Cardiff School of Sport

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Supervisor:	Craig Ranson		

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 SCHOOL OF SPORT

DEGREE OF BACHELOR OF SCIENCE (HONOURS)

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INJURY PREVENTION AND MANAGEMENT PRACTICES AMONGST INDOOR SPORTS CLIMBERS

(Dissertation submitted under the discipline of SCRAM)

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INJURY PREVENTION AND MANAGEMENT PRACTICES AMONGST INDOOR SPORTS CLIMBERS

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Firstly, I would like to express my gratitude to my supervisor Dr Craig Ranson for his insight and continued guidance throughout my dissertation.

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ABSTRACT

The aim of this study was to help establish whether further ‘injury’ familiarization was needed amongst the climbing population and the ‘medical’ profession, and whether this familiarization was primarily general awareness, treatment, or prevention that needed to be advanced through education.

One hundred and twelve questionnaires were distributed between November 2013 and January 2014. Forty-nine questionnaires were emailed to climbers, and 63 were handed directly to climbers at three different indoor climbing/bouldering walls in Bristol and Cardiff. The criteria for selecting participants were that climbers had to be aged 18 years or over, and also have at least two years of climbing experience. The key component of the questionnaire then sought information from the participants on types of injuries along with treatment and preventative strategies commonly used. A total of 67 questionnaires were completed.

Sixty percent of all participants had sustained an injury in the last two years. The total number of distinct injuries recorded was 91. Overuse injuries accounted for 59% of all injuries, whereas traumatic injuries accounted for 41%. Fingers, elbows and shoulders were the most common injury sites. The most prevalent distinct injury was the A2 pulley, occurring in 15% of all diagnosed injuries. Most participants reported receiving informal advice regarding treatments (21%) and preventative strategies (32%) from fellow climbers. The most common advice regarding treatment was rest (24%). Warm ups (24%) was reported as the most effective preventative measure in this study. Elite climbers with climbing experience of over ten years who climb more than twice a week, are at higher risk of injury.

With the repetitive nature of the average age that a climber suffered from injuries such as A2 pulley injury has decreased by 20 years in the past decade. Effective treatments and preventative advice for injuries has come from medical professionals, demonstrating that the attitude of climbers needs to change. Giving climbers and medical professionals a chance to gain a greater understand of climbing injuries will help them work together to reduce rates and develop interventions that work most effectively. Although some symposiums have been running since 2010, they need to become more regular and at different venues around the country. Future research into effectiveness of new treatment and preventative interventions as well as investigating the psychological mind of a rock climber is warranted.

CHAPTER I

INTRODUCTION

1.0 INTRODUCTION

Rock climbing, in particular indoor climbing, has grown in popularity over the past decades as a competitive sport and a recreational activity (Neuhof, Hennig, Schöffl, I & Schöffl, V, 2011). Statistics released by Sport England in their Active People Survey (APS) included results for Mountaineering, and these data indicate that indoor climbing is likely to have more participants in the next six to twelve months than traditional outdoor climbing (Coldwell, 2012). As the sport has become better understood and recognised, more indoor climbing walls are being built in towns and cities (Limb, 1995) resulting in an estimated increase from 300 to 400 public climbing walls in the UK, in the last five years (Gardner, 2013). Consequently, new walls represent more readily available facilities for climbers to practice new climbing skills, and potentially enhance their abilities in a managed environment (Kidd & Hazelrigs 2009).

The sport of rock climbing is based on a very simple premise, in which a climber seeks to reach the top of a route using a variety of footholds and finger holds (Wyatt, McNaughton & Grant, 1996). Through numerous diverse strategies, climbers can challenge themselves with new routes or higher-level grades to try and progress to undertaking and successfully completing more superior (challenging) routes. In the past five years there has also been a significant increase in provision of bouldering-only centres, which provides the opportunity for rope-free technical climbing, and this is proving a very attractive form of climbing to new participants (Coldwell, 2012). Bouldering is made up of problems consisting of a sequence of difficult repetitive moves with a final end hold. Bouldering walls usually range in height from 2.5 to 4.5m above the ground, and this requires a crash / bouldering mat beneath the climber (K. Phillips, Sassaman & Smoliga, 2012). These new developments within the sport of climbing have allowed climbers to focus more on style and technique, introducing a new level of competition known as ‘sports climbing’ (Haas & Meyers, 1995).

“Sport climbing focuses on the development of athletic ability and on making the most difficult moves possible.” (Paige, Fiore & Houston, 1998, p.2). This type of climbing consists of climbing indoor artificial walls or outdoor natural rock faces that are equipped with permanent bolts (steal rings) that are drilled into the wall/rock (Rooks, 1997). As this new style of climbing has evolved, safety equipment has been improved, minimising the risks of climbers

inappropriately applying safety gear during a climb. These improvements have allowed climbers to become more competitive, and endure harder training than in the past (Paige et al., 1998). The increase in training and the overall evolvement of the sport of climbing has rapidly changed only recently (Bollen & Gunson, 1990). Due to the lowered risk of traumatic injuries and the perceived 'safer' indoor environment, the new generations of climbers are now inclined to push themselves to their limits, in trying to succeed on new and progressively harder routes. This drive to attempt more challenging routes has consequently resulted in a significant change in style, duration, frequency and intensity of rock climbing, subsequently placing greater strain on their joints. This has triggered a change in the types of injuries suffered by today's rock climbers (Bollen, 1994; Maitland, 1992).

In the past decade, rock climbing has seen a rise in unique overuse injuries as opposed to general traumatic injuries (Kubiak, Klugman, & Bosco, 2006). As this sport has seen such a recent and rapid development in popularity (Neuhof et al., 2011), opportunities for longitudinal studies have been limited, resulting in a paucity of injury research data and information associated with this topic. Therefore, further studies need to be undertaken to gather knowledge of the types and rate of injuries (Backe, Ericson, Janson & Timpka, 2009). Furthermore, exploring treatments and preventions will help optimize the training regimes (Sheel, 2004) and allow climbers and physical educators to create a safer climbing environment for the general climbing population (Williams, Hudson & Evans, 2003). In this fairly new sports environment, the importance of prevention and effective treatment of injuries is often overlooked and more research is needed to assess the problem and find solutions (Sheel, 2004). A few previous studies have looked into the most prevalent injuries in the sport, as a consequence of the adjustments in style and training. The aim of this project is to gain a better understanding of the types and rates of climbing injuries, and to try and establish whether there needs to be advances in the education provided to physical educators / professionals and climbers, with regards to the treatment of injuries and associated preventative strategies.

CHAPTER II

CRITICAL REVIEW OF THE LITERATURE

2.0 CRITICAL REVIEW OF THE LITERATURE

2.1 Type and Rates of Indoor Climbing Injuries

Bannister and Foster (1986) described four cases of upper limb injuries associated with rock climbing. The cases highlighted four different injuries including, traumatic injury to both shoulder joint capsules, tendinopathy in both wrists, tenosynovitis of the flexor tendons and avulsion of the terminal insertion of flexor digitorum profundus. Although all four cases were distinct, they all began as minor injuries made worse through an intensive training regime using an indoor climbing wall or weight training. Bannister and Foster (1986) continued to explain that climbers nowadays have increased their training hours either at the gym or using climbing wall-based training. This study indicates that, training-related injuries are increasing. While this study has contributed to the understanding of the newly developed injuries associated with rock climbing, a key limitation was that only four participants were used. The small study sample size means that it is not possible for the study's findings to be confidently extrapolated to represent the general climbing population.

Bollen (1988) conducted a more recent study, using a larger sample size. Bollen's study was similar to Bannister and Foster's (1986) study, and consisted of investigating the most common soft tissue injuries in extreme rock climbers during periods of intense training. Bollen's study was based on a questionnaire survey for extreme climbers, and sought to determine the parts of the body most commonly susceptible to injury specifically through rock climbing. Similar studies have stated that three quarters of sports climbers will suffer from injuries to the upper extremities (Rooks, 1997). Likewise, this study uncovered that 86% of the participants sustained injuries in that area (Bollen, 1988). Wrist and hand injuries accumulated for 50% of the injuries reported. A total of about 16% consisted of elbow injuries specifically, lateral epicondylagia, medial epicondylagia, anterior elbow pain and some rare cases of brachialis sprain, also known as "climbers elbow". Roughly, only 13% of climbers suffered from shoulder injuries including mostly rotator cuff tears, with the occasional impingement syndrome. Researchers were surprised at this finding as climbing requires regular overhead movements, repetitive ascending movements and weight distribution over the shoulder joint (Haas & Meyers 1995). Lower limb injuries occurred in only around 10% of the climbers and those experienced were ligament and adductor sprains, and chronic patella

tendinopathy. Bollen (1988) reported that the most commonly affected site, with 69% of the total injuries, was the proximal inter-phalangeal (PIP) joint, also known as the A2 flexor tendon pulley (Figure 1).

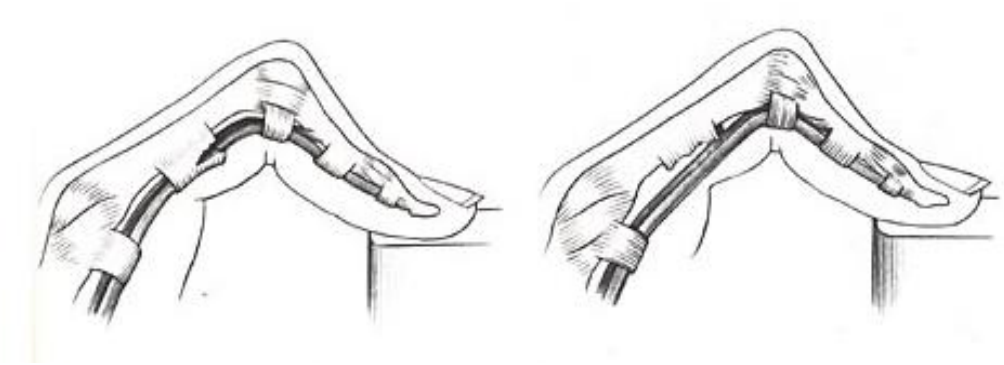

Figure 1. An image of a partial (left) and complete (right) tear of the A2 flexor tendon pulley (Horst, 2008).

