The Epidemiology and Frequency of Rock Climbing Injuries.

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Abstract

Aim: To determine how frequent rock climbing injuries occur and what the lead cause of these injuries is.

Method: Surveys were sent to the climbing community via the New Zealand Alpine Club and New Zealand Association of Outdoor Instructors. These connections resulted in receiving 56 completed surveys through the website SurveyMonkey. We wanted to get a clear understanding of what injuries occurred and therefore asked how many days were made absent from climbing as a result of an injury.

Results: 78.54% of climbers having received an injury in the past 12 months which resulted in anywhere from 1 to over 100 days away from climbing. A total of 42 climbers (75%) indicated they had received an injury from falling, 38 climbers (67.86%) indicated they had received an injury from chronic overuse and 36 climbers (64.29%) had received an injury as a result of strenuous or challenging moves. It is understood that the higher your level of climber and the more you climb had a direct correlation with a higher chance of injury particularly overuse injuries in the wrists, elbows and fingers. The main source of treatment came from physios with 56.76% or injured climbers visiting a physio, followed by 51.35% sourcing advice from fellow climbers and finally 37.84% attending a General Practitioner consult.

Conclusion:

There is a correlation between a higher rate of climbing and more chance of injury. Trauma to the upper extremities is the most present so perhaps people spending more time on warming up and being aware of what they are doing may result in less injuries or at least less serious injuries.
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Finally I would like to thank my family and friends for their ongoing support with my studies and dealing with me being a miserable student for three years. This support will be forever appreciated
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Chapter I - Introduction

Introduction of organisation and relevance of research:

The organisation I am working through is Adventure Southland and they are an adventure based company working out of Southland. One of their major sources of work is their high ropes course and climbing facility. Therefore, my idea to conduct research into climbing injuries and how to prevent them is an idea which was welcomed by open arms from the company. Also because the instructors enjoy personal climbing they have said that where possible they would be more than welcome to assist me where necessary.

Hypothesis

I believe that there will be a direct correlation between strenuous movements and finger injuries. It will also be likely that the more someone climbs, the more likely they are to receive an injury as the will be taking more risks.

Aims and objectives of Project:

As mentioned the aim of my project was to conduct research into why climbing injuries occur, what are these common injuries and finally methods in which these injuries can be prevented. This will in turn mean that my work with climbing groups can greatly be enhanced as I will be able to teach them safe climbing techniques so that their climbs will have a lower chance of injury occurrences. I will also aim to have my research distributed amongst the New Zealand climbing community so that other climbers within the country will be able to benefit from my research and I will then know that I have made a difference.
**Background and Significance of project to organisation:**

As climbing is considered an extreme sport and one that not a lot of people regularly participate in, it is of no surprise that there is not a lot of information or research that has been undertaken in the sport. However, the research that I have been able to unearth is incredibly relevant so apparently I am not the only one who is interested in climbing injuries. The research is relevant as it covers exactly what I wish to research myself so I also know that it is something that will be received well by my pairs and the community.

It is known within the climbing community that most injuries occur in finger pulleys however there are obviously other injuries hence wearing protection like a helmet or even a harness (which is all but necessary). So as I have also mentioned the benefits and significance to my organisation is incredibly apparent with a lot of their contracts being climbing related. Also with staff being interested in climbing outside of work, any potential methods to prevent injury will be welcomed as injury within this job can result in not being able to work and loss of income which no one wants. This will also be beneficial for any advanced clients who may be concerned about potential for injuries.

Unfortunately due to the specialist nature of rock climbing there was not an abundance of literature available for me to review. However I hope that in the future this will not be the case for those that choose to also do research in rock climbing or more specifically injuries received from climbing.
Chapter II – Review of Related Literature

Literature Review:

Unfortunately for me, in regards to my research topic there is not an abundant amount of previous research as climbing is considered an extreme sport so there is not remotely anywhere near as many participants as sports like football, rugby, cricket and so on have. However, in saying that, the relatively small amount of previous research I have found has shocked me as it is so relevant to the research I will be undertaking so therefore I am able to use these previous studies as an excellent guideline and comparative tool for my own research project.

