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Student name:	ELEANOR PARKIN	Student ID:	20006413
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Supervisor:	CATRIN ROWLANDS		
Comments	Section		
	Title and Abstract (5%) Title to include: A concise indication of the research question/problem. Abstract to include: A concise summary of the empirical study undertaken.		
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CARDIFF METROPOLITAN UNIVERSITY
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CARDIFF SCHOOL OF SPORT

DEGREE OF BACHELOR OF SCIENCE (HONOURS)

**SPORT CONDITIONING, REHABILITATION AND
MASSAGE**

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**THE EFFECTS OF PRE-EVENT, LOWER LIMB
MASSAGE ON AN ATHLETE'S PERFORMANCE DURING
AN 800 METER DISTANCE**

SCRAM

ELEANOR PARKIN

ST20006413

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LOWER LIMB MASSAGE ON AN
ATHLETE'S PERFORMANCE
DURING AN 800 METER DISTANCE**

Cardiff Metropolitan University
Prifysgol Fetropolitian Caerdydd

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Abstract

Objective: The primary objective of this study was to determine if pre-event massage had an effect on the time it took to run 800 meters compared to having no massage pre-event.

Method: Ten middle distance university students took part, four male and six female of similar fitness. These participants attended once a week for two weeks, both weeks the participants took part in a warm up. A cross-over design was adopted therefore one week the participants would receive a pre-determined pre-event massage, the other they would not. After either intervention the participants ran 800 meters. On both weeks the participants completed a visual analogue scale (VAS) questionnaire before warming up, after receiving the massage and after running 800 meters. They then individually ran the 800 meters and were timed.

Results: A two-way repeated measure analysis of variance test and a paired and independent t-test were used to analyse the results from the 800 meter times for both interventions. This showed no significant difference between the two interventions on the 800 meter timed runs ($p>0.05$). The VAS questionnaire showed some substantial differences between the interventions. However this has not been analysed in detail to show any psychological effects from the pre-event massage.

Conclusion: A pre-determined pre-event massage has no significant effect on athletic performance. However further research is required to see any psychological benefits.

CHAPTER ONE

INTRODUCTION

Since sports massage has become more popular for modern day athletes the demand for research and more knowledge on the effects is vital. This can be from recreational to elite level athletes, from football players to shot putt individuals using sports massage between training. Athletes also use sports massage in relation to their recovery rate, injury prevention and pre-event preparation (Hemmings, 2001). Pre-event massage is applied within 24/48 hours before the athlete's performance in order to prepare the athlete and muscles for the following exercise whereas post-event massage is applied 24/48 hours after exercise (SPS Ltd, 2003). Both pre and post massage have their own physiological and technical differences. Holey and Cook (1998) claim that circulatory effects of massage could help to reduce muscle soreness, injury to the muscle and increase post exercise rate of recovery.

1.1 Study Rationale

As athletes begin to use massage as a regular tool during training and competition it is important to see if there are any effects that occur from this treatment. There is little research for assessing effects of pre-event massage on performance. Any new information would be significant for athletes, coaches and massage practitioners.

Enhancing sports performance is vital for all athletes as it could be the difference between winning or second place. It is therefore believed by multidisciplinary sports teams that sports massage can have a positive effect on an athlete, whether this is physiological, psychological or part of a training routine (Tiidus & Shoemaker, 1995). Consequently research is required to look at physiological effects as well as psychological which may influence an athlete's performance. The awareness of sports massage benefits has increased along with the demand for safe and effective massage treatment (Hollis, 2009). Many researchers (Cafarelli & Flint, 1992; Fletcher, 2010; Goodwin, Glasister, Howatson, Lockey & McInnes, 2007; Hemmings, Smith, Graydon and Dyson, 2000; Young & Behm, 2003) have tested the effects of sports massage to observe if the effects are positive in relation to athletic performance. This research however is sparse and has no conclusive results to support one another's research. The possible effects of sports massage are affected by the variations of techniques applied. This in turn can create disparities in the results of the massage (Hollis, 2009). Most research methods cannot be accurately replicated due to these variations; depth, time, stroke and rhythm which will be explained later. To increase validity of research into the effects of pre-event massage these variations during the massage should be addressed. Research should also look at the

effects on an Olympic recognised longer running distance such as 400, 800 or 1500 meters. This is to see if the effect of massage changes during a longer period of time as these distances usually last between 40 seconds to four or five minutes for elite athletes. Therefore this study looks at the effects of pre-event, lower limb massage on an athlete's performance during an 800 meter running distance.

1.2 Aims of the Study

This study aims to expose any positive or negative effects from having a pre-event massage before competing on an 800 meter running distance. From the results the aim is to determine whether this type of massage has a physiological effect or whether it could be down to the individual psychological effects from receiving massage.

1.3 Hypothesis

H1: Massage applied to the participants pre-event will significantly improve their 800 meter run time.

H2: No massage applied to the participants pre-event will significantly improve their 800 meter run time.

Null Hypothesis

H01: Massage applied to the participants pre-event will not significantly improve their 800 meter run time.

H02: No massage applied to the participants pre-event will not significantly improve their 800 meter run time.

CHAPTER TWO

REVIEW OF LITERATURE

Literature relating to performance has mainly concentrated on the possibility of massage improving recovery within repeated bouts of exercise. However these studies have shown massage to have limited benefits on performance (Hemmings et al., 2000; Robertson, Watt & Galloway, 2004). There has been previous research into the positive effects of post-event massage on recovery (Weerapong, Hume & Kolt., 2005) however there is limited research into the effects of pre-performance massage, specifically on sports performance (Goodwin et al., 2007). Different massage techniques are used either pre or post event for sports that require speed, strength or power (Cash, 1996).



Figure 1: Time scale of pre-event, intermediate and post event massage

Both pre-event and post-event sports massages are applied for different situations such as for injury prevention or increased recovery rate (King, 1993). These time scales can be seen in figure 1 above.

2.1 Pre-event Preparation for 800 Meters

Stolley (2013) suggests that in order to be successful at achieving the demands of 800 meter running, the athlete needs to ensure there is good basic speed. It has also been suggested that the athlete can utilise their aerobic energy system and therefore the last 400 meters of the 800 meters is ran anaerobically (Greene & Pate, 2004). This is also mentioned by Jarver (1997) (as cited in Horwill, 1995) who suggested that 800 meter running involves great physical stamina due to the distance being 67% anaerobic and 33% aerobic. Therefore suggesting athletes need to be trained for this energy system. During an 800 meter race the whole body is activated and all muscles are in use during movement patterns in manoeuvring around other athletes (Stolley, 2013).

Over an 11 year period from 1987 to 1998, Galloway and Watt (2004) recorded the frequency in which physiotherapists delivered massage at an athletic event. The results showed that massage was used 45.2% of the total number of treatments by the physiotherapist (Galloway & Watt, 2004). However the results also showed that there was no significant indication that massage treatments used increased or decreased over the 11 year period at athletics events. Galloway and Watt (2004) stated that a large proportion of the physiotherapist's treatment time was spent on the massage modality. This suggests that massage is becoming a more popular tool for athletes' pre-event preparation and physiotherapists' recovery treatment method.

2.2 Athletes Pre-event Preparation

2.2.1 Music Protocol

Music has been used for years as an aid to different types of therapy. In more recent time, music has been used in the preparation of an athlete before an event to increase focus (Jarraya, et al. 2012). Some athletes have begun to use music as part of their warm up protocol for motivation, relaxation and inspiration techniques (Simpson & Karageorghis, 2006). Music can also be used during exercise as well as part of cooling down. Simpson and Karageorghis (2006) have shown that listening to music during the warm up stage can enhance an athlete's performance over a 400 meter sprint significantly. This however, was tested on non-elite athletes and therefore cannot be assumed among elite athletes performance. Despite this Jarraya et al. (2012) also showed that listening to music while warming up before a Wingate test enhanced performance for the athletes. These findings support other research in the effects of music on long duration exercise performance (Edworthy & Waring, 2006; Karageorghis, et al. 2009).

Becker, et al. (1994) researched the relationships of different types of music and exercise on 20 children, 20 adults and 20 seniors. The participants were asked to cycle on a stationary bike while listening to three types of music; white noise, frenetic and mellow. Results showed that both music conditions, as opposed to the white noise, had a measurable positive influence on the participants exercise. The reason for this influence has been suggested by Becker, et al. (1994) that the music may have provided a rhythm or pace for the participants to exercise with.

2.2.2 Stretching Protocol

Nelson, Driscoll, Landin, Young and Schexnayder (2005) studied the effects of stretching on 20 meter sprints. Each participant was tested individually over four weeks, each week they were tested using a different protocol; no stretching on either leg, both legs stretched, forward leg stretched (starting leg position), and rear leg stretched. For each of the three stretching conditions', 20 meter sprint times were significantly slower than the sprint times with the no stretching condition. Nelson et al. (2005) concluded that these results showed that stretching before an event may have a negative impact on the athlete's performance for high-power short exercise. It has been reported that the stretch-shortening phenomenon is due to the release of stored elastic energy in the musculotendinous structures. However this is yet to be proven to be reason for pre-event stretching to have no or a negative effect on sprint performance. Following this, Nelson et al. (2005) conducted the testing in a lab setting relying on rate of force production and peak force generation. Therefore the results could be assumed to have the same effect in a sporting setting however this has not been proven.

