01	668	7.42	108	yes
45	6.52	583	6.43	101	no
46		569	6.34		yes
47	7.26	613	7.04	103	no
48	7.13	663	7.39	96	yes
49		492	5.4		yes
50	5.43	714	8.14	67	yes

Participant	Pace of Com PB (km/h	Com time 2017 (min)	Pace of Com time 2017	% time of 2017 race vs	Hx meds after a race
51	6.29	648	7.28	86	yes
52		692	7.59		yes
53	6.32	525	6.03	105	yes
54	6.05	546	6.18	98	no
55	7.23	589	6.47	112	yes
56	6.47	588	6.47	100	yes
57	6.47	604	6.58	98	yes
58		702	8.06		yes
59	8.1	713	8.13	100	yes
60	5.09	502	5.47	93	yes
61		638	7.21		yes
62	6.5	600	6.55	99	no
63		640	7.23		yes
64	7.12	649	7.29	98	yes
65	6.37	656	7.34	87	yes
66	7.02	636	7.2	98	yes
67	5.33	491	5.4	99	yes
68	7.28	700	8.04	91	no
69	7.29	667	7.41	98	yes
70		544	6.16		no
71	8.08	705	8.08	100	yes
72	7.32	569	6.34	115	yes
73	8.15	714	8.14	100	yes
74	5.47	533	6.09	90	yes
75		716	8.15		no
76	6.54	638	7.21	91	yes
77	6.47	635	7.19	90	yes

Participant	Recovery pain meds	Hx of injury	Hx of ortho surgery	Current injury 1	Grade	Current injury 2	Grade
1	NSAIDS	yes	no	yes	2		
2	NSAIDS	yes	yes	yes	4		
3		no	no	no			
4		yes	yes	no			
5		yes	no	yes	2		
6	NSAIDS	yes	yes	no			
7	paracetomal	yes	yes	yes	3		
8		no	no	no			
9	NSAIDS, paracetomal	yes	yes	no			
10	NSAIDS	no	no	no			
11	NSAIDS, cortisone injection, mypro	yes	no	yes	1	yes	2
12		yes	no	no			
13		yes	no	yes	2	yes	1
14	codeine	yes	no	yes	3		
15		yes	no	yes	2		
16		yes	yes	no			
17	anti-inflammatory gel, paracetomo	yes	yes	yes	2		
18		yes	no	yes	2		
19	anti-inflammatory gel	yes	no	no			
20	anti-inflammatory gel	yes	no	no			
21	NSAIDS	yes	no	no			
22	NSAIDS, anti- inflammatory gel	yes	no	no			
23	ibuprofen	yes	no	yes	3		
24	NSAIDS	yes	yes	yes	3		

Participant	Recovery pain meds	Hx of injury	Hx of ortho surgery	Current injury 1	Grade	Current injury 2	Grade
25	bezemax	yes	no	yes	3	yes	3
26		yes	yes	yes	3	yes	3
27		no	no	no			
28	paracetomal	yes	yes	no			
29	NSAIDS	yes	yes	no			
30		yes	yes	yes	4		
31	myprodal	yes	yes	yes	2		
32	NSAIDS, norflex	yes	no	yes	3		
33	NSAIDS	yes	no	no			
34	NSAIDS, paracetomal, anti-inflamm	yes	no	yes	2	yes	3
35		yes	no	no			
36	NSAIDS, anti- inflammatory gel	yes	yes	yes	4	no	
37	NSAIDS	yes	no	yes	3	yes	3
38		yes	no	yes	2		
39		yes	no	yes	2	yes	3
40	NSAIDS	yes	no	yes	2	yes	3
41	NSAIDS, mypaid	yes	no	no			
42		no	yes	no			
43	arnica ice	no	no	no			
44	NSAIDS	yes	yes	yes	2	yes	3
45		no	no	no			
46	NSAIDS	no	no	yes	2		
47		yes	no	yes	4		
48	NSAIDS, anti- inflammatory gel	yes	no	yes	2		
49	myprodal, anti- inflammatory gel	yes	no	yes	2	yes	1
50	ibuprofen	yes	no	no			

Participant	Recovery pain meds	Hx of injury	Hx of ortho surgery	Current injury 1	Grade	Current injury 2	Grade
51	voltaren	yes	no	yes	1		
52	cataflam	yes	no	yes	2		
53	myprodal	yes	no	yes	2	yes	3
54		yes	no	yes	2		
55	NSAIDS, anti- inflammatory gel, par	yes	no	yes	2		
56	codeine	yes	no	yes	3		
57	paracetomal	yes	no	no			
58	NSAIDS, anti- inflammatory gel	yes	no	no			
59	NSAIDS, anti- inflammatory gel	yes	no	no			
60	anti- inflammatory gel	yes	no	no			
61	codeine, anti- inflammatroy gel, NS	yes	no	yes	4	yes	3
62		no	no	no			
63	NSAIDS	no	no	no			
64	paracetomal, anti- inflammatory ge	yes	no	no			
65	NSAIDS, paracetomal	yes	no	yes	3		
66	mypaid	yes	no	no			
67	NSAIDS	yes	no	no			
68		no	no	no			
69	NSAIDS	yes	no	no			
70		yes	no	yes	1		
71	paracetomal, anti- inflammatory ge	yes	yes	yes	2		
72	NSAIDS	yes	no	yes	1		
73	myprodal	yes	yes	no			
74	myprodal	yes	yes	yes	2		
75		no	no	no			
76	NSAIDS, anti- inflammatory gel	yes	yes	yes	2		
77	cataflam	yes	yes	yes	3		