Bollen's (1988) finding with regard to the high frequency of PIP injuries was endorsed by Rooks (1997), who highlighted that the single most common site of injury in rock climbers was the PIP joint; Rooks further established that this injury was present in over 50% of elite sports climbers. Injury to the PIP joint originates from superficialis tenoperiostitis or small tears at its insertion, also known as "climbers finger" (Bollen, 1988). "Climbers finger" occurs as a result of the excessive "bowstringing" over small holds, and the difficult cling grip which climbers will use 90% of the time (Bollen, 1988; Jebson & Steyers, 1997). It was also pinpointed that due to the "pinching" technique used on particular climbing holds, the metacarpophalangeal joint was another common area of injury (Bollen, 1988). The purpose of Bollen's study was to enable athletes to discover appropriate training schedules to help address these ongoing injuries. However, both Bannister and Foster (1986), and Bollen (1988) used high-level climbers as the source of data for their studies. Consequently, the results of these two studies are not necessarily directly relevant to the fastest growing element of the climbing population, namely recreational climbers (Wright, Royle, & Marshall, 2001).

During the 1990's 'bouldering' was added to the culture of rock climbing and the popularity of this style of climbing escalated as a sport, allowing climbers to use bouldering as a core activity or as a training basis in preparation for tackling new superior routes (Peter, 2004). Consequently, bouldering has been the sole cause of many injuries that resulted from

strenuous climbing moves (Jones, Asghar & Llewellyn, 2008) resulting from high stress and fatigue of the climber (Kubiak et al., 2006). This has proven that overuse injuries are an increased area of concern for all climbers, including both recreational and elite participants (Turner, 1999).

A further study by Rooks, Johnston, Ensor, McIntosh & James (1995), explored the injury patterns in recreational rock climbers. Their data was based on completed questionnaires recording previous injuries, combined with a physical examination of the majority of the climbers interviewed. Overall, 90% of the climbers were either suffering from or previously had overuse syndrome. During the physical examination, hands and wrists were recognized as the most common site injured, with this form of injury observed in 50% of the climbers. These injuries involved the digitals flexors and wrist extensors. Shoulder injuries were the next most common problem (evident in 13 climbers), and included rotator cuff tendonitis or impingement. Furthermore, this study highlighted that elite climbers are 50 to 69% at risk of getting proximal interphalangeal joint and digital pulley injuries, whereas beginners were more likely to develop tendinitis. The authors of this study did, however, caveat the validity of their study due to small sample size.

Paige and co-workers (1998) partly addressed the issue of limited sample size, by collecting data from 398 questionnaires completed by individuals from the general climbing population. Using the data, the authors investigated the pattern of injuries in traditional rock climbing compared with sports climbing. They identified that 120 climbers had sustained injuries on natural rock, with 131 climbers suffering injury on artificial walls. The difference in injury patterns with traditional climbing, and sports climbing differ due to the style-specific mechanisms as well as sports climbing puts more stress over a joint, especially the fingers (Paige et al., 1998). However, like many other studies (Rooks, 1997; Bollen, 1988), the upper extremities (particularly fingers) were found to be the most common sites for injuries in both traditional and sports climbing (Paige et al., 1998). Paige and colleagues (1998) confirmed that in sports climbing there was a significant proportion of upper versus lower extremity injuries. It is likely that typical sports climbing injury patterns are a result of the explosive, dynamic and athletic movements this style requires (Haas & Meyers, 1995; Paige et al., 1998). It is proposed these injuries are as a result of regular and persistent practise by climbers on particularly challenging routes they are trying to conquer (Paige et al., 1998). This

repetitive preparation is called “working a route” and specifically exposes climber’s fingers to constant strain and rapid overuse (Paige et al., 1998), which in simple terms could be considered as a form or ‘repetitive strain injury’. Overall, this study was based on a significant sample size gained from a widespread population of climbers, which gives more confidence in the results. However, it is noted that they were not able to evaluate more severe injuries, since data on fatal or career-ending injuries were not collected as part of the study. Excluding these types of injuries could cause significant bias in the results and study conclusions.

A series of more recent studies conducted in the past 10 years, have identified similar results regarding the types and mechanisms of injuries in rock climbing. Jones and colleagues (2008) investigated the prevalence and nature of rock climbing injuries in a cross sectional study based on data collected from five outdoor and six indoor climbing venues in the UK. Their data indicated that 50% of the active rock climbers from the total of 201 questioned had suffered more than one injury in the previous twelve months, resulting in a total of 275 distinct injuries. The mechanisms of injury included 57 (28%) climbers suffering acute injuries from strenuous moves, 67 (33%) climbers sustained chronic overuse injuries and the smallest percentage of 21 (10%) climbers reported acute fall-related injuries.

Similar to previous studies (Logan, Makwana, Mason & Dias, 2004; Wright et al., 2001), Jones and co-workers (2008) found that the most common injury sites due to overuse or strenuous moves were fingers and shoulders. A more recent study also found similar results with a sample of rock climbers from the Swedish Climbing Association (Backe et al., 2009). Their findings reported that from a total of 208 injuries, 93% were overuse injuries in climbers partaking in sports climbing or bouldering, mostly in their fingers and wrists. In contrast, Neuof and colleagues (2011) evaluated injury risk in sports climbing and discovered a completely different outcome. In a 21-page standardized web based questionnaire, researchers received 699 reported injuries, and of these 74.4% were minor severity injuries usually ligament or tendon damage, most commonly in the feet, fingers and legs. There was no significant difference between lower and upper extremity injuries. This disagrees with previous findings that revealed more upper extremity injuries (Bollen, 1988; Rooks, 1997; Paige et al., 1998).

Intriguingly some studies have suggested that more advanced climbing, that is climbing at a higher level and with an increase climbing activity per week, will raise the risk of injury (Logan et al., 2004; Wright et al., 2001). Furthermore, it has been highlighted that those higher level climbers along with those who regularly use different forms of climbing, for example lead (a climber who is leading the route protected by tying to a rope and clipping at intervals to anchors or runners) and bouldering, are more at risk of injury (Jones et al., 2008). Although Jones and colleagues (2008) had significantly large numbers of participants in their study, non-active climbers were not included. Therefore, the more severe injuries that perhaps caused non-active climbers to stop climbing were not recorded, and consequently this may bias the reported observations. In addition, climbers may have also exaggerated injuries or forgotten vital information regarding their injuries although this is often seen in other studies using questionnaires (Paige et al., 1998). Other studies have indicated that men who have climbed for over ten years, and also have a high Body Mass Index (BMI) are within the high risk category (Wright et al., 2001; Logan et al., 2004). However, this contradicted a more recent study stating that BMI and age do not have any influence to climbing injury (Neuhof et al., 2011). On the other hand, this study only included climbers who sought professional medical treatment (Neuhof et al., 2011). This only comprises a small proportion of the climbing fraternity, as we know that a large portion of the general climbing population don't routinely seek medical advice (Bollen, 1988; Jones et al., 2008).

2.2 Management of Climbing Injuries

The results from a number of studies, as reviewed above, have highlighted that the increasing popularity of indoor sports climbing has been accompanied by an increase in a range of new types of climbing injury. As a result, new treatments need to be developed to cope with the new demands of the sport. Climbers may argue that when they went to seek medical advice for their injuries, they sensed the lack of appreciation from health professionals towards the stresses involved in climbing and as a result, believed no help was offered with diagnosis or treatment (Rohrbough, Mudge & Schilling, 2000).

As previously mentioned, soft tissue injuries have been investigated in extreme rock climbers (Bollen, 1988). The study found that 21 climbers out of a total of 86 reported that they sought professional help, with 78% of the group visiting a general practitioner to seek advice.

Similarly, a more recent study on active rock climbers identified only 38% of the climbers received treatment and advice following their injury (Jones et al., 2008). Furthermore, the advice received was primarily from physiotherapists, closely followed by advice from other climbers and doctors. Both studies indicated a very low number of climbers asking for professional help. Those who looked for advice were disappointed with the treatment, and emphasized that they felt the health professionals believed climbers should expect injuries due to the nature of the sport (Bollen, 1988).

Although climbing has become more popular and some climbers are becoming more aware of injuries, there is still limited information on diagnosis and treatment of climbing-related injuries (Kubiak, Klugman & Bosco, 2006). Jebson and Steyers (1997) study was one of the first that described the treatments, through looking at hand injuries in rock climbing. Generally the treatments suggested were conservative treatments consisting of rest, non-steroidal anti-inflammatory medication, range of movement (ROM) exercises, strengthening training, functional exercises and finally protective management, such as taping or splinting (Jebson & Steyers, 1997). The more severe injuries for example, flexor tendon rupture or A2 pulley injury required complex treatment such as surgical repair, reconstruction or perhaps more specifically, a corticosteroid injection (Jebson & Steyers, 1997). Likewise, a more recent study looked into orthopaedic problems in sports climbing and explained the importance of initial treatment (Peters, 2001). It was also demonstrated that ROM, coordination, warm ups, stretching and agonist/antagonist muscle strengthening are effective treatments (Peters, 2001). For example, moving plasticine around the fingers will help regain elements in the climber's muscles.

These treatment methods are proven to be beneficial, however rock climbers have the reputation of being very laid back and anti-establishment, possibly inhibiting their view on injuries and subsequent treatment. Although researchers and health care professionals suggest these ways of treatment and prevention, it appears that climbers tend to self-treat themselves or count on fellow climbers for 'medical' advice (Jones et al., 2008; Logan et al., 2004). In addition, there is also evidence that climbers use online forums and websites to discuss or exchange knowledge concerning treatment and prevention of injuries (Rockclimbing.com, 2013; Climbinginjuries.com, 2013). Whether this is a consequence of

poor feedback from professional practitioners (Bollen, 1988) or simply a personal preference, is yet to be established.

2.3 Prevention

In order to reduce climbing specific injuries, preventative measure need to be addressed. Rooks (1997) produced a study into rock climbing injuries and highlighted that the major cause of injuries is overtraining caused by frequent climbs and fewer rest periods. Likewise, other studies proposed adequate rest between maximal efforts will not only help recovery, but has proven effective in preventing ongoing injuries (Paige et al., 1998; Rohrbough et al., 2000). Furthermore, recent studies have recommended partaking in pain-free activities other than climbing (Williams et al., 2003) along with adapting climbing load and repetitions depending on climber's age and experience, may reduce painful injuries (Backe et al., 2009). This research is not suggesting climbers should lessen their commitment to climbing or complete less challenging climbs; it is simply drawing attention to incorporating rest periods into their climbing regime (Wright et al., 2001).