Similarly, Young and Behm (2003) compared various warm up protocols looking at the effects of static stretching on explosive force and jumping performance. This study found that stretching had a negative effect on these. Taking this into consideration, sprinting has an explosive nature and therefore stretching could also have a negative effect on this. However these studies do not look at middle distance runners and therefore this could have significantly different results.

2.2.3 Warm Up Protocol

The traditional warming up process can prepare the athlete for subsequent stress and increase the athlete's performance (Sander, Keiner, Schlumberger, Wirth & Schmidtbleicher, 2013). Sander et al. (2013) looked at two different warm up protocols; a normal soccer warm up (NWP) involving 5 minutes of running, coordination, stretching and acceleration. The second being the same warm up program combined with functional exercises for trunk muscles (WPS). Testing involved participants performing linear sprints over 30 meters followed by change of direction sprints over 10 meters. The results showed that there were no effects of the WPS on the athletes sprint test in addition to the NWP.

They suggest that the NWP they used, generates sufficient activation for sprint performance (Sander et al., 2013).

Warm up before sprint tests were also used by Stewart, Adams, Alonso, Koesveld and Campell, (2007) who tested the effects of pre-event warm up protocols on sprinting performance in elite footballers. This study used four protocols; no preparation, stretching only, warm up only, or warm up and stretching (Stewart et al., 2007). Each participant then performed three 40 meter sprints at their maximum speed. They found that the athletes who completed a warm up prior to their sprints as opposed to without a warm up had significantly faster time in the 40 meter sprint. Smith (2004) suggests that warm ups are required pre-exercise to increase muscle and tendon suppleness to lengthen muscles.

A review by Fradkin, Zazryn, and Smoliga (2010) found that warming up improved up to 79% of participants' performance during testing. This shows that suitable warm up activities improves performance and therefore the previous suggestion (Kilding, Tunstall, & Kuzmic., 2008; Sander et al., 2013; Steffen et al., 2008) that warm ups have a negative or null effect cannot be proven in this case. Limitations of this review of studies are the varied warm up conditions for each study. This made it difficult to reliably compare the studies and their results. Similarly there were few 'well conducted' controlled trials; therefore to further develop this study and determine the effects of warm ups on performance more of these are required.

2.2.4 Massage Protocol

Pre-event sports massage is used usually alongside a warm up before the athlete's event or training in order to prepare physically and psychologically. Massage and specifically pre-event massage increases circulation and fluid movement, flushing the tissue from chemical irritants and toxins (Holey & Cook, 1998). However there still has not been any distinctive evidence which supports the long term hypothesis that pre-event massage can have a positive effect on performance for an athlete.

Benjamin and Lamp (2005) state that massage can be part of an athlete's ritual before their event. They believe massage is used as a combination of a warm up and reducing muscle tension in order to reduce muscle pulls and tears. Athletes who have regular massage can prevent acute injuries from strains or tears and chronic injuries such as repetitive strains (Benjamin & lamp, 2005).

2.3 Sports Massage Techniques and Length

Swedish massage is the most commonly preferred sports massage delivered which involves Effleurage, Petrissage and Tapotements (Callaghan, 1993). Effleurage involves sliding movements across the skin with applied pressure (Benjamin & Lamp, 2005). Petrissage however uses kneading and lifting of the skin compared to Tapotements which involves percussion techniques such as Hacking, Cupping and Slapping (SPS Ltd, 2003).

Sports masseurs believe massage that is specific to an athlete is more beneficial and show significantly better performance than a previously designed massage that may not fit the needs of the athlete (Cash., 1996). Techniques, speed and depth need to be considered and altered in order to be most appropriate for each athlete. However during studies this is harder to test therefore most studies use a pre-determined massage protocol. Arabaci (2008) used Swedish massage of Effleurage, Petrissage, and Tapotement similarly to Goodwin et al. (2007) which was applied by two masseurs to the lower limbs simultaneously. The masseurs previously practiced the stroke speeds and depths on themselves in order to familiarise themselves creating a plan for the massage. This strength of the study creates validity in massage, therefore similar effects on each participant. Arabaci (2008), likewise to Goodwin et al. (2007) used a pre-designed massage, therefore not created for the participant's individual needs. As previously mentioned this could be a limitation to this study as the athletes needs were not taken into consideration and adapted for their benefit. Goodwin et al. (2007) also ensured the masseurs were all familiarised with the stroke order, techniques and rate in order to be consistent and minimize variations between the massages received.

Sports massage used prior to a race usually need to be stimulating for the muscles required as well as for the athlete. Therefore requiring the massage to be vigorous and involve stimulating techniques such as Vibrations and Tapotements (Goodwin et al., 2007). In a study by Fletcher, (2010) pre-event massage was applied for nine minutes with Effleurage at 30 strokes each minute and petrissage at 60 strokes per minute, implying this was at a fast tempo. The massage was applied to the lower limbs using superficial techniques in order to stimulate the athletes muscles used in sprinting. It is believed that this massage would produce more compliant tissue, which subsequently increases elastic properties of the muscles. Fletcher, (2010) suggested that in sprinting a stiffer musculotendinous unit contributes an elastic component, this supplies extra power for high stride frequency consequently improving sprint performance.

Lower limb massage is usually used in track events as most athletes find this the most beneficial area. Effleurage strokes can be used on all parts of the lower limb to initially warm up the muscles and spread oil. The practitioner strokes the skin with pressure towards the heart, using hands or forearm. Effleurage produces physiological effects on the body by creating friction to warm up the skin, subcutaneous and muscle tissue. It also increases circulation, cell permeability and cell metabolism to speed up the removal of waste and increases the supply of nutrients. Mechanical effects include improved venous and lymphatic flow using the one way valve system (SPS Ltd, 2003).

Tapotements can be used on the lower limbs for pre-event due to the vigorous and fast pace that is required. Physiologically this technique stimulates the sensory nerve endings via the receptors in the skin. It also stimulates the autonomic nervous system which involves the fight or flight mechanism (SPS Ltd, 2003). Tapotements create Erythema of the skin which subsequently draws the blood circulation to the skin through the capillaries. These effects lengthen the subsequent muscles benefiting middle distance runners stride length and avoid injury (Harmer,1991).

Many studies in massage literature argue the length of time a pre-event massage should be delivered for. King (1993) suggests that a pre-event warm up massage should last for 15-20 minutes for optimal results. They also recommended that pre-event massage should be performed lightly, for a short period of time to muscles involved in the activity. Additionally massage should be applied with an 'up-tempo' pace using rhythm in order to prepare the athlete. Cash (1996) agrees that pre-event massage should focus on the main muscles required for the upcoming event. Cash (1996) suggests that relaxing the athlete slightly may be beneficial due to natural excitement, nervousness and adrenaline already applied to the athlete.

Benjamin and Lamp (2005) stress that pre-event massage should not cause pain to the athlete but should involve techniques that increase circulation around the required major muscles with an upbeat tempo for 15-20 minutes. Robertson et al. (2004) identified that lower limb massage should be delivered for 10 minutes or 10–30 minutes for it to be beneficial. However Tiidus and Shoemaker (1995) disagreed and stated that 15-30 minutes of massage showed little benefit and can be counterproductive. Therefore between 10 and 20 minutes is suggested to be the optimum time for a pre-event massage. As a result a 12 minute pre-event massage would be an effective amount of time which could be replicated in a sporting environment.

2.4 Pre-Event Massage

Pre-event massage has both a physiological effect and a psychological effect on the recipient. Sports massage optimises mental preparation, range of movement, energy rise and concentration levels and in turn optimises performance (see figure 2) (Benjamin & Lamp, 2005).

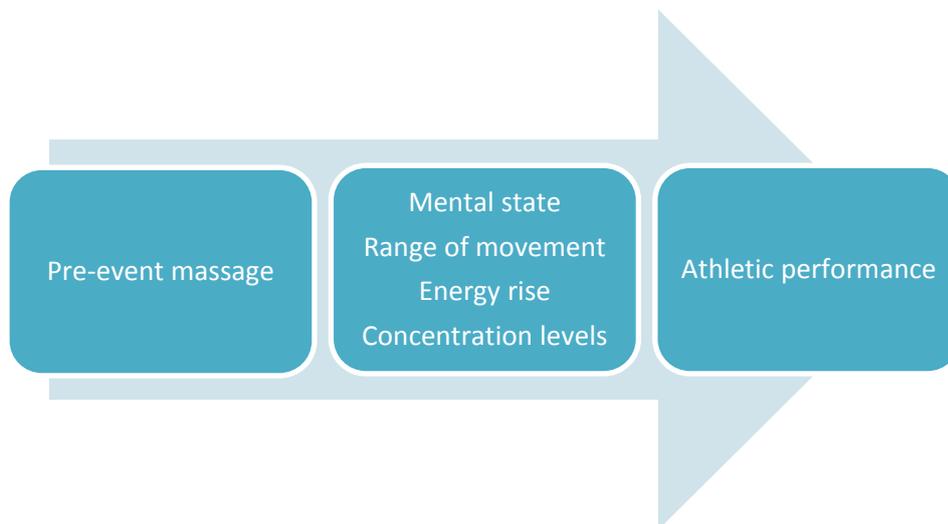


Figure 2: Diagram to show the process between pre-event massage and its effect on an athlete's performance.