Participant	pain/ neuro meds	Meds 1	Meds 2	PCS - Total	PCS - rumin	PCS - magnif	PCS - help	AFAQ	PSEQ
1	yes	NSAIDS		10	4	3	3	12	60
2	yes	NSAIDS		21	11	4	6	24	60
3	no			24	11	9	4	25	60
4	no			20	5	5	10	14	59
5	no			13	3	4	6	13	60
6	no			3	1	1	1	23	48
7	yes	cortisone	paracetan	21	11	4	6	24	60
8	no			4	1	1	2	21	42
9	no			10	4	2	4	21	60
10	no			13	4	3	6	26	55
11	no			14	5	4	5	28	60
12	no			21	11	4	6	24	60
13	no			4	1	1	2	21	60
14	no			16	4	5	7	18	48
15	no			16	6	4	6	26	60
16	no			9	5	2	2	21	53
17	no			12	5	4	3	23	45
18	no			23	5	5	12	16	50
19	no			10	4	2	4	14	45
20	no			7	3	2	2	11	55
21	no			18	10	0	8	11	25
22	no			8	4	3	1	12	60
23	no			4	1	1	2	14	60
24	no			30	9	7	14	23	48

Participant	pain/ neuro meds	Meds 1	Meds 2	PCS - Total	PCS - rumin	PCS - magnif	PCS - help	AFAQ	PSEQ
25	no			10	4	4	2	17	50
26	no			4	1	1	2	14	60
27	no			14	5	2	7	14	54
28	no			16	5	3	8	22	45
29	no			24	12	5	7	26	42
30	no			14	5	4	5	28	60
31	no			16	4	3	9	18	55
32	yes	ART		19	6	8	5	16	41
33	no			16	6	1	9	36	45
34	no			15	5	2	8	33	40
35	no			8	3	2	3	21	60
36	no			2	0	0	2	22	60
37	no			5	3	0	2	19	59
38	no			18	9	5	4	26	45
39	no			49	16	11	22	26	45
40	no			6	4	2	0	25	45
41	no			17	7	5	5	27	60
42	no			35	13	5	17	22	60
43				2	1	0	1	10	57
44	no			16	4	3	9	16	55
45	no			17	7	5	5	22	35
46	no			5	2	1	2	12	59
47	no			0	0	0	0	18	43
48	no			4	0	2	2	16	47
49	no			7	3	3	1	8	53
50	no			7	4	1	2	17	60

Participant	pain/ neuro meds	Meds 1	Meds 2	PCS - Total	PCS - rumin	PCS - magnif	PCS - help	AFAQ	PSEQ
51	no			7	4	0	3	19	59
52	no			35	13	5	17	21	60
53	no			9	5	2	2	21	60
54	no			18	8	6	4	18	58
55	no			7	5	1	1	16	60
56	no			32	13	5	14	23	43
57	no			3	0	2	1	15	60
58	no			20	9	3	8	26	40
59	no			38	12	8	18	34	45
60	no			31	14	7	10	32	60
61	no			18	8	6	4	26	55
62	no			7	4	1	2	17	60
63	no			23	9	8	6	18	59
64	no			28	9	5	14	13	40
65	yes	catafast		22	8	7	7	24	58
66	no			4	1	2	1	21	51
67	no			4	2	1	1	10	57
68	no			5	2	1	2	12	59
69	no			20	9	3	8	26	40
70	no			7	5	1	1	15	60
71	no			20	9	3	8	27	40
72	no			35	13	5	17	21	60
73	no			9	5	2	2	22	60
74	no			4	0	2	2	17	60
75	no			18	8	6	4	20	60
76	no			35	13	5	17	22	59
77	no			18	8	6	4	17	58

Participant	Day 1 - ave	Day 1 - wo	Day 1 - lea	Day 1 - no	Day - Pain	Day 1 - me	Day 2 - ave	Day 2 - wo	Day 2 - lea	Day 2 - no	Day 2 PSS	Day 2 - me
1	4	8	0	4	4	n/a	3	4	1	1	2.25	n/a
2	6	8	1	5	5	ibuprofen	7	8	5	7	6.75	ibuprofen
3	7	8	0	7	5.5	panado	6	7	0	7	5	n/a
4	7	8	5	7	6.75	arnica	7	7	7	7	7	arnica
5	6	6	2	5	4.75	n/a	4	4	2	2	3	
6	4	7	0	4	3.75	n/a	4	6	0	1	2.75	n/a
7	6	8	1	5	5	n/a	7	8	5	7	6.75	n/a
8	1	1	0	1	0.75	n/a	0	0	0	0	0	n/a
9	5	6	0	5	4	voltaren,	3	4	1	4	3	voltaren,
10	6	8	0	8	5.5	n/a	7	8	7	7	7.25	n/a
11	7	8	0	5	5	myprodol	2	3	1	1	1.75	n/a
12	6	8	0	5	4.75	aspirin	1	1	1	1	1	aspirin
13	1	2	0	1	1	n/a	1	1	0	0	0.5	n/a
14	6	9	1	7	5.75	myprodol	6	8	5	7	6.5	n/a
15	6	7	4	6	5.75	myprodol	6	7	2	5	5	myprodol
16	7	9	0	6	5.5	n/a	4	4	4	4	4	n/a
17	9	10	9	9	9.25	n/a	7	9	7	7	7.5	n/a
18	7	8	5	7	6.75	n/a	7	7	7	7	7	n/a
19	4	8	0	4	4	n/a	3	4	1	1	2.25	n/a
20	7	9	2	8	6.5	myprodol	6	8	3	7	6	myprodol
21	7	9	5	0	5.25	besemax	5	6	3	3	4.25	n/a
22	5	8	0	4	4.25	n/a	3	5	0	2	2.5	n/a
23	7	7	1	5	5	ibuprofen	4	6	2	5	4.25	ibuprofen
24	6	8	6	5	6.25	arcoxia	5	5	3	3	4	n/a