Rock climbing has already brought to light the positive effects on rehabilitation for ankle stability. For that reason there is clear evidence that with the correct periods of rest, climbing should work as a good preventative measure, rather than a cause for injuries (Schweizer, Bircher, Kaelin & Ochsner, 2005).

In contrast, other studies have proposed that to enhance performance and decrease likelihood of potential injury, climbers should develop a good climbing technique (Haas & Meyers, 1995; Paige et al., 1998). As well as good climbing technique, a previous study recommended alternative training techniques would reduce the risk of pulley injuries (Koukoubis, Cooper, Glisson, Seaber, & Feagin Jr, 1995). Furthermore, recent studies have found significant prevention interventions such as, reducing commonly used grips, for example the open and closed crimp grip (Figure 2). They advised to avoid utilizing the 'crimp grip' in repetitive climbing training exercises to reduce pulley injuries in particular (Rooks, 1997; Warme & Brooks, 2000). In addition, redirecting sports climbers to more natural rock faces along with emphasising footwork, should be helpful (Rooks, 1997). As a consequence

of the new styles of climbing, climbers should strengthen their tendons and ligaments instead of the muscle to ensure their fingers can handle the stress. (Paige et al., 1998).

Figure 2. Examples of the open crimp grip (left) and closed crimp grip (right) (Peter, 2004).

Stress on fingers is an inevitable part of climbing. Therefore, the most frequently used preventative measure is taping to the fingers as it helps to provide protection and support, especially to the tendons (Shea, K, Shea, B & Meals, 1992; Kubiak et al., 2006). In addition, further studies suggested circumferential finger taping and athletic tape helps to support the connective tissue and reduce the risk of pulley injuries (Jebson & Steyers, 1997; Paige et al., 1998). However, there are other recent studies which proposed that there was no clear evidence as to whether taping the fingers has a preventative value (Backe et al., 2009), whilst others argued that using external taping does not work well against flexor tendon sheath injury in a climbing athlete (Warme & Brooks, 2000).

In addition, recent updated studies have discovered that progressive strength and conditioning (S&C) programmes that mimic climbing activities can reduce risk of injury (Williams et al., 2003). K. Phillips and colleagues (2012) conducted a very recent study looking into ways of optimizing rock climbing performance through sport-specific strength and conditioning. The findings suggested that S&C programmes should include exercises involving similar movement patterns to rock climbing along with incorporating specific climbing grip exercises to improve finger and hand strength endurance. Warming up before any

exercise is always necessary and with all the strains placed on the body during climbing, raising the heart rate and stretching the muscles is essential for optimizing climbing performance and prevention of injuries (R. Phillips, 2011).

2.4 Summary

In conclusion, the literature review found that the most common type of injury in indoor rock climbing is an overuse injury in the upper extremities of the body. Furthermore, the review clearly identified that only a limited proportion of climbers routinely sought professional medical advice, and the importance of preventative measures associated with climbing reword. It seems as though physicians and other health care providers lack thorough understanding of climbing injuries and their management. Therefore, the purpose of this study will be to help establish whether further ‘injury’ familiarization is needed amongst the climbing population and the ‘medical’ profession, and whether this familiarization is primarily general awareness, treatment, or prevention that needs to be advanced through education.

CHAPTER III

METHODS

3.0 METHODS

3.1 Participants

The participants in this study were climbers of the general climbing population. This included a range of climbers from lower level to elite. Questionnaires were either emailed to climbers or directly handed out at three different indoor climbing/bouldering walls in Bristol and Cardiff. Sixty-seven climbers filled out the questionnaires (mean ± SD age, 37 ± 12 years; height, 1.75m ± 0.09m; body mass, 70.6kg ± 8.28kg). This study excluded under 18 year olds. A specific two year time frame of injuries was chosen because any recollection of events further back in time would have proven difficult for the participant, and any shorter time frame would not provide enough data. Therefore, climbers who had not been climbing for two years or more were also excluded from this study. Both genders were included as the general climbing population includes males and females.

Cardiff School of Sport's ethical approval was granted for the final approved questionnaire. (See appendix C) To satisfy the School's policy it was also necessary for participants included in the study to give informed consent by signing a consent form prior to filling out the questionnaire. Confidentiality was preserved by keeping all the data anonymous. A copy of the final approved questionnaire and the consent form is included in Appendix A.

3.2 Questionnaire Development

Prior to the main study, a pilot study was used to test the methods, which was in this case the questionnaire. The main aim of the pilot study was to give the researcher some reliable feedback on whether the questions needed adjusting and whether the logical progress of the questionnaire was appropriate. It was important to ensure that the questions were understandable and clear. In addition, the estimated time it took to complete the questionnaire in the pilot study was evaluated. This would allow the researcher to inform participants in the main study how long it would take to complete the questionnaire, before they agreed to participate. The questionnaire was piloted using three rock climbers (n=3) and two (n=2) non-climbers. Non-climbers were utilized because if they could understand the questions, then

there was a high possibility that more experienced rock climbers would also comprehend the form. A copy of the pilot questionnaire is included in Appendix B.

The pilot study highlighted some key areas for adjustment. Participants involved in the pilot study gave feedback indicating that some questions were unclear, and they suggested various adjustments and additional questions which should be incorporated in order to extract as much data as possible. Firstly, additional general and climbing background information was deemed to be useful, such as height, weight and dominant arm / leg. This information would lead to a greater understanding of the injuries when analysing the data. Also specific questions were simplified to ensure understanding and consequently maximising responses. Small descriptions were added to the questions in order to help distinguish between trauma and overuse injuries, as well as examples of injuries as a guide for the participant. Participants in the pilot study highlighted that the options in some multiple choice questions were too limited, therefore, more choices were added. Finally, the section of the questionnaire that asked questions specifically about one of their injuries was duplicated three times. This allowed the researcher to investigate three injuries further, retrieving more data for the study.

The French climbing system (5b, 5c, 6a, 6a+ etc) was used to assess the technical ability of each participant on the climbing wall (lead/roped) This is the standard grading system used in indoor climbing venues in the UK (Gresham, 2010). The French grading system 'Fountainbleau' was applied to collect the participant's bouldering grade. This bouldering system is used all across Europe (Dru, 2008).

An injury was defined in one of two ways, traumatic or overuse, with the help of some examples to guide the participant. A traumatic injury was defined as a sudden injury that required them to immediately stop training or competing. An overuse injury was expressed as a gradual onset.

3.3 Data Collection

One hundred and twelve questionnaires were distributed between November 2013 and January 2014. Forty-nine were sent through email and 63 were given by direct engagement with climbers at three different indoor climbing/bouldering walls in Bristol and Cardiff.

Climbers who were approached directly were given a brief verbal introduction to the study, including a short explanation of the various sections of the questionnaire. On average it took approximately 5-10 minutes to complete and hand back to the researcher. The participants who received a questionnaire by email also received the same brief introduction but in a written format. They were asked to email the questionnaire back to the researcher with the appropriate consent forms attached. Once the completed questionnaires were received, copies were printed and filed. In accordance with the School's policy, all questionnaires collected were kept in a secure folder only accessible to the researcher and the supervisor. These records will be destroyed once the study has been formally completed and assessed.

3.4 Data Analysis

Analysis and evaluation of the data set was undertaken using Microsoft Excel. Data was input into a custom made worksheet and a range of graphs and tables were produced to evaluate and interpret the data set.

CHAPTER IV

RESULTS

4.0 RESULTS

Sixty-seven questionnaires were completed (63 from face-to-face collection and four by email). The gender split for the collected data was 81% males, and 19% females. The mean number of years climbing experience was 11.6 years (SD 10.6). Participants on average climbed on a climbing wall (lead/roped) once a week and nearly twice a week on a bouldering wall. Most participants who climbed more than twice a week on a climbing wall (83%) and/or twice a week on a bouldering wall (94%), had sustained an injury in the past two years (Table 1). The mean number of times a participant went climbing outdoors was 23 times a year. All participants who indicated they climbed at grade 7a and above on the climbing wall and fb7a and above on the bouldering wall, had reported at least one injury in the last two years (Table 2). From a total of 67 participants, 40 (60%) had sustained an injury in the last two years and a total of 91 injuries were recorded. Seventy-two percent of these injuries occurred whilst on a bouldering wall and only 28% happened on a climbing wall.

Table 1. Summary of injury results related to how often participants climbed on climbing and bouldering walls (Totals < 100% due to missing data in some participants)

Climbing Wall Injuries				Bouldering Wall Injuries			
No. of climbing sessions per week	Number of climbers	Number injured	% (Injuries to climber)	No. of climbing sessions per week	Number of climbers	Number injured	% (Injuries to climber)
≤1	42	19	50	≤1	30	14	47
>1 to ≤2	11	9	82	>1 to ≤2	15	9	60
>2	6	5	83	>2	16	15	94
N/A	8	7	87.5	N/A	6	2	33
Total	**67**	**40**	**60**	**Total**	**67**	**40**	**60**

Table 2. Summary of injury results related to climbing/bouldering wall grades (Totals < 100% due to missing data in some participants)

	Climbing Wall Injuries				Bouldering Wall Injuries		
Climbing Grade	Number of climbers	Number injured	% (Injuries to climbers)	Bouldering Grade	Number of climbers	Number injured	% (Injuries to climbers)
up to 5a	1	0	0	up to 5a	3	1	33
5a-5c	10	3	30	5a-5c	13	6	46
6a-6c	40	23	57.5	6a-6c	27	18	67
7a&above	10	10	100	7a&above	9	9	100
N/A	6	4	67	N/A	15	6	40
Total	**67**	**40**	**60**	**Total**	**67**	**40**	**60**

4.1 Injury Mechanism

4.1.1 Traumatic Injuries

From a total of 91 distinct injuries, 41% were traumatic (sudden onset) injuries. Table 3 shows that upper extremity injuries accounted for 76% of all traumatic injuries. The largest percentages of these were sustained in the fingers (32%) and shoulders (22%). Only five participants suffered injuries to the lower extremities (Figure 3), mostly consisting of knee injuries (8%).