Goodwin et al. (2007) studied the effects of massage on a 30 meter sprint distance using 37 male university students. This study used a counterbalanced cross-over design as each participant was tested under three conditions; 15 minute lower-limb pre-event sports massage, 15 minute placebo ultrasound and rest. The tests required that each participant completed a 10 minute warm up followed by the three 30 meter sprints with a five minute recovery period between each test. The results showed that the 15 minute lower limb massage did not have a significant effect on the participants sprint time. This could be as any effect may have been utilised through the 10 minute warm up. This limitation of the study implies that the warm up should be completed prior to the massage to avoid any benefit being diminishing in the warm up.

These findings reiterate previous research by Harmer (1991) who also found no effect on the participants sprint time during an on-the-spot running test which involved participants jogging while not moving forward or backwards. Harmer (1991) suggested that any effects from receiving massage would deplete after 10 minutes or during warming up. This would conclude that the optimal time for the athlete to receive massage would be within 10 minutes of the start of the event in order for it to have an effect on performance.

Similarly Fletcher (2010) looked at pre-competition massage on 20 meter sprints. The study involved 20 male athletes that took part in one of three warm up modalities; pre-event massage, traditional warm up or pre-event massage together with a traditional warm up. Results of this study showed that athletes who took part in the traditional warm up and also the massage combined with a warm up were significantly faster than the athletes that just had the massage. The massage modality for pre-event preparation showed a decrease in the 20 meter sprint in comparison to the traditional warm up. This therefore would suggest that pre-event massage is questionable due to it appearing to have no effect on the participants improving their sprint performance (Fletcher, 2010). In fact massage combined with a warm up had similar effect to athletes as a traditional warm up. This shows that combined would be most effective at an event for athletes however the time availability before an event may not be realistic.

Fletcher (2010) and Goodwin et al. (2007) both found that pre-event massage did not have an effect on sprint performance compared to a traditional warm up. Factors that create variables for the results can include the techniques used in the massage delivered. Other studies have been more specific in which massage techniques were used to allow for reliability such as, grading the depth and pace of massage (Hunter, Watt, Watt & Galloway, 2006; Robertson, Watt & Galloway, 2004). Goodwin et al. (2007) suggested that future studies should highlight the differential mechanisms to the response from massage techniques and to consider any potential changes of the effects over time. However, both Fletcher (2010) and Goodwin et al. (2007) recognise that pre-determined massage protocols limit the variability of delivering the optimum effects to each individual.

2.5 Effects of Pre-event Massage

2.5.1 Physiological Factors

Pre-event sports massage aims to physically stimulate the sensory receptors to 'fire up' the body in preparation for competition (Weerapong et al., 2005). During sporting activities physical preparation is important such as warm ups, stretching and massage. This is in order to avoid injury, increase injury resilience and enhance performance (Cone, 2007).

Massage creates a physiological response by increasing circulation which supplies nutrients and removes substances at cellular level (Cash, 1996). This increase in circulation generates erythema on some clients and a rise in skin and muscle temperature (Goodwin et al., 2007).

Research undertaken by Arabaci (2008) and Goodwin et al. (2007) examine the benefits of improved range of movement on performance by improving musculotendinous compliance during massage. This causes a decrease in elastic storage in the eccentric phase of muscle contraction and thus decreasing musculotendinous power and consequently performance (Fletcher, 2010). Weerapong et al. (2005) stated massage can create mechanical pressure which consequently increases muscle compliance resulting in an increase of range of motion at the joint. King (1993) also agrees that full range of movement can be improved however by using Cross-fibre techniques to reduce adhesion in soft tissue, repairing the muscle. King (1993) also states that massage reduces muscle tightness and this therefore can improve muscle tone, flexibility of the athlete and overall promote muscle balance. Brook (1992) states that flexibility is important for all middle distance runners to avoid injury during the excessive movements through joints. These factors achieved from massage allow the athlete to gain full running stride particularly optimum strides during sprinting (Brook, 1992). Arroyo-Morales et al. (2011) stated that the hypothesised effects of pre-performance massage are injury prevention due to an increase in muscle flexibility and a decrease in muscle tension. Results from this study showed that massage prior to an activity had a negative effect on the subsequent muscular performance. However Arroyo-Morales et al. (2011) indicated that this finding cannot be generalised to pre-performance massage having a negative effect on athletic performance.

Running performance is made up of two components; stride length and stride frequency which if affected can improve performance (Hunter, Marshall & McNair, 2004). Arabaci (2008) found a significant improvement in the sit and reach test after the lower limb massage suggesting an increase in flexibility at the hip joint. Therefore massage which improves musculotendinous unit stiffness and the release of trigger points can improve flexibility, and particularly at the hip. This suggests that if massage can improve flexibility at the hip, stride length and stride frequency may be positively affected too. Moss (2004) explained that by increasing strength and flexibility the nervous system must be trained to accommodate a longer stride length. Disputing this, Harmer (1991) looked at the effects of pre-event massage on stride frequency before 'on-the-spot' running. The study found no significant effect on stride frequency however they noted that stride frequency needs to be tested and analysed along with stride length in order to achieve a more suitable outcome. Weerapong et al. (2005) state that many sportsmen and their teams believe that massage increases the flow of oxygenated blood to muscles in preparation for exercise reduces muscle tension and neurological excitability. Goodwin et al. (2007) agrees with this suggesting that neurological effects could increase performance, this is by having an effect on force-generating capacities, subsequently decreasing neuromuscular excitability, pain and muscle spasm. Arabaci's (2008) study supported Goodwin et al. (2007) and Weerapong et al. (2005) as previously mentioned there was a significant improvement during the sit and reach test. However Arabaci (2008) also found a decrease in performance after the massage in vertical jump, ten meter acceleration, 30 meter sprint from a standing position and leg reaction time tests suggesting massage decreases power to the muscles. However due to the limited number of participants the results from this study cannot be generalised and subsequently a larger sample size is required in order to verify the outcome. This should include a number of various techniques of massage applied prior to explosive and high speed activities. This study was similar to Goodwin et al. (2007) as both aimed to look at the acute effects of pre-performance lower limb massage on explosive and high speed capacities and flexibility. Arabaci (2008) also used a similar protocol to Goodwin et al. (2007) where all participants took part in a standard 15 minute warm up followed by not only 30 meter sprint but also a vertical jump test and sit and reach test. The participants then received either a massage, performed static stretching exercises or had passive rest for 15 minutes. The three tests were completed immediately after the interventions which found that lower limb massage had no or negative effect on the vertical jump, speed and reaction time, however a positive effect on the sit and reach test.

2.5.2 Psychological Factors

Psychological influences have been widely proven to have an effect on an athlete's mental state during performance (Arroyo-Morales et al., 2011; Browne and Mahoney., 1984; Weinberg and Gould., 2007). Sports psychologists have an important role in preparing an athlete to mentally prepare them in a system that works for the individual.

King (1993) suggested that massage generates self confidence in athletes however each athlete can be psychologically affected differently after receiving a pre-event massage. Some prefer to feel motivated and energetic whereas others choose to be relaxed and calm, this can be due to their sport or just personality. In order to achieve the best outcome for the athlete it is important to take into consideration their preference. It is also vital for the athletes to be introduced to different types of massage, to become familiar and adopt their preference. This also can be an advantage for psychological benefits or a method to reduce stress levels, particularly before an event. A study conducted by Leivadi et al. (1999) analysed the difference between effects of massage therapy or relaxation therapy in 30 dance students. Stress hormones decreased only in the massage therapy group but both groups reported a decrease in their state trait anxiety levels.

Weinberg, Jackson, and Kolodny, (1988) used a Profile Of Mood States (POMS) (McNair, Lorr, and Droppleman, 1981) to show a positive relationship between massage, exercise and mood state. This study specifically looked at subscales of tension, depression, anger and fatigue. After the massage these all reduced subsequently, as a result Weinberg et al. (1988) stated that the intervention was associated with the positive mood states and the psychological well-being of the athletes recorded.