Participant	Day 1 - ave	Day 1 - wo	Day 1 - lea	Day 1 - no	Day - Pain	Day 1 - me	Day 2 - ave	Day 2 - wo	Day 2 - lea	Day 2 - no	Day 2 PSS	Day 2 - me
25	5	7	1	6	4.75	n/a	2	4	2	3	2.75	n/a
26	1	2	0	1	1	n/a	1	1	0	0	0.5	n/a
27	7	8	0	5	5	n/a	2	3	1	1	1.75	n/a
28	9	9	0	9	6.75	paracetom	5	7	1	6	4.75	paracetom
29	8	9	4	6	6.75	disprin	4	5	1	1	2.75	n/a
30	7	8	0	4	4.75	n/a	2	3	0	0	1.25	n/a
31	6	9	1	7	5.75	myprodol	6	8	5	7	6.5	n/a
32	10	10	5	10	8.75	norflex	9	10	4	8	7.75	n/a
33	7	8	4	8	6.75	adcodol	7	8	3	7	6.25	mypaid
34	7	7	4	8	6.5	n/a	7	7	3	7	6	n/a
35	5	8	0	4	4.25	n/a	3	5	0	2	2.5	n/a
36	1	1	0	1	0.75	n/a	0	0	0	0	0	n/a
37	9	9	0	9	6.75	myprodol	6	8	6	6	6.5	myprodol
38	9	9	1	9	7	n/a	5	7	1	6	4.75	n/a
39	7	8	1	6	5.5	disprin	1	5	1	3	2.5	n/a
40	8	8	0	8	6	n/a	5	7	1	6	4.75	n/a
41	4	8	0	6	4.5	spasmed	6	8	4	6	6	n/a
42	5	7	4	0	4	n/a	4	5	2	0	2.75	n/a
43	7	7	3	5	5.5	n/a	5	5	2	2	3.5	n/a
44	6	9	1	7	5.75	n/a	6	8	5	7	6.5	n/a
45	8	9	4	6	6.75	n/a	4	5	1	1	2.75	n/a
46	5	5	2	3	3.75	n/a	3	4	3	3	3.25	n/a
47	0	0	0	0	0	n/a	6	7	0	5	4.5	ibuprofen
48	5	7	2	5	4.75	diclofenak	8	9	5	8	7.5	dicloflam
49	5	7	2	6	5	mybulen	4	6	1	5	4	n/a
50	5	7	3	5	5	ibuprofen	4	6	4	4	4.5	ibuprofen

Participant	Day 1 - ave	Day 1 - wo	Day 1 - lea	Day 1 - no	Day - Pain	Day 1 - me	Day 2 - ave	Day 2 - wo	Day 2 - lea	Day 2 - no	Day 2 PSS	Day 2 - me
51	1	2	1	1	1.25	n/a	2	3	0	0	1.25	n/a
52	4	8	0	6	4.5	cataflam	6	8	4	6	6	n/a
53	5	7	0	3	3.75	myprodol	3	5	0	1	2.25	n/a
54	8	9	3	8	7	neurofen	7	8	2	2	4.75	n/a
55	8	1	5	6	5	voltaren	4	4	4	0	3	n/a
56	6	7	0	4	4.25	cataflam	3	4	2	2	2.75	cataflam
57	4	5	3	3	3.75	paracetom	0	0	0	0	0	n/a
58	3	7	0	1	2.75	catafast	2	3	0	1	1.5	n/a
59	6	8	5	9	7	cataflam	8	8	6	8	7.5	cataflam
60	6	8	6	6	6.5	n/a	5	6	5	4	5	panado
61	3	4	0	2	2.25	n/a	7	10	3	7	6.75	myprodol
62	5	6	1	5	4.25	n/a	3	5	1	3	3	n/a
63	9	10	0	9	7	ibupain	7	7	4	6	6	ibupain
64	3	5	0	3	2.75	norflex	2	3	1	1	1.75	norflex
65	7	9	0	5	5.25	n/a	3	4	1	2	2.5	n/a
66	3	5	1	2	2.75	n/a	2	2	1	1	1.5	n/a
67	7	8	4	8	6.75	adcodol	7	8	3	7	6.25	mypaid
68	5	5	2	3	3.75	n/a	3	4	3	3	3.25	n/a
69	3	7	0	2	3	cataflam	2	3	0	1	1.5	cataflam
70	8	9	6	6	7.25	n/a	5	5	5	1	4	mypaid
71	3	6	1	1	2.75	voltaren	2	3	0	2	1.75	n/a
72	4	7	0	5	4	cataflam	6	8	4	5	5.75	cataflam
73	5	8	1	3	4.25	myprodol	3	5	0	1	2.25	myprodol
74	5	6	2	5	4.5	myprodol	8	8	5	8	7.25	myprodol
75	6	7	1	1	3.75	n/a	4	6	4	4	4.5	n/a
76	5	6	1	3	3.75	n/a	3	5	1	1	2.5	n/a
77	8	9	3	8	7	cataflam	7	8	2	2	4.75	cataflam