Table 3. Areas of the body presented with the most traumatic injuries

Body Part Injured	Total Injuries
Upper Extremities	28 (76)
Fingers	12 (32)
Shoulder	8 (22)
Elbow	4 (11)
Lower Extremities	5 (13.5)
Knee	3 (8)

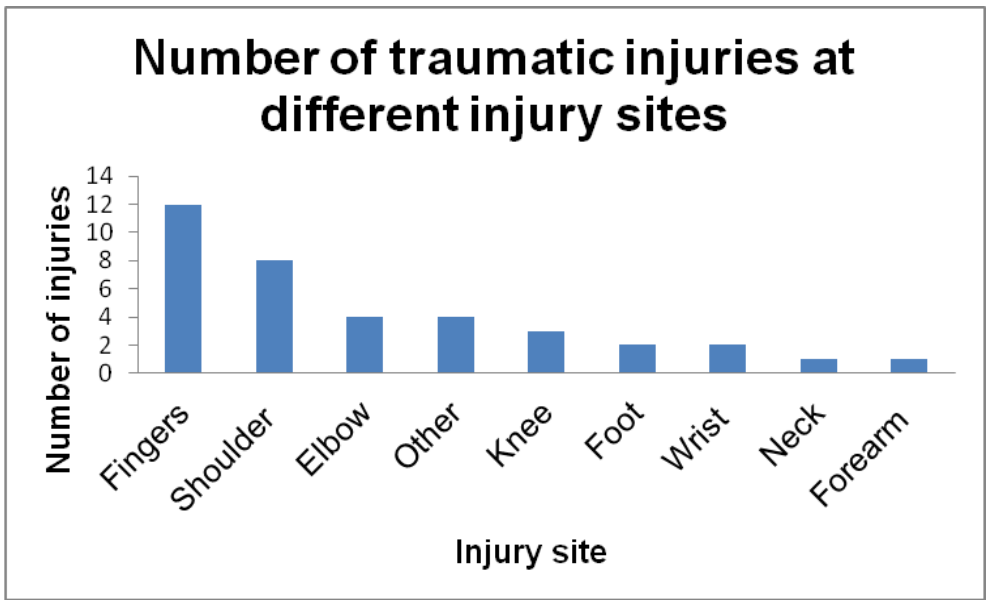

Figure 3. The number of traumatic injuries sustained at a variety of injury sites.

4.1.2 Overuse Injuries

Overuse injuries accounted for 59% of all injuries. Table 4 shows that 89% of overuse injuries occurred in the upper limbs. The majority were found at the elbow (31.5%) and the fingers (24%). Injuries to the lower limbs only occurred in five participants (Figure 4).

Table 4. Areas of the body presented with the most overuse injuries

Body Part Injured	Number (%) of Injuries
Upper Extremities	48 (89)
Elbow	17 (31.5)
Fingers	13 (24)
Shoulder	6 (11)
Lower Extremities	5 (9)
Knee	3 (6)

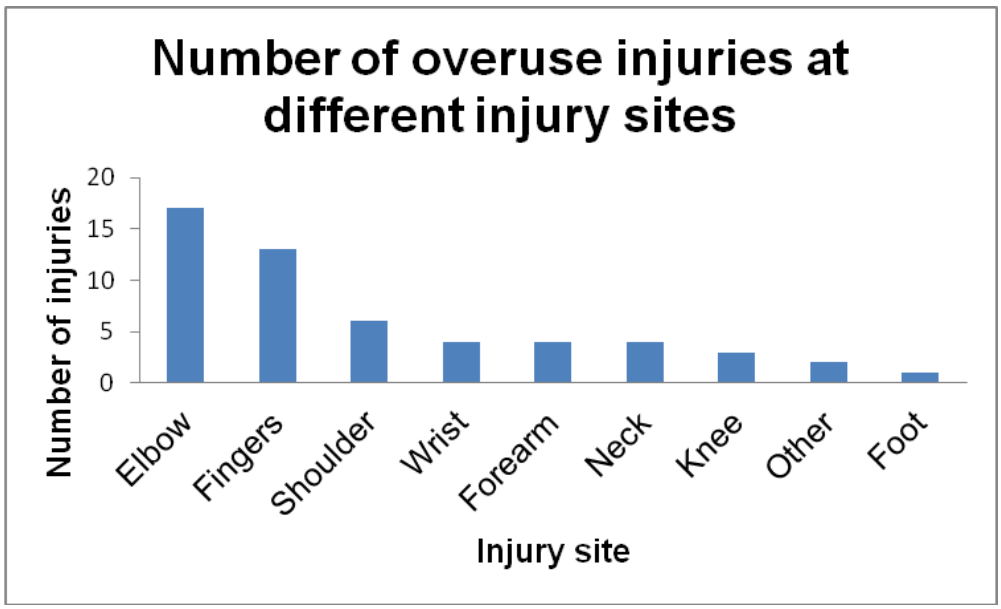

Figure 4. The number of overuse injuries sustained at a variety of injury sites.

4.3 Types of Injuries

Seventy-six (84%) out of the total 91 distinct injuries, were identifiable. Table 5 summarizes the types and frequency of injuries suffered by participants, as well as the mean age of the participants who had sustained the various injury types. Finger tendon injuries accounted for nearly a quarter (24%) of all diagnosed injuries. This included those diagnosed specifically with an A2 pulley injury (15%) and those non-specific finger tendon injuries (9%). The mean age of the participants who had suffered A2 pulley injuries was 34 years (SD 7.04) and 89% occurred on the bouldering wall. Rotator cuff injuries were the next most common accounting for 12%. Elbow injuries accounted for 18% of all diagnosed injuries. Mostly these were tennis elbow, seen in six (8%) participants. Only one climber (1%) reported having arthritis at the age of 57 years.

Table 5. Types, frequencies and average age of diagnosed injuries suffered by participants

Type of injury	Number (%) of climbers	Mean climber age (years)
A2 Pulley	11 (15)	34
Rotator cuff injury	9 (12)	37
Finger tendon injury	7 (9)	35
Tennis elbow	6 (8)	44
Upper back/neck pain	5 (7)	36
Other shoulder injuries	5 (7)	38
Other elbow strains/sprains	5 (6)	31
Torn knee ligament/meniscus	4 (5)	43
Golfer's elbow	3 (4)	44
Ankle ligament	3 (4)	49
Bicep Injury	3 (4)	33
Broken toe	2 (3)	26
Wrist strain/overuse	2 (3)	29
Arthritis	1 (1)	57

Table 6 summarises the data collected from the participants, with regard to the amount of climbing time they had ‘lost’ as a result of climbing injuries. The data shows that nearly half (45%) of the participants kept on training through their injuries or their injuries were on-going. Few participants were out of climbing for more than 70 days (2%).

Table 6. Amount of time participants were unable to climb

Days unable to climb	Number (%) of injuries
Kept on training/ Injury on-going	49 (45)
0 days	8 (7)
1-7 days	17 (16)
8-21 days	21 (19)
22-35 days	4 (4)
36- 70 days	7 (6.5)
>70 days	2 (2)

4.4 Source of Advice and Types of Treatments Given to Climbers

Twenty-seven (42%) injured participants sought professional medical advice for their injuries and 38 (58%) injured participants did not seek professional medical advice. Table 7 shows some of the most common people or places participants used to get advice or treatment. The majority of injured participants (21%) sought advice from fellow climbers. A number of participants (19%) looked on websites for advice on treating their injury. Most participants who sought medical professional advice or treatment went to their GP/Doctor (13%) or Physiotherapist (13%). Eleven percent of these injured participants did not seek any advice at all for their injury.

Table 7. Most common types of person/place participants sought their advice/treatment from

Type of person/place	Number (%) of climbers
Fellow Climbers	18 (21)
Websites	16 (19)
GP/Doctor	11 (13)
Physiotherapist	11 (13)
Osteopath	9 (11)
No Advice	9 (11)

Table 8 illustrates the types of treatment that participants received from medical professionals or non-medical professionals. Rest was the most common treatment proposed by both medical professionals (23%) and non-medical professionals (24%). A number of participants indicated that reduced training (17%) was recommended by non-medical professionals. Less common advised treatments were medication (2%) and injections (1%). Overall, just over half (52%) of those participants using treatment suggestions from medical professionals indicated that it was 'very effective' and only five (19%) didn't follow the advice given because they considered that it was too time consuming. In total, 85% of those participants using treatments from non-medical professionals found it were 'somewhat effective' and only 15% believed it to be 'very effective'.

Table 8. Types of treatment recommended to participants by medical professionals and non-medical professionals

Medical Professionals		Non-medical Professionals	
Types of treatment	Number (%) of climbers	Types of treatment	Number (%) of climbers
Rest	17 (23)	Rest	21 (24)
Manipulation/ Massage	11 (15)	Reduced Training	15 (17)
Training/ Strengthening	10 (13.5)	Massage	10 (12)
Ice	9 (12)	Modified Training	9 (10.5)
Reduced training	7 (9.5)	Ice	9 (10.5)

4.5 Preventative Strategies

From the total participants who had sustained injuries in the last two years, 32 (80%) reported that they had used preventative measures in the past. Table 10 shows that a large proportion of the participants indicated that they received preventative strategies from fellow climbers (32%) and websites (20%). Only 20% of preventative strategies were from medical professionals. Very few participants got their guidance from a GP (3%). Table 10 demonstrates some of the most common preventative strategies used by climbers. Almost a quarter (24%) of the participants used a warm up for injury prevention. The minority of participants used nutritional supplements (6%). Table 11 indicates that participants found that

the most effective preventative strategies were warm ups (24%) and rest periods (19%). Figure 5 demonstrates that only one (2%) participant found massage most effective.