However the literature is dated and a more recent study by Micklewright, Griffin, Gladwell, and Beneke (2005) found no significance in their results, indicating that massage did not have any effect on mood state. However it was proposed that although the results from both studies were contradicting they cannot be compared as some features of the studies were different. It has been noted that Weinberg et al. (1988) study was conducted 25 years ago when massage was far less common and understood. This is compared to the study by Micklewright et al. (2005) less than 10 years ago on participants which may have come across massage previously. Therefore it has been proposed that Weinberg et al. (1988) participants' mood responses may have been influenced socially or culturally.

During the study by Stewart et al. (2007) the participants were asked to answer a questionnaire after their sprint tests. A Visual Analogue Scales questionnaire was used in which the participant rated on a scale with, 'my worst performance' and 'my best performance' at each extreme. The results from the questionnaire showed that the participants who had the warm up protocol felt that the warm up was the only explanation to how well they performed and recorded higher ratings after their sprints. Complimenting this, the participants that completed warm up prior to their three trials were averagely 0.13 seconds faster on their first trial. However by their third trial this difference was reduced to only 0.01 second. Stewart et al. (2007) nevertheless suggested that the athletes that participated in only the warm up scored themselves higher ratings due to guessing that they performed a faster sprint time even without feedback of their actual time. On the other hand if the participants did not have any improvement in the trials but felt psychological benefits this preparation tool cannot be overlooked and needs to be researched further.

2.6 Pre-event Massage and Performance

Galloway and Watt (2004) stated that in the United Kingdom massage had totalled 45% of treatments for athletes from physiotherapy. Benjamin and Lamp (2005) suggest that massage applied skilfully can improve an athlete's performance by optimising positive factors in their performance, such as range of movement, connective tissue, alertness and concentration levels. Many other studies previously mentioned also agree that massage aids in range of movement which could subsequently improve stride length (Arabaci, 2008; Goodwin et al., 2007; King, 1993; Weerapong et al., 2005). Benjamin and Lamp (2005) also state that pre-event massage decreases injury potential and supports healing of soft tissue. This is by removing cellular debris and delivering nutrients to muscles, thus improving an athlete's performance (Benjamin & Lamp, 2005).

During massage it is important to take into consideration individuals and their sport as it may be more beneficial to ask athletes what their preference is in order to achieve a more appropriate massage to enhance their performance (Cash, 1996).

2.7 Aims and Purpose of the Study

From researching effects of massage, it is clear that studies are limited and have found no significant effects from it particularly in sprinting. Therefore, it is becoming more important to discover the effects of pre-event massage on an athlete's performance, positive or otherwise. Research undertaken by Arabaci (2008), Goodwin et al. (2007) and Harmer (1991) have all shown to have no effect on athlete's performance. Their research particularly applies to sprinting therefore it is not known if this theory would also apply to longer distances. However, these studies have produced a gap in literature showing that pre-performance massage has not been applied to a longer distance, for example an 800 meter distance runner.

Therefore this study aims to research the possible effects of pre-event massage on a distance of 800 meters. This distance reflects on middle distance runners and could be applied to long distance endurance runners too. Being a longer distance may show that pre-event massage does improve performance in distances more than 30 meter sprint as previously concluded. The current study will use visual analogue scale similar to the one used in the study by Stewart et al. (2007). This will be used before testing, after the warm up, after the pre-event massage and after the 800 meters using a scale to understand if the participant physically and/or psychologically felt the pre-event massage had any benefit.

CHAPTER THREE

METHODOLOGY

3.1 Pilot Study

A pilot study was carried out initially to gain familiarity with the area of study. This also ensured that the 800 meter testing, questionnaires and massage techniques were all as intended prior to the first actual testing. This was to avoid problems arising during data collection, therefore the pilot study involved one participant that is not involved in the study to run through the whole testing procedure. The results from this were not used in the study and no issues occurred during the testing, therefore no changes were made to the study.

3.2 Participants

Ten participants volunteered to take part in this study; four male and six female athletes of all similar fitness and all train together. All athletes were current university middle distance runners, training typically more than 2 times a week.

This group of athletes were chosen as pre-event massage on shorter distances found to have no subsequent effect. This was shown in the study by Goodwin et al. (2007) who tested the effects of pre-event massage over a 30 meter distance. Therefore, participants who normally run distances of 800 meters or more are good subjects for this study.

The participants were Cardiff metropolitan university students with a mean age of 20 years old (± 0.66). All 10 participants were healthy and had no injuries during testing. The group were informed about the aims and procedures of the study and each were given a participants information form (see appendix A). The information form explained what they would take part in, any risks, benefits for taking part and informed consent to agree to take part. The participants were also asked to fill out a client assessment form with details of medical status and current information (see appendix B). This was checked to highlight any contraindications with each participant, however all participants were cleared of this and could take part in the study.

The group were informed that their information would remain anonymous and would be only used in the current study. They were also given the option to withdraw from the study at any time with no further reasoning.

3.3 Instruments

Instruments used throughout this study including the massage table and oils were kept consistent throughout testing. The same massage medium of oil (Biotone, hypoallergenic oil, California) was used in order to avoid participants receiving different effects from other massage mediums. These procedures were in order to ensure validity and reliability throughout the testing to ensure unbiased results.

In order to record the results a stopwatch (Fastime, 0, North Yorkshire, United Kingdom) was used to record the timed runs and also each individual lap. The use of a SMART speed timing gates (Smartspeed, Fusion sport, Brisbane, Australia) was originally the equipment to be used for the timing. However this was unavailable and therefore a stopwatch was used. This has been recognised as a limitation for this study and therefore if this study was replicated more reliable method for timing should be used. The data from the stopwatch was immediately transferred onto Microsoft excel.

The testing was conducted at Cardiff metropolitan university using the national indoor athletic centre (NIAC) track. Each participant used the indoor 200m length track in order to be reliable in relation to climate and environmental factors.

Three minutes after each participant finished their test they were provided with a short VAS questionnaire specifically created for this study to record how they felt before, during and after the testing (see appendix C). The questionnaire included questions about the athletes physical and psychological feelings throughout the study. For each question, the participants selected their answer by choosing which word they felt was the best match on the scale. This type of questionnaire was easy for the participants to understand, use and answer. As the questionnaire was specific to the study it has not been tested for reliability, however the questions were based particularly in relation to the study and therefore were relevant. The questionnaire also was not the primary source of data for this study and consequently should aid or reflect participants 800 meter times. This subsequently could backup any results from analysing the timing data.

3.4 Procedure

During this study the participants were asked to individually run an 800 meter distance while being timed. This occurred twice over two weeks, one run with pre-event massage and one run without. Each participant received a 12 minute pre-event massage before one of their timed runs and not on their other. All participants completed the warm up protocol (see appendix D) before each of their two tests. Each warm up and pre-event massage (see appendix E) were completed exactly the same for every participant, so the results were consistent throughout the study.

3.4.1 Protocol

After the participants completed the participant information form and client assessment form previously mentioned, they were asked to sign an informed consent form (see appendix F) agreeing to take part in the study.

The study randomly split the participants equally into two groups to create the cross over design. This design was used during the testing in order to reduce any behavioural patterns and learning effects on the 800 meters which has been shown by Gratton and Jones (2010).

Participants completed their testing individually in order for their times to be accurate to their running pace and not influenced by other runners or tactical influence. Each participant was given the VAS questionnaire and asked to honestly answer the first question. It was decided that the warm up should be before the pre-event massage due to research by Harmer (1991) suggesting that any massage effects would diminish within the warm up after massage. The participants were asked to follow a warm up protocol which the assessor conducted lasting for 10 minutes (see appendix D). This warm up involved a light jog to begin, followed by drills such as high knees, heel flicks and high skipping and then dynamic and static stretching. This protocol was chosen as it was based on the warm up by Goodwin et al. (2007) and was similar to warm up routines the participants take part in already. Therefore they were familiar to the activities and stretches used. The warm up was immediately prior to the run or pre-event massage in order to simulate an race situation.

After the warm up group A had one minute to prepare themselves before beginning their 800 meter timed run, this included answering the next two questions from the VAS questionnaire. This was to avoid the individuals losing any effect from the warm up and to mimic a warm up before an 800 meter event. Group B followed the warm up by a 12 minute pre-event massage, (see appendix E) after which they had 2 minutes to prepare themselves. This involved answering the next two questions from the VAS questionnaire before running their 800 meter timed run. Each participant began from a standing start at the same point on the track in order to simulate a start of an 800 meter race.

On the second week all the participants again individually completed the 10 minute warm up. The groups then swapped over from the previous week and therefore group A received a 12 minute massage followed by running their 800 meter timed run. Group B however did not receive a massage in the second week and therefore after their warm up began the 800 meter timed run. Table 1 shows this cross-over design for both weeks and both interventions.

Table 5: Showing weeks, groups and massage protocol

	First Week	Second Week
Group A	No Massage	Pre-event Massage
Group B	Pre-event Massage	No Massage

3.4.2 Massage Procedure

The massage was delivered at the side of the indoor athletics track to represent a pre-event massage before an 800 meter competition.