Participant	Day 3 - ave	Day 3- wo	Day 3- lea	Day 3- nov	Day 3- PSS	Day 3- me	Day 4- ave	Day 4- wo	Day 4- lea	Day 4- nov	Day 4- PSS	Day 4- me
1	1	4	0	0	1.25	n/a	0	1	0	0	0.25	n/a
2	7	8	4	5	6	n/a	4	5	4	4	4.25	n/a
3	4	6	0	0	2.5	n/a	2	2	0	0	1	n/a
4	5	5	5	5	5	n/a	4	4	4	4	4	n/a
5	3	3	2	2	2.5	n/a	2	2	1	1	1.5	n/a
6	1	3	0	0	1	n/a	0	1	0	0	0.25	n/a
7	7	8	4	4	5.75	n/a	4	5	4	4	4.25	n/a
8	0	0	0	0	0	n/a	0	0	0	0	0	n/a
9	1	2	0	0	0.75	n/a	0	0	0	0	0	n/a
10	6	7	6	6	6.25	n/a	4	5	3	3	3.75	n/a
11	0	0	0	0	0	n/a	0	0	0	0	0	n/a
12	1	1	0	0	0.5	n/a	0	0	0	0	0	n/a
13	0	0	0	0	0	n/a	0	0	0	0	0	n/a
14	5	7	3	6	5.25	n/a	3	5	1	2	2.75	n/a
15	6	7	3	4	5	n/a	3	4	1	2	2.5	n/a
16	2	3	1	1	1.75	n/a	1	1	1	1	1	n/a
17	5	7	4	4	5	n/a	4	5	3	3	3.75	n/a
18	5	6	5	5	5.25	n/a	4	4	4	4	4	n/a
19	1	4	0	0	1.25	n/a	0	1	0	0	0.25	n/a
20	6	7	3	6	5.5	n/a	2	3	1	1	1.75	n/a
21	2	3	1	1	1.75	n/a	1	1	0	0	0.5	n/a
22	2	3	0	0	1.25	n/a	2	3	0	0	1.25	n/a
23	3	3	0	2	2	ibuprofen	2	2	0	1	1.25	n/a
24	4	4	4	4	4	n/a	2	2	1	1	1.5	n/a

Participant	Day 3 - ave	Day 3- wo	Day 3- lea	Day 3- nov	Day 3- PSS	Day 3- me	Day 4- ave	Day 4- wo	Day 4- lea	Day 4- nov	Day 4- PSS	Day 4- me
25	2	3	2	2	2.25	n/a	1	2	1	1	1.25	n/a
26	0	0	0	0	0	n/a	0	0	0	0	0	n/a
27	0	0	0	0	0	n/a	0	0	0	0	0	n/a
28	4	5	1	3	3.25	slowmag	2	3	1	1	1.75	n/a
29	2	3	0	0	1.25	n/a	1	2	0	0	0.75	n/a
30	0	0	0	0	0	n/a	0	0	0	0	0	n/a
31	5	7	3	6	5.25	n/a	3	5	1	2	2.75	n/a
32	5	9	1	1	4	n/a	3	3	0	0	1.5	n/a
33	6	7	3	6	5.5	mypaid	6	6	3	6	5.25	mypaid
34	6	7	3	6	5.5	n/a	6	6	3	6	5.25	n/a
35	2	3	0	2	1.75	n/a	0	0	0	0	0	n/a
36	0	0	0	0	0	n/a	0	0	0	0	0	n/a
37	6	6	5	6	5.75	n/a	4	4	3	4	3.75	n/a
38	4	5	1	2	3	n/a	2	3	1	1	1.75	n/a
39	3	4	1	1	2.25	n/a	1	1	1	1	1	n/a
40	4	5	1	2	3	n/a	2	3	1	1	1.75	n/a
41	2	4	1	2	2.25	n/a	0	0	0	0	0	n/a
42	2	3	1	0	1.5	n/a	1	2	1	0	1	n/a
43	1	1	1	1	1	n/a	0	0	0	0	0	n/a
44	5	7	3	6	5.25	n/a	3	5	1	2	2.75	n/a
45	2	3	0	0	1.25	n/a	0	0	0	0	0	n/a
46	3	5	2	3	3.25	n/a	2	2	0	1	1.25	n/a
47	4	5	3	4	4	arnica gel	3	4	2	2	2.75	arnica gel
48	6	7	4	5	5.5	n/a	6	7	4	6	5.75	n/a
49	2	3	0	2	1.75	n/a	0	0	0	0	0	n/a
50	7	9	6	6	7	ibuprofen	3	4	2	2	2.75	n/a