Table 9. Sources climbers used for gaining advice on preventative strategies

Source of advice	Number (%) of climbers
Fellow climbers	23 (32)
Websites	20 (28)
Magazines/ books	12 (17)
Physiotherapist	6 (8.5)
Osteopath	6 (8.5)

Table 10. Types of preventative strategies used by participants

Type of preventative strategies	Number (%) of climbers
Warm up	28 (24)
Resting periods	17 (14.5)
Varying climbing technique	15 (13)
Conditioning	15 (13)
Cool down	15 (13)
Massage	10 (8.5)
Taping	10 (8.5)
Nutritional supplements	7 (6)

Table 11. Preventative strategies participants found most effective

Preventative strategy	Number (%) of climbers
Warm up	10 (24)
Rest periods	8 (19)
Conditioning/ strengthening	7 (16)
Varying climbing technique	4 (9)

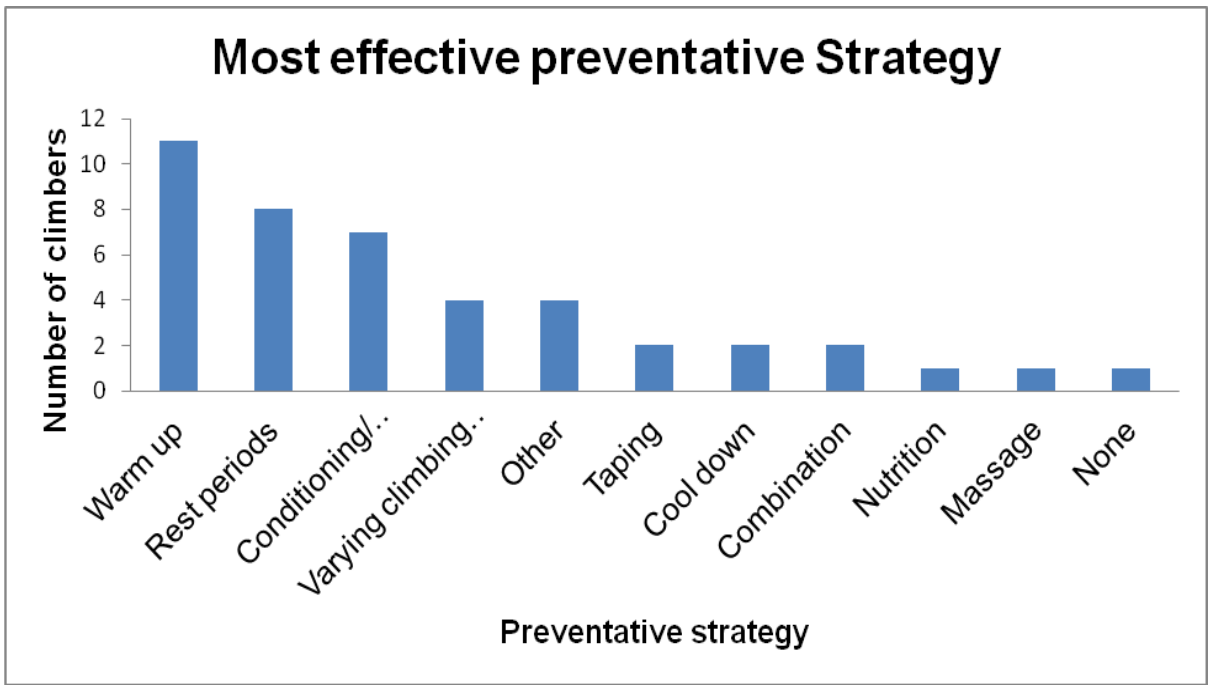

Figure 5. Preventative strategies that participants found most effective.

CHAPTER V

DISCUSSION

5.0 DISCUSSION

The aim of this study was to identify the most common injuries occurring on indoor climbing and bouldering walls, and how rock climbers did, or did not, manage their injuries through treatment and preventative techniques. There is limited literature regarding rock climbing related injuries and an associated lack of knowledge of treatment and preventative measures. The data from this study supports the hypothesis that the majority of the climbers seek advice for treatment and prevention from unprofessional medical personnel. This proved evident as the reported injuries were not always diagnosed by medical professionals but often self-diagnosed by climbers themselves.

5.1 Risk Factors

In terms of vulnerability, beginners are typically perceived to be more at risk due to their lack of in-depth knowledge of the sport. However, the ‘recent’ developments in safety equipment associated with indoor climbing facilities, now mean that beginners are not so exposed to high injury risk. The indications are now that elite climbers are far more at risk. This present study found that all participants who climbed at 7a and above, or fb7a and above, had sustained an injury in the past two years. Although elite climbers are likely to adopt longer training sessions, it might be assumed that they would be more knowledgeable of climbing dangers, consequently giving them a superior understanding of ways to prevent and treat injuries. This contradiction indicates that a greater depth of climbing knowledge does not equate to climbers adopting best practice with regard to preventative measures and appropriate treatments. These results agree with Rooks and colleagues (1995) who found that there was difference in the types of injuries suffered by elite climbers compared with beginners, possibly as a result from elite climbers enduring repetitive overuse injuries whereas beginners may cause damage through muscle weaknesses. The study also with Wright et al. (2001), finding that participants with experience of over ten years are at higher risk of injury. An obvious explanation for this outcome would be due to warn out muscles and joints. However, a contributing factor could be that a number of the participants had been climbing for over 20 years, and during this time had received little or no professional support significantly aligned with climbing injuries and their treatment.

The study found that injury risk was distributed equally between both sexes. Likewise, there was no significant risk factor with climbers who had a higher BMI. This supports the findings of Neuof and co-workers (2001) who found no link between BMI and age, and climbing injuries; but contradicts the study by Wright et al. (2001) who found that males with high BMI's were more at risk of injury.

The study found that the combination of different types of climbing (e.g. lead / roped / bouldering) wasn't a dominant factor with regard to injury risks. This suggests that combining different styles of climbing may allow muscles and joints to recover faster when repetitive matching movement patterns are practiced in different types of climbing. As there is easy access to venues for different styles of climbing, climbers can climb more frequently which may explain why previous studies have found that climbers who took part in different forms of climbing were more likely to injure themselves (Logan et al., 2004; Wright et al., 2001). The evidence in this study shows that nearly three quarters of injuries occurred on the bouldering wall, which tends to indicate that the rise in overuse injuries may be linked to the increase in bouldering practice.

The climbing environment, and particularly the indoor style, has become very competitive in the recent years, changing from a hobby to a recognized sport. Within this study, participants who climbed more than twice a week on climbing or bouldering wall were far more at risk of injury. Although many injuries might be minor, climbers also have a tendency to ignore them and work through the pain or discomfort. Paige and colleagues (1998) agreed, explaining the concept of 'working a route', which 'forces' climbers to repetitively attempt a route until successful completion. Through the competitive nature of the sport, climbers can grow in determination and resilience to help them conquer these challenging routes. This present study found a nearly half of participants who sustained an injury kept on climbing or reported the injury as 'on-going'. They were often reluctant to reduce their climbing schedules, which consequently migrated the 'minor injury' to a more serious overuse injury. Previous studies concur with these findings, highlighting that typically bouldering injuries have arisen from overloaded stress and fatigue (Kubiak et al., 2006).

5.2 Common Areas of Injury

The competitive nature of the sport is encouraging climbers to try more physically demanding routes, putting strain on their bodies, and consequently overuse injuries are becoming more prevalent. In this present study overuse injuries accounted for over half of all injuries. Overuse injuries occur when there has been an initial damage to the tissue, and insufficient time is given for recovery and repair. With the tendency for longer duration training sessions, there is a much higher risk of getting an overuse injury than a traumatic injury. The vast majority of overuse injuries were found in the upper extremities, especially the elbows and fingers. These findings are consistent with the majority of studies in this field, revealing that an injury to the upper extremity was most prevalent (Bollen, 1988; Rooks, 1997; Paige et al., 1998). Rooks (1997) even suggested that within the general climbing population, three quarters of climbers will suffer from upper extremity injuries. However, a study by Neuof et al. (2011) discovered there was no significant difference between the amount of upper and lower extremity injuries. Although much research has focused on upper extremity injuries, lower extremity injuries are also relatively common. Therefore, future studies could look at the most common lower extremity injuries in climbing and how these have altered over the years.

In agreement with many previous studies (Bollen,1988; Logan et al., 2004; Neuof et al., 2011; Paige et al., 1998; Rohrbough et al., 2000 & Rooks, 1997) finger tendon injuries were the most common distinct injury. They accounted for nearly a quarter of all diagnosed injuries, with over half of these being identified as A2 pulley injuries. However, as some of these injuries were self-diagnosed by the climbers, there was no clear indication of whether these were full pulley ruptures, or merely just strains. Interestingly, the average age for the participants who had sustained an A2 pulley injury was 34 years old, whereas in a previous study by Logan et al. (2004), the average age of finger pulley injuries was 57. This may indicate that the average age of this new generation of climbers suffering from this injury is now significantly lower. Studies have found that the current average age range of climbers is similar to that of 20 years ago, typically ranging in the high 20's (Bollen, 1988; Paige et al., 1998) – this is lower than this current study. Therefore this may suggest that the increased intensity of training and climbing now associated with the sport has caused the development of injuries that were not prevalent 20 years ago in climbers in their thirties. In addition, an

increased risk of an early onset of osteoarthritis is likely in athletes who have suffered from these types of injuries.

5.3 Management of Injuries

Climbing injuries are quite distinct from other sports injuries, therefore often quite misunderstood or mistreated by medical professionals. In this study most participants, when injured, sought advice from fellow climbers or found recommendations on websites. Other studies found similar results with most reporting that advice was most frequently received from fellow climbers (Jones et al., 2008; Logan et al., 2004). A limited number of participants in this study sought their advice from medical professionals, and this is consistent with findings of Bollen (1988) and Jones et al. (2008). They discovered that very few climbers sought treatment or advice on their injuries and if they did, many did not ask medical professionals. As mentioned in previous studies (Jones et al., 2008; Logan et al., 2004), the reason behind why climbers don't seek advice from medical professionals remains unclear but maybe associated with the 'macho / no nonsense character of many climbers.

Most of the advice given to participants who sought advice from both medical professionals and non-medical persons was rest. A previous study supported these findings, with rest recorded as their most popular treatment method (Jebson & Steyers, 1997). Although massage was highlighted as another common treatment intervention, this may have been due to the fact one of the venues offered treatment with a massage therapist or physiotherapist. Strengthening training was considered 'trendy' and, less frequently used, although other studies have suggested specific range of movement and coordination exercises would be beneficial (Peters, 2001). Participants reported that they did not follow treatments given by medical professionals because they considered them to be too time consuming. Interestingly, the majority of the climbers who did follow professional advice, found it to be very effective, therefore demonstrating the climber education is needed. Furthermore, evidence now tends to indicate that the problems associated with effective management of injuries is due to a lack of engagement from the climbers to the prescribed treatment, rather than the effectiveness of the treatments given by medical professionals. Therefore perhaps instead of placing significant emphasis on the importance of one-off treatment advice, it would be more effective if more informal and regular interventions were more easily accessible to climbers. As

previously mentioned before, there is evidence of a shift towards this approach, with massage therapy now being seen within some climbing venues.