As previously mentioned there is no specific length of time pre-event massage should be applied for and therefore research has suggested little effects from a 10 minute massage, however any longer than 20 minutes is believed to be counterproductive (Lightfoot, Char, McDermont, & Goya., 1997; Tiidus & Shoemaker.,1995; Zainuddin, Newton, Sacco, & Nosaka., 2005). Therefore in this study a 12 minute pre-event massage was chosen in order to establish optimum massage duration. A pre-determined massage protocol was

used in order to keep any effects consistent with all participants. This was applied to the participants quadriceps and hamstrings on both legs and was similar to the study conducted by Goodwin et al. (2007) which involved effleurage, petrissage and tapotement techniques.

Previously before the study took place the participants were asked where they would prefer the massage to be applied. The most popular two body parts were the quadriceps and hamstrings and therefore these were the chosen areas during the study. The use of Biotone, hypoallergenic massage oil was used on the participants to avoid friction during the fast pace.

The massage (see appendix E) protocol was designed to be applied at a fast pace in order to warm up the muscles and stimulate the participants before the testing with intention to get the best out of their performance. A limitation for many of the studies is the lack of consistency, specifically looking at the pace of the strokes. Fletcher (2010) however created a consistency of 30 strokes per minute for effleurage and 60 strokes per minute for petrissage for each participant. Therefore during this study a metronome was used to ensure the same pace of the hand skills were applied and therefore the same amount of strokes for each participant. This was used at 80 beats per minute in order to create a fast pace for pre-event. Previously the masseur practiced different speeds using the metronome to find a comfortable rhythm while at a fast pace.

Each technique was applied to the quadriceps and hamstrings for 15-60 seconds each and 5 minutes per limb in the prone and supine position (see appendix E). The 'on skin' massage time lasted 10 minutes with the remainder two minutes for client changing position, changing towel position and oil application. This was applied by the same qualified sports masseur each time to ensure reliability. The massage again was immediately prior to the testing in order to stimulate a race and to prepare the athletes most effectively.

Appendix E shows the order and timing for the massage and each technique used which was designed based on previous research (Goodwin et al., 2007; Robertson et al., 2004; Zainuddin et al., 2005). This was to ensure the massage was specifically aimed for pre-events to stimulate the muscles in order to achieve the best effects.

A stopwatch was used during the massage to ensure the timing for the individual techniques was kept the same for each leg in the prone and supine position among all participants for fairness. The massage depth was applied lightly as this was a pre-event

massage however this could not be measured accurately. On the other hand the same masseur applied each massage and therefore aimed to apply the same pressure for each participant.

Each participant was informed of the type of massage delivered prior to the massage and techniques used to ensure they would be comfortable with the massage to achieve positive effects. They were asked previously if they had had a massage before and what to expect from the practitioner on the day.

3.5 Data Collection and Analysis

The mean and standard deviation were calculated for all participants' age, weight and height. The mean shows the average of the data shown and the central tendency to be measured (Jaisingh, 2000).

Table 6: Showing mean and standard deviation for age, weight and height of the participants

	Mean	Standard Deviation
Age	20	0.666667
Weight	9.72	1.27275772
Height	5.64	0.340587727

During this study, Microsoft Excel (Microsoft, USA) and Statistical Package for the Social Sciences (SPSS for Windows 19, SPSS, Inc., Chicago, IL) software was used to statistically analyse the data. A paired T-test was used to analyse the individual participant's results from their two timed runs over the two weeks. This compared massage to non-massage times for the 800 meter distance. The paired T-test is designed

to look at the differences between two groups, this measures the mean of each group and analyses the difference (Gratton & Jones, 2010). This type of test was used due to the aim of the study being to see if there is any effect of pre-event massage on an 800 meter time. Split times for each of the four laps were also timed and analysed. For this a two-way repeated measured ANOVA was used to measure any differences between the individual laps for the two interventions. Additionally the results from the VAS questionnaire were compared to the participants time for 800 meters to see if there was any relationships between the two.

3.6 Ethical Approval and Considerations

It has been emphasised by Punch (1994) that confidentiality, stress to the participant and researcher and identification should all be considered and reduced during the study. Therefore when creating the proposal for this study all participation to the study was analysed and reduced. Each document used in this study has been confidential and will be destroyed after completion on the study. This study gained ethical approval from Cardiff Metropolitan university ethics committee before further development to the study took place.

All participants were reminded throughout the testing that if they were contraindicated or injured they may not be allowed to continue to take part in the study. Similar to this they were also informed that they were able to withdraw from their participation in the study at any stage giving no reason. Each participant was told and all understood that their personal information would be confidential according to the Data Protection Act (1998) and if any information was used it would be concealed and destroyed after the study.

CHAPTER FOUR

RESULTS

This chapter shows the results from the above study for testing the difference between intervention 1 (pre-event massage) and intervention 2 (no massage) on running 800 meters. In chapter one the two hypotheses suggested that intervention 1 would significantly improve the 800 meter times or intervention 2 would significantly improve the 800 meter times. The two null hypotheses suggested that either intervention 1 would not significantly improve the 800 meter times or intervention 2 would not significantly improve the 800 meter times. The null hypotheses have been accepted and the others have been rejected. The data was reported as mean and standard deviation (SD) values and significance was accepted as $p < 0.05$ (mean \pm SD Intervention 1 verses intervention 2, $p < 0.05$).

4.1 Overall Results

For this study a paired T-test, independent T-test and a two-way repeated measures analysis of variance (ANOVA) were used to analyse the different pre-event protocols. A paired T-test was adopted as there was a need to establish any differences or similarities between the two interventions on the 800 meter times. Thomas, Nelson and Silverman, (2011) suggested that a Paired T-test should be accepted if there are two interventions; such as massage and no massage. This is so it would be possible to evaluate whether the two interventions are significantly different based on their average data.

For the purpose of this study all the results were collected in minutes, seconds and tenths of a second. However during inputting the data it was converted into seconds to be consistent throughout the rest of the study.

Table 3 below shows the mean and standard deviation for intervention 1 and intervention 2 times. The data shows that the two interventions did not have a significant difference between each other ($p > 0.05$).

Table 7: All participants' mean time to complete 800 meters and standard deviation for both interventions

All Participants	Mean (s)	Standard deviation	Significant P Value
Intervention 1	157.17	18.76	p>0.05
Intervention 2	157.11	19.81	

It is evident from looking at these descriptive statistics in table 3 that the means are very similar and the standard deviation is large which only shows an initial idea for the difference between both interventions and therefore more statistical support is required.

The large standard deviation suggests a greater difference between the results, particularly in intervention 2. This could be due to the participants being male and female and therefore having a vast difference in their 800 meter times. Consequently it is important to also look at males and females separately.

4.2 Male and Female Results

Table 4 below shows the females mean and standard deviation for both interventions' times for 800 meters. An independent t-test was adopted to analyse the male and female participants for both interventions. This was to identify whether there were any significant differences when looking at the genders separately.

Table 8: Showing the mean and standard deviation for intervention 1 and intervention 2 for the female participants

Females	Mean (s)	Standard Deviation	Significant P Value
Intervention 1	166.28	17.83	p>0.05
intervention 2	166.87	19.39	

This table shows very similar means for both interventions with only 0.5834 between them. This is reflected from looking at the SPSS data results where the Levene's test for equal variance was assumed as the significance value was above 0.05. This can be seen in table 4 above showing no significant difference in the 800 meter results between the two interventions for females ($p>0.05$).

The males mean and standard deviation are shown below in table 5. Again from conducting an independent t-test from the male's results the significant value was again above 0.05 and therefore equal variance was also assumed.

Table 9: Showing the mean and standard deviation of both interventions for the male participants.

Males	Mean (s)	Standard Deviation	Significant P Value
Intervention 1	143.50	10.50	$p>0.05$
intervention 2	142.48	8.64	

The data results show no significant difference between the two inventions. However the mean values in table 5 have a one second difference between the two interventions. Despite this the standard deviation is larger for intervention 1 suggesting more varied results for the males during their 800 meters after a pre-event massage.

Table 4, for the female results shows that the standard deviation is larger for intervention two, whereas in table 5 for the male participants their intervention one standard deviation was larger.

4.3 Lap Results

Through using a two-way repeated measures ANOVA test on the data assuming sphericity, the results showed no significant difference between the two interventions ($p>0.05$). Therefore using the two-way repeated measured ANOVA and a post hoc test, analysis of results per lap were looked at to reveal any differences. An analysis of the four individual lap times for the participants over the two interventions was conducted to display any significant differences between the laps.

From looking at the tests in SPSS and specifically Mauchly's test of Sphericity the significance value is 0.00 which is less than the critical value of 0.05. Therefore sphericity cannot be assumed and the Greenhouse-Geisser is required (Field, 2013).