Participant	Day 3 - ave	Day 3- wo	Day 3- lea	Day 3- nov	Day 3- PSS	Day 3- me	Day 4- ave	Day 4- wo	Day 4- lea	Day 4- nov	Day 4- PSS	Day 4- me
51	0	1	0	0	0.25	n/a	0	0	0	0	0	n/a
52	2	3	1	2	2	n/a	2	3	1	1	1.75	n/a
53	0	0	0	0	0	n/a	0	0	0	0	0	n/a
54	5	6	2	4	4.25	n/a	4	5	2	2	3.25	n/a
55	7	8	4	6	6.25	n/a	0	0	0	0	0	n/a
56	3	3	2	2	2.5	n/a	2	2	1	2	1.75	n/a
57	0	0	0	0	0	n/a	0	0	0	0	0	n/a
58	1	2	0	1	1	n/a	1	2	0	2	1.25	n/a
59	6	6	4	6	5.5	cataflam	5	6	4	5	5	panado
60	2	2	2	2	2	n/a	1	2	1	1	1.25	n/a
61	7	7	5	7	6.5	myprodol	9	10	7	7	8.25	n/a
62	0	0	1	0	0.25	n/a	0	0	0	0	0	n/a
63	4	5	3	4	4	n/a	4	4	2	3	3.25	n/a
64	1	1	0	0	0.5	n/a	0	0	0	0	0	n/a
65	1	1	1	1	1	n/a	0	0	0	0	0	n/a
66	3	3	1	2	2.25	n/a	1	1	1	1	1	n/a
67	6	7	3	6	5.5	mypaid	6	6	3	6	5.25	mypaid
68	1	1	1	1	1	n/a	0	0	0	0	0	n/a
69	2	2	2	2	2	n/a	1	1	1	1	1	n/a
70	7	8	4	6	6.25	mypaid	1	1	1	1	1	n/a
71	3	3	2	2	2.5	n/a	2	2	1	1	1.5	n/a
72	2	3	1	1	1.75	n/a	2	2	1	1	1.5	n/a
73	0	0	0	0	0	n/a	0	0	0	0	0	n/a
74	6	7	4	5	5.5	myprodol	6	7	4	5	5.5	myprodal
75	3	5	3	3	3.5	n/a	2	3	1	1	1.75	n/a
76	2	2	0	0	1	n/a	0	0	0	0	0	n/a
77	5	5	2	4	4	cataflam	4	5	2	2	3.25	n/a

Participant	Day 5- ave	Day 5- wo	Day 5- lea	Day 5- nov	Day 5- PSS	Day 5- me	Day 6- ave	Day 6- wo	Day 6- lea	Day 6- nov	Day 6- PSS	Day 6- me
1	0	0	0	0	0	n/a	0	0	0	0	0	n/a
2	4	5	3	3	3.75	n/a	5	7	3	6	5.25	ibuprofen
3	0	0	0	0	0	n/a	0	0	0	0	0	n/a
4	3	3	3	3	3	n/a	1	1	1	1	1	n/a
5	1	1	1	1	1	n/a	1	1	1	1	1	n/a
6	0	0	0	0	0	n/a	0	0	0	0	0	n/a
7	4	5	3	2	3.5	n/a	5	3	0	0	2	n/a
8	0	0	0	0	0	n/a	0	0	0	0	0	n/a
9	0	0	0	0	0	n/a	0	0	0	0	0	n/a
10	3	3	2	2	2.5	n/a	1	1	1	1	1	n/a
11	0	0	0	0	0	n/a	0	0	0	0	0	n/a
12	0	0	0	0	0	n/a	0	0	0	0	0	n/a
13	0	0	0	0	0	n/a	0	0	0	0	0	n/a
14	2	4	1	2	2.25	n/a	2	1	0	1	1	n/a
15	2	3	1	2	2	n/a	1	2	1	1	1.25	n/a
16	0	0	0	0	0	n/a	0	0	0	0	0	n/a
17	2	2	1	2	1.75	n/a	1	2	0	1	1	n/a
18	3	3	3	2	2.75	n/a	1	1	1	1	1	n/a
19	0	0	0	0	0	n/a	0	0	0	0	0	n/a
20	0	0	0	0	0	n/a	0	0	0	0	0	n/a
21	0	0	0	0	0	n/a	0	0	0	0	0	n/a
22	1	2	0	0	0.75	n/a	1	2	0	0	0.75	n/a
23	1	2	0	1	1	n/a	1	1	0	1	0.75	n/a
24	0	0	0	0	0	n/a	0	0	0	0	0	n/a

Participant	Day 5- ave	Day 5- wo	Day 5- lea	Day 5- nov	Day 5- PSS	Day 5- me	Day 6- ave	Day 6- wo	Day 6- lea	Day 6- nov	Day 6- PSS	Day 6- me
25	1	3	1	1	1.5	n/a	1	2	1	1	1.25	n/a
26	0	0	0	0	0	n/a	0	0	0	0	0	n/a
27	0	0	0	0	0	n/a	0	0	0	0	0	n/a
28	0	1	0	0	0.25	n/a	0	0	0	0	0	n/a
29	0	0	0	0	0	n/a	0	0	0	0	0	n/a
30	0	0	0	0	0	n/a	0	0	0	0	0	n/a
31	2	4	1	2	2.25	n/a	2	1	0	0	0.75	n/a
32	0	0	0	0	0	n/a	0	0	0	0	0	n/a
33	5	6	3	6	5	mypaid	5	5	2	4	4	mypaid
34	5	6	3	6	5	n/a	5	5	2	4	4	n/a
35	0	0	0	0	0	n/a	0	0	0	0	0	n/a
36	0	0	0	0	0	n/a	0	0	0	0	0	n/a
37	4	5	4	4	4.25	n/a	4	4	3	3	3.5	n/a
38	0	1	0	0	0.25	n/a	0	0	0	0	0	n/a
39	0	0	0	0	0	n/a	0	0	0	0	0	n/a
40	0	0	0	0	0	n/a	0	0	0	0	0	n/a
41	0	0	0	0	0	n/a	0	0	0	0	0	n/a
42	1	2	1	0	1	n/a	0	0	0	0	0	n/a
43	0	0	0	0	0	n/a	0	0	0	0	0	n/a
44	2	4	1	2	2.25	n/a	2	1	0	0	0.75	n/a
45	0	0	0	0	0	n/a	0	0	0	0	0	n/a
46	1	1	0	1	0.75	n/a	0	0	0	0	0	n/a
47	2	3	1	1	1.75	arnica gel	3	4	2	2	2.75	arnica gel
48	4	5	3	4	4	n/a	4	4	3	2	3.25	n/a
49	0	0	0	0	0	n/a	0	0	0	0	0	n/a
50	1	1	0	0	0.5	n/a	0	0	0	0	0	n/a