5.4 Preventative Strategies

Preventative strategies in the sport of rock climbing are almost more important than treatment itself. If climbers understand and follow these preventative measures, chronic overuse injuries can largely be prevented. The majority of injured climbers within the study reported they had used preventative strategies at least once in the past. Although this is a positive, only the climbers who had been injured in the last two years could answer this question. Therefore, this caused biased results as a large amount of participants were excluded. Most climbers received these preventative measures from fellow climbers and websites, with very few reaching out to medical professionals. As with treatment methods, effective preventative strategies are more likely to be provided by medical professionals, rather than ad-hoc suggested methods advised by fellow climbers. The most common and most effective measure reported was warm ups. Perhaps this is because ‘warm up areas’ have been introduced within indoor climbing zones, providing a positive reminder to climbers to warm up before taking to the wall. As expected and in agreement with Schweizer et al. (2005) and Wright et al. (2001), rest periods were another popular preventative strategy employed. A continuous emphasis on varying climbing technique has been evidential in studies at an increasing rate, and was identified as one of the most beneficial preventative strategies in this study.

The biggest development for climbing injury prevention has been ‘strength and conditioning’. In this study, conditioning was one of the popular strategies, and this finding is supported by previous studies (K. Phillips, 2012). There is a risk however that the climbers may not retain accurate knowledge of the specific preventative strategy and misuse it. As a consequence, a badly implemented preventative intervention can lead to a heightened risk of injury. Strength and conditioning coaches, with a full understanding of the demands and movement patterns specific to climbing, would be highly beneficial to ensure a balance workload.

The list of newly developed injuries previously mentioned, are easier to prevent than to cure (Rooks, 1997), therefore stressing that implementation of preventative measures is of critical benefit to climbers. A significant example is osteophytes or bony spurs which have been identified in some climbers, consequently, causing authors to be worried about the development of osteoarthritis amongst climbers (Paige et al., 1998). This study presented with only the one participant suffering from arthritis. However, a number of climbers complained of finger pain which had not yet been diagnosed. This indicates that correct early diagnosis of these finger injuries may prevent a climber later suffering from osteoarthritis.

5.5 Recommendations

The discussion about whether taping for climbers proves beneficial is still on-going. In agreement with Backe et al. (2009) and Warme and Brooks (2000) taping was not one of the most effective preventative measures reported by climbers in this study. A fairly new development in taping, known as Kinesio Tape (K Tape), could offer a new variation of this intervention technique. However, little to no research has been conducted with this product, specifically for the sport of climbing. Although an individual sport, climbing is constructed of a tight nit community of people who in most respects gather advice from each other. K Tape could present a very practical and effective new advancement in the climbing environment because climbers can easily apply it to each other. This would suit the time conscious nature of the rock climber. As K Tape has only grown in popularity over the last couple of years, future research is required to determine the effects and mechanisms of using K Tape solely on climbers for treatment or prevention.

The British Mountaineering Club now presents weekend meetings which allow professionals such as doctors, physiotherapists and national climbing coaches to discuss recent injury patterns, treatments and preventions. At some of these meetings recreational and elite climbers attend. Within the sessions, experts such as Volker Schöffl, give presentations and workshops on things like taping, climbing injury statistics, first aid and nutritional advice. Volker Schöffl is one of the leading experts of climbing related injuries in the world (Colton, 2010). There has been extremely positive feedback from those in the climbing community who have had the opportunity to attend these meetings. These symposiums are a huge step in the right direction. The first one took place only as recently as 2010, with subsequent ones

being organised every two years. Although a huge success, injury patterns can change significantly in two years with new interventions developing quickly, and therefore annual meetings might be more beneficial. During these meetings, medical professionals have discovered that climbers are highly motivated patients but require a different approach regarding the return to the sport. This issue was identified several times during this study, and is supported by findings from other studies. Symposiums lay emphasis on the fact that medical professionals have little awareness of treatment of climbing injuries. Nevertheless this is an encouraging start to acknowledging climbers' injuries and making information more widely available to both climbers and health professionals.

Further research however is needed to gather more evidence on pattern of injuries, risk factors, effectiveness of treatments and prevention strategies. More investigation into the psychology of the rock climber would also be beneficial in order to understand better why there is such a reluctance to seek professional diagnosis and treatment, and how to make information and treatment more attractive and accessible to the climbing community.

5.6 Limitations

The key limitations of this study were that questionnaires were only taken from three climbing venues. This meant that this study only accounted for only a small selection of the general climbing population. Therefore, whilst these results add to the body of knowledge provided by existing studies and provide more evidence regarding rates of climbing injuries and treatments, they cannot be considered as wholly representative.

Another limitation was that the injuries were not always clinically and professionally diagnosed as some participants diagnosed themselves or sought advice from medically untrained persons. Therefore, this may have caused biased results as participants may have described the injuries inaccurately, either exaggerating or underestimating the importance of symptoms and injuries.

The time frame of two years may have proven difficult for some participants, with regard to remembering the details of injuries from early in the period, resulting in inaccurate reporting of injuries. This could cause some unreliable data and invalidate the overall outcomes of the

findings. This problem could be addressed by undertaking say annual surveys over an extended period of two or three years.

CHAPTER VI

CONCLUSION

6.0 CONCLUSION

The aim of this study was to help establish whether further familiarization with injuries was needed amongst the climbing population and the health professionals and whether it's the general awareness or the treatment and prevention that need the advanced education or both.

The study outlined the potential risk factors associated with climbing. The higher risk categories included elite climbers, climbing experience of over ten years and a high training schedule. Elite climbers are driven individuals, pushing themselves to the limit, which applies added stress on their bodies, triggering potential injuries. Time away from training or competition is tough for any athlete and particularly for climbers who are reluctant to reduce their training hours, resulting in very little time for recovery, followed by unmanageable injuries. Long term climbing practice links with muscle fatigue and worn out joints. In addition, in the earlier years of that climbing experience, (over 10 years ago), there was limited knowledge of injuries which would have resulted in misdiagnosis, ineffective treatment and virtually no prevention. Combining different styles of climbing within training has shown some positive effects as each style has its unique movement pattern and stresses on the body. This variety appears beneficial as these stressors can be limited and controlled which results in a change in the injury pattern. Bouldering has been identified to be a prime factor in the occurrence of overuse injuries.

Climbers are more at risk of suffering from an overuse injury compared with a traumatic injury. Furthermore, the overuse injuries occurred mostly in the upper extremities. Due to the repetitive nature of the sport with constant pulling movements involving the fingers, shoulders and elbows, a change in upper extremity overuse injuries is doubtful. More specifically climbers are likely to suffer from an injury to the finger tendons known as A2 pulley injury. Again, this injury will always be prominent in climbing because of the constant stress placed on the finger in hand positions such as crimp grips. An increased area of concern is the seemingly lower average age range of climbers suffering with this injury. In this study, the average age is 20 years lower than shown in previous studies. Therefore in order to prevent early occurrence of this type of injury, measures need to be put in place to provide better awareness of risks, offer prevention strategies and effective treatments.

Most participants admitted to seek advice from fellow climbers. Although there may be some benefit to be gained from fellow climbers' experience of injury, the medical professionals will always hold a more in depth understanding of injuries and their treatment. Treatment methods such as rest, massage and strengthening were most popular in this study. Indoor climbing venues providing massage therapy facilities may be a factor in the increased use of this practice. Although we can put emphasis on treatments, the overall change in rates of injuries will primarily come from preventative strategies. Strength and conditioning for climbers has been gradually reviewed and with the right coaching can help prevent most of these upper extremity injuries. Taping has always been popular with climbers, however the recent development of K Tape may prove more effective. Warms ups and varying climbing techniques are also key areas medical professionals need to explore more.

The participants reported that treatments given by medical professionals were very effective which indicates that it is the attitude of the climber that needs to change. A common topic in previous studies has been whether the attitude of the climbers regarding rehabilitation will positively change when medical professionals become more knowledgeable of climbing injuries and more involved with the sport. There is already a development regarding this as meetings, also known as symposiums, are being held every two years, giving climbers and medical professionals the chance to discuss injuries, treatment and prevention.

A change in the rates and types of climbing injuries will not happen overnight. A gradual change in attitude is needed. Better awareness will be achieved with new interventions emerging. These yearly symposiums with medical professionals and climbers are vital and should become more regular at various climbing venues around the country. Developing a greater understanding for the reasons behind why climbers have this attitude towards treatment will help advance to more attractive and accessible treatment for climbers. Therefore, future research looking primarily into the psychology of a rock climber is warranted. There is potential for great improvement with further research which will feed into strategies for better awareness, prevention, treatment and ultimately reduction of injuries.

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APPENDICES

APPENDIX A

FINAL QUESTIONNAIRE

Indoor sports climbing injuries: trends in prevention and treatment

Participant number: ☐☐☐

My name is Joni Warner and I am a Sports Rehabilitation student at Cardiff Metropolitan University conducting a study into injuries sustained at indoor climbing walls. The information gained will improve the understanding of preventing and managing both gradual and sudden onset climbing injuries.

If you are under 18 years of age or started climbing less than two years ago you cannot take part in this study.

Background Information
The aim of the study is to provide physical educators, health professionals and climbers with better knowledge of the prevalent injuries sustained in indoor climbing and the trends in their treatment and prevention.

The benefits of the study:
Climbers such as you, physical educators and other health professionals will gain a better understanding of injury rates and risk factors. The findings can then be applied to improve climbing injury prevention and treatment strategies.

Your role as the participant:
You will be asked to fill out a questionnaire about injuries you have had in the past and how you went about treating or preventing them. The questionnaire should take no longer than 5-10 minutes. There are no serious risks involved in taking part in this study. However if a question makes you feel uncomfortable and may affect you psychologically, you may refuse to answer it.