Table 10: Showing both interventions and their laps mean and standard deviation

Intervention	Lap	Mean	Standard Deviation
1	1	37.71	3.17
	2	38.79	4.18
	3	40.43	5.56
	4	40.24	6.67
2	1	37.04	3.12
	2	38.74	4.55
	3	40.54	5.99
	4	40.59	6.67

Table 6 shows the mean and standard deviation for each lap for both interventions. The biggest difference between the laps was between lap 1 for both interventions with 0.67 difference. This also shows the significant main effect of the study which is time, the independent variables being the interventions on the dependent variable which is time ($p=0.032$). However when looking at the laps individually with combined interventions there was no significant difference. Further statistical tests are required to look at the individual laps for both interventions individually. Significant interaction did not show any significant differences as there were no significant differences between the two interventions.

Table 11: Showing the comparison between laps and any significant differences

Laps	Significance value
1,2	0.339
1,3	0.114
1,4	0.308
2,3	0.071
2,4	0.493
3,4	1.000

The interventions did not show a significant difference ($p > 0.05$) similarly to the relationship between the interventions and laps ($p > 0.05$). However the laps did show a significant difference of 0.032.

Next the pairwise comparisons were analysed, showing no significant difference between the laps. However laps 2 and 3 show a substantial difference (38.77 ± 4.26 vs 40.49 ± 5.62) $p = 0.071$ and therefore is approaching a significant difference.

4.4 Visual Analogue Scale Questionnaire Results

Lastly the VAS questionnaires the participants filled out was analysed, however a statistical test was not conducted due to this not being the main results for this study. The mean and standard deviations for the individual questions are shown below in Figure 3. All results are out of 10 on the VAS scale, questions can be seen in table 8.

Table 8: Visual analogue scale questionnaire questions

Number:	Question:
1	What was your current mood before coming to testing?
2	How beneficial do you think the warm up was?
3	How beneficial was the pre-event massage?
4	How did your legs feel before the 800 meters?
5	How did your legs feel during the 800 meters?
6	How did you feel overall after the 800 meter run?

Figure 3 shows the results for the six questions for both interventions apart from question three which only applies to intervention 1. Question one shows no difference in the means between the two interventions (6.8 ± 0.79 vs 6.8 ± 1.81) $p > 0.05$. There is also little difference between the two interventions in question two (7.1 ± 1.60 vs 7.3 ± 1.77) $p > 0.05$ and again in question six (5.8 ± 1.75 vs 5.5 ± 1.78) $p > 0.05$. Whereas there was a difference between the means for the two interventions in question four (6.8 ± 1.81 vs 5.9 ± 2.02) $p > 0.05$ and again in question five (6.7 ± 1.95 vs 5.7 ± 1.57) $p > 0.05$.

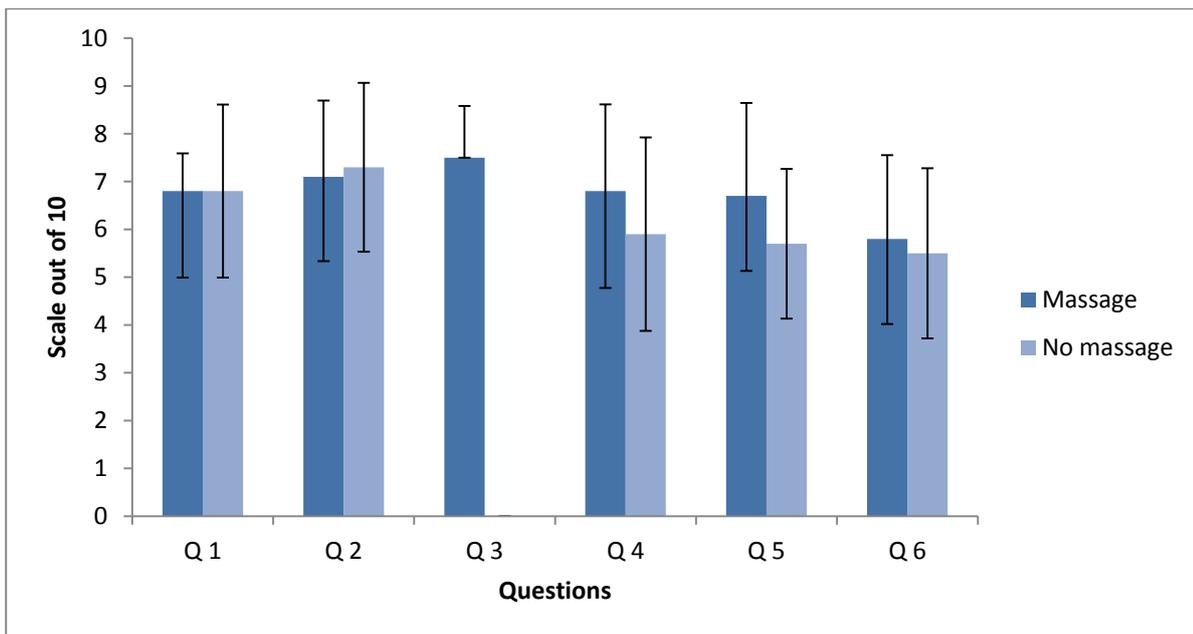


Figure 3: Showing the VAS questionnaire questions and their means and standard deviation for both interventions.

CHAPTER FIVE

DISCUSSION

After researching and reviewing the existing findings on pre-event massage effects on running it was clear the gap in this literature fell when looking at longer running distances, such as 800 meters. Therefore the purpose of this study was to see if there were any benefits from receiving a pre-event lower limb massage before running 800 meters. From looking at the results it is clear that all the hypotheses shown in chapter one have been rejected and the null hypothesis has been accepted. This is due to the results showing no significant difference between the two interventions and therefore pre-event massage having no effect on the time to complete an 800 meter distance. However this could be looked into further to see if there are individual benefits for some athletes.

5.1 Overall finding for this study

The results shown in table 3 presented no significant difference between the two interventions for all participants. These results indicate that the athletes did not have a positive yet nor a negative reaction to the pre-event massage protocol.

These findings agree with literature in this domain as Fletcher (2010) and Goodwin et al. (2007) both found that pre-event massage did not have an effect on their participants sprint performance compared with a traditional warm up. The pre-event massage in the study by Fletcher (2010) consisted of nine minutes of effleurage and petrissage compared to the 15 minute massage in Goodwin et al. (2007) study which additionally included tapotement. The current study likewise used effleurage and tapotement however for a 12 minute period. This length of time was appropriate for a realistic pre-event preparation; however 12 minutes was a relatively short period of time for massaging two legs. This therefore only allowed three minutes per muscle group and consequently was not long enough for each technique to have physiological effect. As previous research suggests between 10 and 20 minutes is an appropriate and effective period of time for applying pre-event massage (Benjamin & Lamp., 2005; Robertson et al., 2004; Tiidus & Shoemaker., 1995). Despite this these studies used different massage techniques and different muscles groups and therefore it is difficult to compare.

Additionally Arabaci (2008) and Harmer (1991) also found similar findings of no effects from pre-event massage on performance. However Harmer (1991) suggested that if there were any effects from the massage that they would diminish during the warm up. During this study the warm up was completed before the pre-event massage was applied to avoid

this speculation. Despite this the results continued to show no physical effect of massage on the 800 meter distance. Previous research has shown many physiological effects that occur from massage, however it is difficult to prove if this occurred during the study. Therefore the current study may not have adopted these physiological effects in the 12 minute period. On the other hand if these effects did occur there is no research to suggest this transfers onto the athletes performance, as the physiological effects are similar to warming up which does not particularly improve performance.

The standard deviation for the results from the current study showed that intervention had more varied results compared to the massage protocol. It was suggested the large standard deviation could be due to having male and female participants and ultimately their times varying. Taking this into consideration it was important to look at the genders separately.

5.2 Gender Differences

Table 4 and five highlighted the male and female participants' results separately for both interventions. The males had a 1.03 second difference in their means between the two interventions. This suggested that the males ran faster without the massage protocol, however there was no significant difference between the two interventions. Nevertheless the standard deviation showed that the male's results for intervention one were more varied compared to intervention two. This also could propose that some participants had more or less of an effect from intervention 1 than others. The suggestion that the times were more varied could be due to different reactions athletes have towards pre-event massage. The current study shows that some participants ran a faster time after intervention 1 than intervention 2 and vice versa. Similar to the current study, Arabaci (2008) and Goodwin et al. (2007) used a pre-designed massage and consequently not applied for individual needs. Cash (1996) suggested that massage that is specific to an athlete is more beneficial, however for research purpose this is harder to control.

On the other hand contradicting the males results, the females standard deviation for intervention two was larger than intervention one. The female's means for both interventions were very similar and had only a 0.58 second difference. Therefore suggesting that there were no significant difference between the interventions, which was reiterated in the significant p value. Nevertheless when comparing this to the VAS

questionnaire results question three showed that on average the participant's felt the benefit of the pre-event massage was 7.5 out of 10 on the scale. The standard deviation for this question was 1.08 which was relatively small compared to the other standard deviations for other questions. This would suggest that the participants felt the pre-event massage was beneficial to them before their 800 meters, it is proposed that this would have been psychological belief. King (1993) suggested that massage generates self confidence in the athlete which could reflect the scores given in the VAS questionnaire. However as the results show no differences between the interventions this suggested that having self-confidence will not improve performance. Equally Leivadi et al. (1999) found that stress hormones decreased after massage was applied. Subsequently massage can calm athletes down before competing, however this could be detrimental if athletes would prefer to be 'psyched up' before their event. Despite this, in a practical racing situation having more self-confidence and reduced stress levels prior to competing may have some benefits.