Participant	Day 5- ave	Day 5- wo	Day 5- lea	Day 5- nov	Day 5- PSS	Day 5- me	Day 6- ave	Day 6- wo	Day 6- lea	Day 6- nov	Day 6- PSS	Day 6- me
51	0	0	0	0	0	n/a	0	0	0	0	0	n/a
52	0	0	0	0	0	n/a	0	0	0	0	0	n/a
53	0	0	0	0	0	n/a	0	0	0	0	0	n/a
54	3	4	1	2	2.5	n/a	2	3	1	1	1.75	n/a
55	0	0	0	0	0	n/a	0	0	0	0	0	n/a
56	1	2	1	1	1.25	n/a	0	0	0	0	0	n/a
57	0	0	0	0	0	n/a	0	0	0	0	0	n/a
58	0	0	0	0	0	n/a	0	0	0	0	0	n/a
59	4	5	3	4	4	n/a	3	4	2	1	2.5	n/a
60	0	0	0	0	0	n/a	0	0	0	0	0	n/a
61	6	8	4	5	5.75	n/a	2	3	1	1	1.75	n/a
62	0	0	0	0	0	n/a	0	0	0	0	0	n/a
63	2	2	2	2	2	n/a	1	1	1	1	1	n/a
64	0	0	0	0	0	n/a	0	0	0	0	0	n/a
65	0	0	0	0	0	n/a	0	0	0	0	0	n/a
66	1	1	0	1	0.75	n/a	1	1	0	1	0.75	n/a
67	5	6	3	5	4.75	mypaid	5	5	2	4	4	mypaid
68	0	0	0	0	0	n/a	0	0	0	0	0	n/a
69	0	0	0	0	0	n/a	0	0	0	0	0	n/a
70	0	0	0	0	0	n/a	0	0	0	0	0	n/a
71	1	1	1	1	1	n/a	0	1	0	0	0.25	n/a
72	0	0	0	0	0	n/a	0	0	0	0	0	n/a
73	0	0	0	0	0	n/a	0	0	0	0	0	n/a
74	4	5	2	4	3.75	myprodal	4	4	3	2	3.25	myprodal
75	1	1	1	1	1	n/a	0	0	0	0	0	n/a
76	0	0	0	0	0	n/a	0	0	0	0	0	n/a
77	3	4	1	2		n/a	2	2	1	1	1.5	n/a

Participant	Day 7- ave	Day 7- wo	Day 7- lea	Day 7- nov	Day 7- PSS	Day 7- me	Day 8- ave	Day 8- wo	Day 8- lea	Day 8- nov	Day 8- PSS	Day 8- me
1	0	0	0	0	0	n/a	0	0	0	0	0	n/a
2	5	8	3	5	5.25	parcetoma	8	9	4	6	6.75	ibuprofen
3	0	0	0	0	0	n/a	0	0	0	0	0	n/a
4	0	0	0	0	0	n/a	0	0	0	0	0	n/a
5	1	1	1	1	1	n/a	1	1	1	1	1	n/a
6	0	0	0	0	0	n/a	0	0	0	0	0	n/a
7	0	0	0	0	0	n/a	0	0	0	0	0	n/a
8	0	0	0	0	0	n/a	0	0	0	0	0	n/a
9	0	0	0	0	0	n/a	0	0	0	0	0	n/a
10	0	0	0	0	0	n/a	0	0	0	0	0	n/a
11	0	0	0	0	0	n/a	0	0	0	0	0	n/a
12	0	0	0	0	0	n/a	0	0	0	0	0	n/a
13	0	0	0	0	0	n/a	0	0	0	0	0	n/a
14	0	0	0	0	0	n/a	0	0	0	0	0	n/a
15	1	1	0	1	0.75	n/a	0	0	0	0	0	n/a
16	0	0	0	0	0	n/a	0	0	0	0	0	n/a
17	1	1	0	0	0.5	n/a	0	1	0	0	0.25	n/a
18	0	0	0	0	0	n/a	0	0	0	0	0	n/a
19	0	0	0	0	0	n/a	0	0	0	0	0	n/a
20	0	0	0	0	0	n/a	0	0	0	0	0	n/a
21	0	0	0	0	0	n/a	0	0	0	0	0	n/a
22	1	1	0	0	0.5	n/a	0	0	0	0	0	n/a
23	1	1	0	1	0.75	n/a	1	1	0	1	0.75	n/a
24	0	0	0	0	0	n/a	0	0	0	0	0	n/a