Your rights as the participant:
It is your right to withdraw anytime during this study. Please ensure that the researcher is aware that you have withdrawn from the study.

Your protection to privacy:
All information collected will remain anonymous. A participant consent form is not included in this study, however you must be made aware that completion of the questionnaire implies consent to participate in this study. The statement written below explains the protection to privacy consent. (Data Protection Act 1998)

I consent to the processing of my personal information for the purposes of this research study. I understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.2

Name: ..... **Sign here**: ..... **Date:** ( )/( )/( )

Thank you for agreeing to complete the questionnaire below:

General Information

Male ☐ Female ☐ Height: .....m Weight: .....Kg

Age: ..... years D.O.B: ( )/( )/( )

Climbing Background

How long have you been rock climbing? .....years .....months

How often do you climb on an indoor climbing wall *(Requiring the use of a rope)* /bouldering wall *(short wall with soft landing area, not requiring the use of a rope)*?

Climbing wall: ……times/week ……times/month …….times/year

Bouldering wall: ……times/week ……times/month …….times/year

How often do you climb outdoors?

.... times/week .... times/month ....times/year

What is your current grade on the climbing wall *(Requiring the use of a rope)*? *(using French grading system*)

Not known ☐ Up to 5a ☐ 5a-5c ☐ 6a-6c ☐ 7a and above☐

What is your current grade on bouldering wall *(short wall with soft landing area, not requiring the use of a rope)*? *(using Fontainbleau grading system*)

Not known ☐ Up to fb5a ☐ fb5a-5c ☐ fb6a-6c ☐ fb7a and above☐

What is your dominant arm?

Left ☐ Right ☐ Ambidextrous (No dominant side) ☐

What is your dominant leg?

Left ☐ Right ☐ Ambidextrous (No dominant side) ☐

In the last 2 years *(Nov 2011- Nov 2013)*, have you sustained an injury whilst using an indoor climbing (leading/roped) wall/bouldering wall?

Yes ☐ No ☐

*If **'YES'**, please continue to Q1. If **'NO'**, then you do not need to complete the rest of the questionnaire.*

Q1) In the last 2-years have you sustained any trauma *(sudden)* injuries (e.g. Broken arm, knee or ankle ligament sprain) whilst indoor climbing?

Yes ☐ No ☐

If **'NO'**, Go straight to **(Q3)**

If **'YES'**, in which part of the body did it/they occur? *(Please put a number in the box(es) that indicate the number of times you've had an injury in that body part)*

Fingers ☐ Wrist ☐ Forearm ☐ Elbow ☐ Shoulder ☐ Foot ☐ Neck ☐ Knee ☐

Other ☐ *(please specify)*.....

Q2) What was the diagnosis for these injuries? *(Please state only your 3 most severe injuries i.e. those that resulted in the most amount of days when you weren't able to climb, or had to modify your climbing)*

1)
2)
3)

Q3) Did you sustain any overuse *(gradual onset)* injuries (e.g. Tennis Elbow)?

Yes ☐ No ☐

If **'NO',** Go straight to **(Q5).**

If **'YES',** in which part of the body did it/they occur? *(Please put a number in the box(es) that indicate the number of times you've had an injury in that body part)*

Fingers ☐ Wrist ☐ Forearm ☐ Elbow ☐ Shoulder ☐ Foot ☐ Neck ☐ Knee ☐

Other ☐ *(please specify)*.....

Q4) What was the diagnosis for these injuries? *(Please state only your 3 most severe injuries i.e. those that resulted in the most amount of days when you weren't able to climb, or had to modify your climbing)*

1)
2)
3)

In respect to your most severe injury *(the injury that resulted in the most amount of days that you weren't able to climb)*:

Q5) Where did it occur? on the climbing(leading/roped) wall ☐ on the bouldering wall ☐

Q6) When did this injury occur?

0-6 months ago ☐ 7-12 months ago ☐ 1-2 years ago ☐

Q7) Was the injury significant/severe enough to cause you to immediately stop climbing?

Yes ☐ No ☐

Q8) For how many days were you unable to participate in indoor climbing activities? *(Tick one box only)*

0 ☐ 1-7 ☐ 8-21 ☐ 22-35 ☐ 36-70 ☐ >70 ☐

I kept Training/competing ☐ Injury is on-going ☐

Q9) Did you seek medical advice/treatment? Yes ☐ No ☐

If 'YES' continue to (Q10). If 'NO' go to (Q16)

(Q10) How long after the injury did you go and seek medical advice/ treatment? *(Please tick one box only)*

The same day ☐ 1 day later ☐ 2-3 days later ☐ 4-7 days later ☐ 8-21 days later ☐ >21 days later ☐

Q11) Which of the following professionals did you seek medical advice/treatment from? *(Please tick all that apply...)*

Emergency room (A&E) ☐ GP/Doctor ☐ Physiotherapist (NHS or Private) ☐

Sports Massage Practitioner☐ Chiropractor ☐ Osteopath ☐

Other☐ *(please specify)……..*

Q12) <u>How was the diagnosis made?</u>

Physical Examination ☐ X-ray☐ MRI ☐ Ultrasound ☐ Other☐ *(please specify)……..*

Q13) <u>What was the diagnosis?</u> (e.g. Tennis Elbow -Lateral Epicondylitis)

……
……..

Q14) <u>What was the recommended treatment?</u> *(Please tick all that apply…)*

None ☐ Medication ☐ Rest ☐ Reduced training ☐ Ice ☐ Heat ☐ Taping ☐

Contrast (Ice and heat) ☐ Manipulation/massage ☐ Surgery☐ Splinting ☐ Specific

Training/Strengthening exercises ☐ Injection ☐*(Please specify type)……..*

Other *(Please specify)……..*

Q15) <u>Did you follow the treatment given?</u> Yes ☐ No ☐

<u>If **'YES'** Was it effective?</u> Very effective ☐ Somewhat effective ☐ Not at all effective ☐

<u>If **'NO'**, why did you not?</u> Too time consuming ☐ too expensive ☐ didn't believe in it ☐

Other ☐ *(please specify)……*

If you <u>DID</u> seek professional help, go to (Q20)

Q16) <u>If you DID NOT seek professional help, where did you seek advice?</u>

Fellow climbers☐ Magazines/books ☐ Websites ☐ I didn't seek advice ☐ other ☐ *(please specify)…….*

Q17) Were you able to identify the injury? Yes ☐ No ☐

If **'YES'**, what was the injury?.....

Q18) What measures *(treatment)* did you take? *(Please tick all that apply…)*

None ☐ Medication ☐ Rest ☐ Reduced training ☐ Modified training ☐

Ice ☐ Heat ☐ Contrast (Ice and heat) ☐ Taping ☐ Massage ☐

Splinting ☐ Training/Strengthening exercises ☐ Injection ☐(*Please specify type)*.....

Other *(Please specify)*.....

Q19) Were these measures *(treatments)* effective? Yes ☐ No ☐

If **'YES'** Was it effective? Very effective ☐ Somewhat effective ☐ Not at all effective ☐

Q20) In the last 2 years *(Nov 2011-Nov 2013),* have you utilised any climbing injury prevention strategies? (E.g. warm up, Rest or taping etc)

Yes ☐ No ☐

If 'YES' continue to (Q21). If 'NO', continue to (Q24).

Q21) Where have you been seeking prevention advice? *(Please tick all that apply…)*

GP☐ Physiotherapist☐ Osteopath ☐ Chiropractor ☐ Fellow climbers ☐

Websites ☐ Magazines/books ☐ Other ☐ *(please specify)*……

Q22) What preventative measures have you taken? *(Please tick all that apply…)*

Conditioning ☐ Warm up ☐ Cool down ☐ Massage ☐ Resting periods ☐

Taping ☐ Varying climbing techniques ☐ Nutritional supplements ☐

Q23) <u>Which measures have been the most effective?</u>

(Please state).....
.....

Q24) <u>If you listed more than one injury in question two please complete the following sections for each additional injury.</u>

If you have only had one injury then you do not have to fill in the rest of the questionnaire and thank you for taking part.

<u>In respect to your second most severe injury</u> *<u>(the injury that resulted in the second highest number of days that you weren't able to climb)</u>*<u>:</u>

Q5) <u>Where did it occur?</u> on the climbing(leading/roped) wall ☐ on the bouldering wall ☐

Q6) <u>When did this injury occur?</u>

0-6 months ago ☐ 7-12 months ago ☐ 1-2 years ago ☐

Q7) <u>Was the injury significant/severe enough to cause you to immediately stop climbing?</u>

Yes ☐ No ☐

Q8) <u>For how many days were you unable to participate in indoor climbing activities?</u> *<u>(Tick one box only)</u>*

0 ☐ 1-7 ☐ 8-21 ☐ 22-35 ☐ 36-70 ☐ >70 ☐

I kept Training/competing ☐ Injury is on-going ☐

Q9) <u>Did you seek medical advice/treatment?</u> Yes ☐ No ☐

If 'YES' continue to (Q10). If 'NO' go to (Q16)

(Q10) How long after the injury did you go and seek medical advice/ treatment? *(Please tick one box only)*

The same day ☐ 1 day later ☐ 2-3 days later ☐ 4-7 days later ☐ 8-21 days later ☐ >21 days later ☐

Q11) Which of the following professionals did you seek medical advice/treatment from? *(Please tick all that apply...)*

Emergency room (A&E) ☐ GP/Doctor ☐ Physiotherapist (NHS or Private) ☐

Sports Massage Practitioner ☐ Chiropractor ☐ Osteopath ☐

Other ☐ *(please specify)……*

Q12) How was the diagnosis made?

Physical Examination ☐ X-ray ☐ MRI ☐ Ultrasound ☐ Other ☐ *(please specify)……*

Q13) What was the diagnosis? (e.g. Tennis Elbow -Lateral Epicondylitis)

……
.....