5.3 Lap Differences

Next a two-way repeated measures ANOVA and post hoc test were used to identify any differences between the lap times in both interventions.

From looking at table 6 it was clear to see that on average both interventions had very similar results. In addition to this the first lap for both interventions had a 0.67 difference, being the largest mean difference suggesting that massage averagely had a detrimental effect on the participants. However these differences were only 100th of a second and therefore cannot be seen as a substantial difference. No significant difference between the laps in both interventions could be due to the design of the pre-event massage. The massage used effleurage and Tapotements for 12 minutes, this length of time could be too short to produce physiological effect on the participants. On the other hand the massage was applied to the quadriceps and hamstrings and therefore could have been more beneficial to other muscles.

The comparison between laps was also analysed to see any relationship between the laps during the 800 meters. The laps did show a significant difference of $p=0.032$, as the times increased over the 800 meters, nevertheless this was assumed before testing. Although the results presented no significant differences, lap two and three displayed that the results were approaching a significant difference between them. It is unclear why this is however if there were more participants, particularly males this could alter the difference to being significant.

5.4 Visual Analogue Scale questionnaire results

Finally the VAS questionnaire was used to see if the results from the main data times were reflected in the questionnaires. This then may suggest whether any psychological effects that influenced the participants' time were reiterated in the answers from the questionnaire. On the other hand if there were no effects from the pre-event massage on the 800 meter time then the questionnaire would be analysed to see if it suggests massage had psychological effects instead.

The first question was 'what was your current mood before coming to the testing?' which was explained that this was overall, mentally, physically and emotionally which scored a mean 6.8 for both interventions. This is positive as it implies that the participants were feeling similar to the previous week, resulting in fairer testing.

After completing the warm up the participants were asked 'how beneficial did you think the warm up was?'. Again this question was explained as how the warm up physically and psychologically benefited the participant in preparation to running. The mean for both interventions scored on average 7, with only 0.2 difference between them. Therefore provided similar results displaying that the warm up was found to have similar benefits during both interventions.

Research by Sander et al. (2013) suggested a general warm up generates sufficient activation for sprint performance. Likewise Stewart et al. (2007) found that pre-event warming up protocols significantly improved their participants sprint time as opposed to without a warm up.

Question four asked how the participants' legs felt before the 800 meters. Results showed that after the participants had the pre-event massage they scored substantially higher compared to the testing without massage. This proposes that the massage protocol had a

positive psychological effect on the participants as it made them feel better prior to the 800 meters. This is also reiterated in question five when the participants were asked to grade how their legs felt during the 800 meters. From looking at Figure 3, question five shows that on average the participants gave the massage intervention 1.00 higher than no massage. Consequently participants found their legs felt better during the 800 meters after having the pre-event massage. These findings of the current study reflect Weinberg et al. (1988) outcome that massage reduces tension, depression, anger and fatigue. If these effects occurred in the current study which showed no difference between the interventions, it is suggested that reduced anger or tension is not required for running athletes. Many athletes may prefer to feel energetic and focused rather than calm and relaxed, particularly in speed and power events. Alternatively, Weinberg et al. (1988) added that the massage intervention was associated with positive mood states and psychological well-being. Massage releases endorphins which creates a positive mood state in the athlete which can be a positive during a practical situation.

On the other hand question six asked 'how did you feel overall after the 800 meter run?' where there was very little difference between the means for either interventions. This indicated that although throughout the 800 meters participants on average felt better with intervention 1, after running there was little difference in how the participants felt. This could propose that any psychological effect pre-event massage has, this does not persist throughout the whole 800 meters. Alternatively most athletes after running an 800 meter distance would feel exhausted and score fairly low on the scale too.

From looking at the 800 meter times and the results from the VAS questionnaire, it was evident that there was a wide range of results for both interventions. Therefore suggested that some individual participants did have a physical positive effect from the pre-event massage. Participants in the current study were not exposed to frequently receiving massages; however some may have come across the procedure before. This therefore creates varied reactions from all participants to whether they have had massage at all before. The same can be applied to psychological responses the individuals had, and consequently it is important to not overlook individual benefits that can occur from massage. Jonhagen et al. (2004) stated that athletes who receive massage regularly may be more familiar with how they react to massage compared to those who do not.

5.5 Practical implications

Findings of this study found no significant benefit from receiving massage before competing, however individual psychological benefits cannot be overlooked.

Goodwin et al. (2007) suggested that pre-event massage usually needs to be stimulating therefore the massage needs to be vigorous such as vibrations and tapotement techniques. This recommendation previously was aimed at physiological effects for the athlete, however this could also be taken into consideration for psychological benefits too.

This study used a 12 minute pre-event massage directed onto the lower limbs, involving 10 minutes of hands on massage with two minutes for adding oil and changing position. This time period has been shown to be an optimum time for receiving massage (Robertson et al., 2004). Equally 12 minutes is suitable and realistic period which can be replicated in a practical setting at the side of the athletics track prior to the event.

Although the current study showed massage to not benefit performance, massage was also not shown to have a negative effect either. Therefore if individual athletes feel they benefit from receiving a pre-event massage then massage should be considered appropriate for them.

5.6 Limitations of the current study

There were numerous limitations for this study; many can be overcome in future studies in order to improve the reliability of the study.

The sample size for this study was relatively small and therefore there was no distinctive significant difference for the results. A larger sample of participants would increase reliability and validity and may waver the results to show pre-event massage to have an effect on the distance. Similarly having a mixture of male and female participants found the standard deviation results more varied and although this does not limit this study, future research could focus purely on one gender. Another limitation which could have affected the results was the participants were not asked about their food and drink intake over the two testing weeks. Additionally they were not asked about exercise or training carried out over the testing weeks. These differences over the two testing weeks may have affected the participant's mood or performance level resulting in unreliable or unfair testing.

As previously mentioned a pre-determined massage protocol was used to keep any effects of the massage consistent through all participants. Eisenberg et al. (1993) has recognised over one hundred different massage styles, therefore it is important for studies to explain exactly which style was used in order for the participants to experience the same massage and effects. To improve the effects of the pre-event massage intervention, specific massage for each individual could be designed in order to have better effects for that athlete.

Variations of the massage were reduced for example using a metronome to distinguish the timing and frequency of the strokes. However the depth was not definite and therefore this could have had different effects for each participant. In addition to this although the same massage practitioner was used for all participants it cannot be guaranteed that each participant experienced the same massage entirely. This limitation is a frequent problem within massage studies and within this study all available resources were used to reduce the overall limitations that arise from massage.

During the timing of each 800 meters a stopwatch was used. The use of SMART speed timing gates (Fusion sport in 2004) were originally desired during testing however were unavailable. Therefore future studies need to ensure that either timing gates are used or other means of recording which are more accurate and therefore reliable for results. The study also required the participants to have two testing runs under the two interventions. Therefore the data used only reflected one running time for either intervention, consequently future research should test the participants more than once for each intervention.

From researching previous studies it was clear there were psychological effects from pre-event massage and therefore this was considered during this study. A VAS questionnaire was used to record the participants thoughts and reactions to each stage of the testing. However this questionnaire had not previously been validated and made reliable and therefore could not be used as a primary focus of results to this study.

5.7 Future research

Although the current study has several limitations many of them can be overcome in future studies which have been mentioned above within the limitations.

This study used a pre-determined warm up protocol which had not been tested previously on the participants. Future research needs to investigate prior to testing the usual warm up protocol the participants take part in before an event. This will assist the testing to become more realistic and may make the results more accurate. Similarly the participants could take their own warm up for how they believe would be beneficial to themselves.

Likewise the massage protocol was pre-determined and therefore was not specific to the participants' individual needs or preferences. Equally the participants were not familiarised with the massage procedure and therefore reactions and feelings towards the massage were not apparent until testing. Consequently future research needs to introduce the massage protocol to the participants prior to testing. Furthermore studies could look at testing the different pre-event massage techniques to discover if they have varying effects on the participants.

The VAS questionnaire was specifically designed for this study and therefore there has been no reliability tested on this questionnaire. Subsequently the questions could be more accurate and explained better so that the participants understand what is being asked. Secondly the VAS questionnaire could be statistically analysed in order to gain more evidence to whether massage has a psychological effect on performance.