Participant	Day 7- ave	Day 7- wo	Day 7- lea	Day 7- nov	Day 7- PSS	Day 7- me	Day 8- ave	Day 8- wo	Day 8- lea	Day 8- nov	Day 8- PSS	Day 8- me
25	1	1	1	1	1	n/a	1	1	1	1	1	n/a
26	0	0	0	0	0	n/a	0	0	0	0	0	n/a
27	0	0	0	0	0	n/a	0	0	0	0	0	n/a
28	0	0	0	0	0	n/a	0	0	0	0	0	n/a
29	0	0	0	0	0	n/a	0	0	0	0	0	n/a
30	0	0	0	0	0	n/a	0	0	0	0	0	n/a
31	0	0	0	0	0	n/a	0	0	0	0	0	n/a
32	0	0	0	0	0	n/a	0	0	0	0	0	n/a
33	4	5	2	4	3.75	mypaid	3	4	2	3	3	mypaid
34	4	4	2	4	3.5	n/a	3	4	2	3	3	n/a
35	0	0	0	0	0	n/a	0	0	0	0	0	n/a
36	0	0	0	0	0	n/a	0	0	0	0	0	n/a
37	3	3	3	3	3	myprodol	3	3	3	3	3	n/a
38	0	0	0	0	0	n/a	0	0	0	0	0	n/a
39	0	0	0	0	0	n/a	0	0	0	0	0	n/a
40	0	0	0	0	0	n/a	0	0	0	0	0	n/a
41	0	0	0	0	0	n/a	0	0	0	0	0	n/a
42	0	0	0	0	0	n/a	0	0	0	0	0	n/a
43	0	0	0	0	0	n/a	0	0	0	0	0	n/a
44	0	0	0	0	0	n/a	0	0	0	0	0	n/a
45	0	0	0	0	0	n/a	0	0	0	0	0	n/a
46	0	0	0	0	0	n/a	0	0	0	0	0	n/a
47	2	3	1	1	1.75	arnica gel	1	2	0	0	0.75	n/a
48	2	2	2	1	1.75	n/a	0	1	0	0	0.25	n/a
49	0	0	0	0	0	n/a	0	0	0	0	0	n/a
50	0	0	0	0	0	n/a	0	0	0	0	0	n/a

Participant	Day 7- ave	Day 7- wo	Day 7- lea	Day 7- nov	Day 7- PSS	Day 7- me	Day 8- ave	Day 8- wo	Day 8- lea	Day 8- nov	Day 8- PSS	Day 8- me
51	0	0	0	0	0	n/a	0	0	0	0	0	n/a
52	0	0	0	0	0	n/a	0	0	0	0	0	n/a
53	0	0	0	0	0	n/a	0	0	0	0	0	n/a
54	1	1	1	1	1	n/a	0	1	0	0	0.25	n/a
55	0	0	0	0	0	n/a	0	0	0	0	0	n/a
56	0	0	0	0	0	n/a	0	0	0	0	0	n/a
57	0	0	0	0	0	n/a	0	0	0	0	0	n/a
58	0	0	0	0	0	n/a	0	0	0	0	0	n/a
59	2	2	1	0	1.25	n/a	1	1	1	0	0.75	n/a
60	0	0	0	0	0	n/a	0	0	0	0	0	n/a
61	1	1	1	1	1	n/a	0	0	0	0	0	n/a
62	0	0	0	0	0	n/a	0	0	0	0	0	n/a
63	0	0	0	0	0	n/a	0	0	0	0	0	n/a
64	0	0	0	0	0	n/a	0	0	0	0	0	n/a
65	0	0	0	0	0	n/a	0	0	0	0	0	n/a
66	0	1	0	0	0.25	n/a	0	1	0	0	0.25	n/a
67	4	5	2	4	3.75	mypaid	3	4	2	3	3	mypaid
68	0	0	0	0	0	n/a	0	0	0	0	0	n/a
69	0	0	0	0	0	n/a	0	0	0	0	0	n/a
70	0	0	0	0	0	n/a	0	0	0	0	0	n/a
71	0	0	0	0	0	n/a	0	0	0	0	0	n/a
72	0	0	0	0	0	n/a	0	0	0	0	0	n/a
73	0	0	0	0	0	n/a	0	0	0	0	0	n/a
74	2	2	1	1	1.5	n/a	1	1	1	1	1	n/a
75	0	0	0	0	0	n/a	0	0	0	0	0	n/a
76	0	0	0	0	0	n/a	0	0	0	0	0	n/a
77	1	1	0	0	0.5	n/a	0	1	0	0	0.25	n/a

Participant	Day 9 - ave	Day 9- wo	Day 9- lea	Day 9- nov	Day 9- PSS	Day 9- me	Day 10- av	Day 10- w	Day 10- le	Day 10- nc	Day 10- PS	Day 10- meds
1	0	0	0	0	0	n/a	0	0	0	0	0	n/a
2	8	9	5	7	7.25	norflex, vi	8	9	4	7	7	norflex, vimovo
3	0	0	0	0	0	n/a	0	0	0	0	0	n/a
4	0	0	0	0	0	n/a	0	0	0	0	0	n/a
5	1	1	1	1	1	n/a	1	1	1	1	1	n/a
6	0	0	0	0	0	n/a	0	0	0	0	0	n/a
7	0	0	0	0	0	n/a	0	0	0	0	0	n/a
8	0	0	0	0	0	n/a	0	0	0	0	0	n/a
9	0	0	0	0	0	n/a	0	0	0	0	0	n/a
10	0	0	0	0	0	n/a	0	0	0	0	0	n/a
11	0	0	0	0	0	n/a	0	0	0	0	0	n/a
12	0	0	0	0	0	n/a	0	0	0	0	0	n/a
13	0	0	0	0	0	n/a	0	0	0	0	0	n/a
14	0	0	0	0	0	n/a	0	0	0	0	0	n/a
15	0	0	0	0	0	n/a	0	0	0	0	0	n/a
16	0	0	0	0	0	n/a	0	0	0	0	0	n/a
17	0	0	0	0	0	n/a	0	0	0	0	0	n/a
18	0	0	0	0	0	n/a	0	0	0	0	0	n/a
19	0	0	0	0	0	n/a	0	0	0	0	0	n/a
20	0	0	0	0	0	n/a	0	0	0	0	0	n/a
21	0	0	0	0	0	n/a	0	0	0	0	0	n/a
22	0	0	0	0	0	n/a	0	0	0	0	0	n/a
23	1	1	0	1	0.75	n/a	1	1	0	1	0.75	n/a
24	0	0	0	0	0	n/a	0	0	0	0	0	n/a