Q14) What was the recommended treatment? *(Please tick all that apply…)*

None ☐ Medication ☐ Rest ☐ Reduced training ☐ Ice ☐ Heat ☐ Taping ☐

Contrast (Ice and heat) ☐ Manipulation/massage ☐ Surgery ☐ Splinting ☐ Specific

Training/Strengthening exercises ☐ Injection ☐ *(Please specify type).....*

Other *(Please specify).....*

Q15) Did you follow the treatment given? Yes ☐ No ☐

If **'YES'** Was it effective? Very effective ☐ Somewhat effective ☐ Not at all effective ☐

If **'NO'**, why did you not? Too time consuming ☐ too expensive ☐ didn't believe in it ☐ Other *(please specify)……*

If you DID seek professional help, go to (Q20)

Q16) If you DID NOT seek professional help, where did you seek advice?

Fellow climbers☐ Magazines/books ☐ Websites ☐ I didn't seek advice ☐ other ☐ *(please specify)……*

Q17) Were you able to identify the injury? Yes ☐ No ☐

If **'YES'**, what was the injury?.....

Q18) What measures *(treatment)* did you take? *(Please tick all that apply…)*

None ☐ Medication ☐ Rest ☐ Reduced training ☐ Modified training ☐

Ice ☐ Heat ☐ Contrast (Ice and heat) ☐ Taping ☐ Massage ☐

Splinting ☐ Training/Strengthening exercises ☐ Injection ☐(*Please specify type)*.....

Other *(Please specify)*.....

Q19) Were these measures *(treatments)* effective? Yes ☐ No ☐

If **'YES'** Was it effective? Very effective ☐ Somewhat effective ☐ Not at all effective ☐

Q20) If you have another additional injury, please complete the following section of the questionnaire.

If you have no more additional injuries you do not have to fill in the rest of the questionnaire and thank you for taking part.

In respect to your third most severe injury *(the injury that resulted in the third highest number of days that you weren't able to climb)*:

Q5) Where did it occur? on the climbing(leading/roped) wall ☐ on the bouldering wall ☐

Q6) When did this injury occur?

0-6 months ago ☐ 7-12 months ago ☐ 1-2 years ago ☐

Q7) Was the injury significant/severe enough to cause you to immediately stop climbing?

Yes ☐ No ☐

Q8) For how many days were you unable to participate in indoor climbing activities? *(Tick one box only)*

0 ☐ 1-7 ☐ 8-21 ☐ 22-35 ☐ 36-70 ☐ >70 ☐

I kept Training/competing ☐ Injury is on-going ☐

Q9) Did you seek medical advice/treatment? Yes ☐ No ☐

If 'YES' continue to (Q10). If 'NO' go to (Q16)

(Q10) How long after the injury did you go and seek medical advice/ treatment? *(Please tick one box only)*

The same day ☐ 1 day later ☐ 2-3 days later ☐ 4-7 days later ☐ 8-21 days later ☐ >21 days later ☐

Q11) Which of the following professionals did you seek medical advice/treatment from? *(Please tick all that apply...)*

Emergency room (A&E) ☐ GP/Doctor ☐ Physiotherapist (NHS or Private) ☐

Sports Massage Practitioner ☐ Chiropractor ☐ Osteopath ☐

Other ☐ *(please specify)*.....

Q12) How was the diagnosis made?

Physical Examination ☐ X-ray☐ MRI ☐ Ultrasound ☐ Other☐ *(please specify)……..*

Q13) <u>What was the diagnosis?</u> (e.g. Tennis Elbow -Lateral Epicondylitis)

……
.....

Q14) <u>What was the recommended treatment?</u> *(Please tick all that apply…)*

None ☐ Medication ☐ Rest ☐ Reduced training ☐ Ice ☐ Heat ☐ Taping ☐

Contrast (Ice and heat) ☐ Manipulation/massage ☐ Surgery☐ Splinting ☐ Specific

Training/Strengthening exercises ☐ Injection ☐*(Please specify type)*.....

Other *(Please specify)*.....

Q15) <u>Did you follow the treatment given?</u> Yes ☐ No ☐

<u>If **'YES'** Was it effective?</u> Very effective ☐ Somewhat effective ☐ Not at all effective ☐

<u>If **'NO'**, why did you not?</u> Too time consuming ☐ too expensive ☐ didn't believe in it ☐ Other *(please specify)……*

If you <u>DID</u> seek professional help, you do not have to fill in the rest of the questionnaire and thank you for taking part.

Q16) <u>If you DID NOT seek professional help, where did you seek advice?</u>

Fellow climbers☐ Magazines/books ☐ Websites ☐ I didn't seek advice ☐ other ☐ *(please specify)……..*

Q17) <u>Were you able to identify the injury?</u> Yes ☐ No ☐

<u>If **'YES'**, what was the injury?</u>.....

Q18) <u>What measures *(treatment)* did you take?</u> *(Please tick all that apply…)*

None ☐ Medication ☐ Rest ☐ Reduced training ☐ Modified training ☐

Ice ☐ Heat ☐ Contrast (Ice and heat) ☐ Taping ☐ Massage ☐

Splinting ☐ Training/Strengthening exercises ☐ Injection ☐(*Please specify type)*.....

Other *(Please specify)*.....

Q19) <u>Were these measures *(treatments)* effective?</u> Yes ☐ No ☐

<u>If **'YES'** Was it effective?</u> Very effective ☐ Somewhat effective ☐ Not at all effective ☐

Thank you for taking part in this study on indoor sports climbing injuries, treatments and preventions.

APPENDIX B

PILOTED QUESTIONNAIRE

Rock Climbing Injuries in Indoor Venues

I am a Sports Rehabilitation student at Cardiff Metropolitan University conducting a study into injuries sustained at indoor climbing walls and the current trend in preventing and treating those injuries. This will include traumatic and overuse injuries.

I would be very grateful if you could complete the questionnaire below:

General Information

Initials: …… Sex: male ☐ female ☐

Age: …….. years D.O.B: ( )/( )/( )

Climbing Background

How long have you been rock climbing? ……..years

How often do you climb on an indoor climbing wall/bouldering wall?

Climbing wall: ……times/week ……times/month …….times/year

Bouldering wall: ……times/week ……times/month …….times/year

What is your current grade on bouldering wall?:

Up to 5a ☐ 5a-5c ☐ 6a-6c ☐ 7a and above ☐

What is your current grade on the climbing wall?:

Up to 5a ☐ 5a-5c ☐ 6a-6c ☐ 7a and above ☐

In the last 2 years *(Nov 2011- Nov 2013)*, have you sustained an injury due to indoor climbing?

Yes ☐ No ☐

*If **'YES'**, please continue to Q1. If **'NO'**, then you do not need to complete the rest of the questionnaire.*

Q1) Did you sustain any trauma *(sudden)* injuries?

Yes ☐ (*please specify*)…….. No ☐

If **'YES'**, in which part of the body did they occur? *(Please tick all that apply…)*

Fingers ☐ Wrist ☐ Forearm☐ Elbow ☐ shoulder☐ Foot ☐ Neck☐ Knee☐

Other☐ *(please specify)……*

Q2) Did you sustain any overuse *(on-going/worn)* injuries?

Yes ☐ (*please specify)……..* No ☐

If **'YES'**, in which part of the body did they occur? *(Please tick all that apply…)*

Fingers ☐ Wrist ☐ Forearm☐ Elbow ☐ shoulder☐ Foot ☐ Neck☐ Knee☐

Other☐ *(please specify)……*

In respect to your most recent injury:

Q3) Where did it occur? on the climbing wall ☐ on the bouldering wall ☐

Q4) Did you seek medical advice/treatment? Yes ☐ No ☐

If 'YES' continue to (Q5). If 'NO' go to (Q10)

Q5) Which of the following professionals did you seek medical advice/treatment from?

GP ☐ Physiotherapist ☐ Chiropractor ☐ Osteopath ☐

Emergency room ☐ Other☐ *(please specify)……..*

Q6) How was the diagnosis made? Examination ☐ X-ray☐ MRI ☐ Other☐ *(please specify)……..*

Q7) What was the diagnosis *(outcome)*?

……

Q8) What was the recommended treatment? *(Please tick all that apply…)*

None ☐ Medication ☐ Rest ☐ Reduced training ☐ Ice ☐ Heat ☐ Taping ☐

Contrast (Ice and heat) ☐ Manipulation/massage ☐ Surgery ☐ Splinting ☐

Q9) Did you follow the treatment given? Yes ☐ No ☐ If **'YES'** Was it effective? Yes ☐ No ☐
If **'NO'**, why did you not?

Too time consuming ☐ too expensive ☐ don't believe in it ☐ Other *(please specify)*……

If you DID seek professional help, go to (Q14)

Q10) If you **DID NOT** seek professional help, where did you seek advice?

Fellow climbers ☐ Magazines/books ☐ Websites ☐ I didn't seek advice ☐ other ☐ *(please specify)*…….

Q11) Were you able to identify the injury? Yes ☐ No ☐

If **'YES'**, what was the injury?.....

Q12) What measures *(treatment)* did you take? *(Please tick all that apply…)*

None ☐ Medication ☐ Rest ☐ Reduced training ☐ modified training ☐

Ice ☐ Heat ☐ Taping ☐ Contrast (Ice and heat) ☐ massage ☐ Splinting ☐

Q13) Were these measures *(treatments)* effective? Yes ☐ No ☐

Q14) In the last **2 years *(Nov 2011-Nov 2013)***, have you been using prevention to avoid injury?

Yes ☐ No ☐

If 'YES' continue to (Q15). If 'NO', then you do not need to complete the rest of the questionnaire.

Q15) Where have you been seeking prevention advice? *(Please tick all that apply…)*

GP☐ Physiotherapist☐ Osteopath ☐ Chiropractor ☐ Fellow climbers ☐

Websites ☐ Magazines/books ☐ Other ☐ *(please specify)……*

Q16) What preventative measures have you taken? *(Please tick all that apply…)*

Conditioning ☐ Warm up ☐ Cool down ☐ Massage ☐ Resting periods ☐

Taping ☐ Varying climbing techniques ☐ Nutritional supplements ☐

Q17) Which measures have been the most effective?

(Please state).....
……..

I consent to the processing of my personal information for the purposes of this research study. I understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.2

Thank you for taking part in this study on indoor sports climbing injuries, treatments and preventions.

APPENDIX C

ETHICS STATUS

Cardiff Metropolitan University
Prifysgol Fetropolitan Caerdydd
UWIC

Date: 18/03/14

To: Joni Warner

Project reference number: 13/05/390U

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

Dr Craig Ranson
Supervisor

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