Studies undertaken in the future should also take into consideration what the participants fitness levels are, such as novice or elite. Furthermore if all the participants are at a similar level and have comparable training routines they can all be tested as similar ability. Additionally to improve testing accuracy future studies should test the two interventions over three recorded running times each. However if athletes are tested in the same environment several times they may produce the learning effect and this would obscure the results. Therefore it is important for further research to create testing that involves a randomised cross-over design to reduce these learning effects.

CHAPTER SIX

CONCLUSION

There are many different research ideas to the benefits of pre-event massage on performance, from sprinting to jumping. However these studies have conflicting results and do not confirm any distinctive evidence that support one another. Additionally there has been suggestions that pre-event massage does not have any benefit for improvement in performance, despite this athletes continue to use massage interlinked with their training and event preparation. Furthermore there has been a lack of research into middle distances such as 800 meters.

The current study coincides with the common outcome from previous literature that pre-event massage does not have a significant effect on performance. However, no other study has investigated the effects of massage on 800 meters. Despite this, the results continued to show no significant effect from receiving a pre-event massage, nevertheless the results neither showed a positive nor negative effect on the participants, and therefore pre-event massage cannot be seen to be unbeneficial.

Furthermore the individual results could aid in positive psychological effects for the athletes. This finding can additionally be transferred into a sporting environment to improve the positive psychological benefits pre-competition.

However further research is required in order to analyse if there are any different effects between genders. It is also necessary to research into how different individuals respond to pre-event massage in order to confirm if massage is an important aspect for them in the future.

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APPENDICES

APPENDIX A
PARTICIPANT INFORMATION FORM



Cardiff Metropolitan University

Prifysgol Fetropolitan Caerdydd

UWIC

Participant information form

'The effects of pre-event, lower limb massage on an athlete's performance during an 800 meter distance'

Background

This study will attempt to understand if there are any positive or negative effects on an athlete's performance during an 800 meter distance after receiving a lower limb pre-event massage. It is being undertaken by a Cardiff Metropolitan university undergraduate.

Why you have been asked

You have been invited to take part in this study as you are between the ages of 18 and 25 and a current Cardiff metropolitan university student. You normally run and train for a distance between 400 meters and long distance events.

What you will take part in

This study will involve 12 participants tested for two days over two weeks. The first testing will involve all the participants taking part in the warm up prescribed which will be restricted to 10 minutes.

The participants will then be randomly put into two groups (group A and B), group A will complete the warm up followed by running the 800 meter timed run. Group B will receive a 10 minute pre-event massage between the warm up and 800 meter run.

One week later, the participants will swap over and again all participants will take part in the warm up protocol. Group A who did not receive the massage the first week will be given a pre-event massage after the warm up and before the second 800 meter run. Therefore group B will not receive a massage the second week, but complete the warm up followed by the 800 meter run.

The whole testing is completed individually so that you are not in a race situation but running for your own time. The massage involves a 10 minute pre-event lower limb massage using effleurage, petrissage and tapotement. This will be designed to stimulate the participants and warm up the muscles before the testing with intention to get the best out of the participant.

What happens to the data

You and your results from this study will be anonymous and only used in this study in order to analyse the effects of pre-event massage on an athlete's performance.

Are there any risks

The only foreseen believed risks during this study are that the participants may become fatigued and/or injured during the testing. To overcome fatigue and therefore a further risk of injury, participants are asked to fill in a physical activity readiness questionnaire before taking part in this study.

Participants may be unwell before or during the testing which may negatively have a further effect on their illness. If the participant is unwell before or during the testing they will be excluded from the study for their own safety.

Are there any benefits from taking part

There are no direct benefits from taking part in this study, however the results will give you a better idea if pre-event massage may be beneficial for you before an event in the future.

What happens next

You will need to complete a participant activity readiness questionnaire and a participant consent form in order to give permission to take part in this study. However you are not obliged to participate in the study and in which case you will not need to fill in the consent form.

Any questions email: st20006413@outlook.uwic.ac.uk

APPENDIX B
CLIENT ASSESSMENT FORM



Cardiff Metropolitan University Prifysgol Fetropolitan Caerdydd

— UMWIC —

PRELIMINARY INFORMATION

Full Name: _____

Age: _____ Gender: _____ Title: _____ Date of Birth: _____

Address: _____

_____ Phone number: _____ Occupation: _____

Name of GP: _____ GP's Address: _____

_____ GP's Phone number: _____

CONTRAINDICATIONS

General health ok? (cough/cold): _____

Blood pressure reading? (last reading, when, who): _____

Medication? What for/Name/dosage/how long? _____

Surgery? What for/procedure/when? _____

Medical Conditions? What/since when? _____

Do you have any allergies? _____

Is there any other information I should be aware of? _____

Participants Signature: _____ **Date:** _____

Practitioners Signature: _____ **Date:** _____

APPENDIX C
VISUAL ANALOGUE SCALE
QUESTIONNAIRE



Visual Analogue Scale Questionnaire Post 800 Meters

1. What was your current mood before coming to the testing?

Negative										Positive
1	2	3	4	5	6	7	8	9	10	

2. How beneficial did you think the warm up was?

Not										very
1	2	3	4	5	6	7	8	9	10	

3. How beneficial was the pre-event massage?

Not										very
1	2	3	4	5	6	7	8	9	10	

4. How did your legs feel before the 800 meters?

Negative										positive
1	2	3	4	5	6	7	8	9	10	

5. How did your legs feel during the 800 meter run?

Negative **1** **2** **3** **4** **5** **6** **7** **8** **9** **10** positive

6. How did you feel overall after the 800 meter run?

Significantly below your average significantly above your average

1 **2** **3** **4** **5** **6** **7** **8** **9** **10**

|

APPENDIX D

WARM UP PROTOCOL

800 meter warm up protocol

- Light jog around 200 meter running track
- Toe raises against wall X 5 each side
- Running drills 2 X 20 meters
 - High knees
 - Heal flicks
 - High skipping
 - Side gallops
 - Grapevine/ karaoke
- Dynamic stretching 1 X 20 meters
 - Walking lunges
 - Calfs
 - Hamstring sweeps
 - Skipping with shoulder rotations – forward and backwards
 - Glute
- Running strides 1 X 30 meters each
 - 50%
 - 70%
 - 90%

APPENDIX E

MESSAGE PROTOCOL

Table 1: Massage techniques and time

Body part/Muscle	Technique	Time Applied For
Left Quadriceps	Effleurage	
	• Flat hand	1 minute
	• 'V'	20 seconds
	• Rotary	20 seconds
	Tapotement	
	• Hacking	20 seconds
	• Cupping	20 seconds
Right Quadriceps	Effleurage	
	• Flat hand	1 minute
	• 'V'	20 seconds
Left Hamstrings	• Rotary	20 seconds
	Tapotement	
	• Hacking	20 seconds
	• Cupping	20 seconds
	Effleurage	
	• Flat hand	30 seconds
	Right Hamstrings	Effleurage
• Flat hand		1 minute
• 'V'		20 seconds
• Rotary		20 seconds
Tapotement		
• Hacking		20 seconds
• Cupping		20 seconds
Left Hamstrings	Effleurage	
	• Flat hand	30 seconds
Right Hamstrings	Effleurage	
	• Flat hand	1 minute
	• 'V'	20 seconds
	• Rotary	20 seconds
	Tapotement	
	• Hacking	20 seconds
	• Cupping	20 seconds
Left Hamstrings	Effleurage	
	• Flat hand	30 seconds

APPENDIX F
PARTICIPANT CONSENT FORM



Cardiff Metropolitan University Prifysgol Fetropolitan Caerdydd

UWIC

Participant Consent form

Title of project: 'The effects of pre-event, lower limb massage on an athlete's performance during an 800 meter distance'

Name of researcher: Eleanor Parkin

1. I confirm that I have read and understand the participant information form dated _____ for the study titled above.
 2. I understand that participating in this study is under my own free will and I can stop taking part at any point without giving a reason.
 3. I understand that the results from my test will be used as data in this study but I will not be identified and will remain anonymous.
 4. I agree to take part in this study.
-

Name of participant (in capitals): _____

Signature of participant: _____

Date: _____

Name of person taking the consent: _____

Signature of person taking the consent: _____

Date: _____

APPENDIX G
ETHICS APPROVAL



Cardiff
Metropolitan
University

Prifysgol
Metropolitan
Caerdydd

Date: 10/03/14

To: Eleanor Parkin

Project reference number: 13/05/289U

Your project was recommended for approval by myself as supervisor and formally approved at the Cardiff School of Sport Research Ethics Committee meeting of 29th May 2013.

Yours sincerely

Catrin Rowlands

Supervisor

Cardiff School of Sport
Cyncoed Campus, Cyncoed
Road, Cardiff, CF23 6XD UK
Ysgol Chwaraeon Caerdydd
Campws Cyncoed, Heol Cyncoed,
Caerdydd, CF23 6XD DU

Telephone Ffôn
+44 (0)29 2041 6591
Fax Ffacs
+44 (0)29 2041 6768
Email E-bost
css@cardiffmet.ac.uk
www.cardiffmet.ac.uk