Participant	Day 9 - ave	Day 9- wo	Day 9- lea	Day 9- nov	Day 9- PSS	Day 9- me	Day 10- av	Day 10- w	Day 10- le	Day 10- nc	Day 10- PS	Day 10- meds
25	1	1	1	1	1	n/a	1	1	1	1	1	n/a
26	0	0	0	0	0	n/a	0	0	0	0	0	n/a
27	0	0	0	0	0	n/a	0	0	0	0	0	n/a
28	0	0	0	0	0	n/a	0	0	0	0	0	n/a
29	0	0	0	0	0	n/a	0	0	0	0	0	n/a
30	0	0	0	0	0	n/a	0	0	0	0	0	n/a
31	0	0	0	0	0	n/a	0	0	0	0	0	n/a
32	0	0	0	0	0	n/a	0	0	0	0	0	n/a
33	3	3	1	2	2.25	mypaid	3	2	1	2	2	mypaid
34	3	3	0	2	2	n/a	3	2	0	2	1.75	n/a
35	0	0	0	0	0	n/a	0	0	0	0	0	n/a
36	0	0	0	0	0	n/a	0	0	0	0	0	n/a
37	3	3	2	2	2.5	n/a	3	3	3	3	3	n/a
38	0	0	0	0	0	n/a	0	0	0	0	0	n/a
39	0	0	0	0	0	n/a	0	0	0	0	0	n/a
40	0	0	0	0	0	n/a	0	0	0	0	0	n/a
41	0	0	0	0	0	n/a	0	0	0	0	0	n/a
42	0	0	0	0	0	n/a	0	0	0	0	0	n/a
43	0	0	0	0	0	n/a	0	0	0	0	0	n/a
44	0	0	0	0	0	n/a	0	0	0	0	0	n/a
45	0	0	0	0	0	n/a	0	0	0	0	0	n/a
46	0	0	0	0	0	n/a	0	0	0	0	0	n/a
47	0	0	0	0	0	n/a	0	0	0	0	0	n/a
48	0	0	0	0	0	n/a	0	0	0	0	0	n/a
49	0	0	0	0	0	n/a	0	0	0	0	0	n/a
50	0	0	0	0	0	n/a	0	0	0	0	0	n/a

Participant	Day 9 - ave	Day 9- wo	Day 9- lea	Day 9- nov	Day 9- PSS	Day 9- me	Day 10- av	Day 10- w	Day 10- le	Day 10- nc	Day 10- PS	Day 10- meds
51	0	0	0	0	0	n/a	0	0	0	0	0	n/a
52	0	0	0	0	0	n/a	0	0	0	0	0	n/a
53	0	0	0	0	0	n/a	0	0	0	0	0	n/a
54	0	0	0	0	0	n/a	0	0	0	0	0	n/a
55	0	0	0	0	0	n/a	0	0	0	0	0	n/a
56	0	0	0	0	0	n/a	0	0	0	0	0	n/a
57	0	0	0	0	0	n/a	0	0	0	0	0	n/a
58	0	0	0	0	0	n/a	0	0	0	0	0	n/a
59	0	1	0	0	0.25	n/a	0	0	0	0	0	n/a
60	0	0	0	0	0	n/a	0	0	0	0	0	n/a
61	0	0	0	0	0	n/a	0	0	0	0	0	n/a
62	0	0	0	0	0	n/a	0	0	0	0	0	n/a
63	0	0	0	0	0	n/a	0	0	0	0	0	n/a
64	0	0	0	0	0	n/a	0	0	0	0	0	n/a
65	0	0	0	0	0	n/a	0	0	0	0	0	n/a
66	0	1	0	0	0.25	n/a	0	0	0	0	0	n/a
67	3	3	1	2	2.25	mypaid	3	2	1	2	2	mypaid
68	0	0	0	0	0	n/a	0	0	0	0	0	n/a
69	0	0	0	0	0	n/a	0	0	0	0	0	n/a
70	0	0	0	0	0	n/a	0	0	0	0	0	n/a
71	0	0	0	0	0	n/a	0	0	0	0	0	n/a
72	0	0	0	0	0	n/a	0	0	0	0	0	n/a
73	0	0	0	0	0	n/a	0	0	0	0	0	n/a
74	0	0	0	0	0	n/a	0	0	0	0	0	n/a
75	0	0	0	0	0	n/a	0	0	0	0	0	n/a
76	0	0	0	0	0	n/a	0	0	0	0	0	n/a
77	0	0	0	0	0	n/a	0	0	0	0	0	n/a