The first article which I found was sourced from the British Journal of Sports Medicine which is a well-known and highly respected journal in which you can have your work published in. The articles title is The Epidemiology of Rock-Climbing Injuries and is a research project into the injuries which are sustained while climbing and whom these injuries occur most in (Jones, 2008). This study was a retrospective cross-sectional study and had 201 participants who returned their surveys (205 were sent out). The range of participants in this study ranged from 16-62 and the author does make a mention that in hindsight they should have included people who don’t climb any longer rather than just current climbers as they may not be climbing due to injuries which they received from a climbing incident. Of the 201 participants, 163 were male and 38 were female (Jones, 2008). Statistics like these really emphasise the ideas that sports such as climbing truly do remain a male dominated sport, this is something I too expect to see in my research so a similar percentage of men to women could be expected. Climbers were asked to indicate injuries they had received and also what sort of climbing that they did in the past 12 months, this was vital in working out if there is a more common trend of injuries depending on what climbing you are doing. The author of this
article found that of the 201 climbers, 101 of them had sustained at least 1 injury in the past 12 months which resulted in a total of 275 anatomical injuries (Jones, 2008). Of these however only 4 climbers reported fractures to their extremities and no concussions were reported, however injuries to the fingers and shoulders were the most common injuries that were reported (Jones, 2008). The author also mentioned that of these injured climbers only 76 sought out treatment or advice in relation to their injuries (Jones, 2008). The author then talks about how it was found that more dedicated climbers whom were operating at a higher level were most at risk of overuse injuries (Jones, 2008). It is also mentioned that there is a wide range of factors which can influence whether a climber falls and if this fall results in an injury, however the author does make a mention that they did not find that a riskier form of climbing may predict injury occurrences (Jones, 2008). The article finishes by mentioning that educating climbers to prevent injuries would be the best intervention method, which is important to me as this covers an aspect of my research so it is fantastic to read that internationally people are interested in preventative methods for climbing injuries (Jones, 2008).

The next article which I reviewed is titled Risk factors for injury in sport climbing and bouldering: a systematic review of the literature written by Kaikanani Y Woolings, Carly D McKay and Carolyn A Emery (Woolings, 2015). This article as the title would suggest is a review of a number of different studies which have been conducted over the years. Their objective was to examine risk factors for injury in sport climbing and bouldering, they did this by searching 12 electronic databases using predetermined inclusion and exclusion factors (Woolings, 2015). 35 possible risk factors were identified as well as potential intervention methods, however results regarding this prevention methods remain inconclusive (Woolings, 2015). These authors
also mention the fact that it is a relatively new field of study with not as much data as other high profile sports with a larger research foundation. It is mentioned that previous studies including primarily an adult population suggest the upper extremity overuse injuries and pulley strains in the fingers were the most common injuries found in climbers across varying disciplines (Woolings, 2015). It is also said that by identifying potentially modifiable risk factors for these injuries could have a possibility to develop prevention strategies (Woolings, 2015). Abstracts and titles from the database search were screened for inclusion and any duplicates were removed, 49 articles were reviewed with only 19 being included (Woolings, 2015). With bouldering and sport climbing being the focus of this study it would have been ideal if the studies said they included these disciplines however most of them did not specify what discipline of climbing was included but it was likely that bouldering or sport climbing were included (Woolings, 2015). Some identified intrinsic risk factors included sex, age, years of experience, skill level, Body Mass Index, Body Weight and grip strength. Extrinsic risk factors included lead climbing, top rope climbing, and volume of climbing and outdoor verses indoor climbing (Woolings, 2015). This is all of importance to my research as a lot of these factors are covered in questions found in my survey. The authors talk about how self-reported warming up were investigated in 3 studies and there was no reported significant difference in injury within the groups (Woolings, 2015). There is also mentioned that some studies investigated yoga and if it benefited injury prevention, how much like warming up there was no significant difference, also prevention was not present when there was more spotters, mats or other safeties put in place (Woolings, 2015). The only measures which showed some hope in preventing injuries were taping wrists and fingers and weight training, this again is important in relation to my research so will be a crucial start point when I begin to develop my own methods (Woolings, 2015). This also covers a section of the article where the authors suggest that potentially
lacking muscular strength can result in a higher frequency of musculoskeletal injuries (Woolings, 2015). They also mention that the majority of studies were retrospective surveys which are subject to biases associated with cross-sectional studies, this could subsequently be a limiting factor to my own research (Woolings, 2015). They finish by saying research into previous injuries should also be conducted as it has been proven that previous injury can be a predictor for injury in other sports, climbing technique is something else which should be covered as poor technique can result in a lot of injuries (Woolings, 2015). Being able to further develop these preventative methods will reduce strain on healthcare providers and will also help in awareness throughout the climbing community as participants will be able to help each other in preventing injuries.

The next form of literature I reviewed was a web page that discusses the issues surrounding finger injuries which are well known to be one of the most common injuries in the world of climbing. The web page titled Finger fixes which was written by Amanda Fox solely aims at discussing finger injuries and how they are treated. She opens by saying “What climbers fear most isn’t heights, falls or mangled toes-it’s finger injuries” (Fox, 2012). This is a very powerful statement as for anyone who climbs seriously they know how detrimental a finger injury can be. The author then goes onto describe the three most common finger injuries that a climber will receive; A2 pulley strain or rupture, flexor tendon tear or a collateral ligament strain (Fox, 2012).

The most common of the three injuries is the A2 pulley injury, the pulley consists of bands of fibres that hold tendons to the bone which are located between the base of the finger and the middle knuckle. Generally, occurs when a foot slips and unexpected force is put on the hand, a climber will usually hear a pop and feel pain which will be followed by swelling and possibly bruising. This is the least
serious of the three injuries and usually won’t affect your strength, it will also not require surgery but climbers will most likely need to strap the injured finger for the rest of their climbing life (Fox, 2012).

The next injury is a flexor tendon tear, tendons which run from the inside of the elbow, down the forearm and join the fingers (beneath the pulleys). Tendons, as we know connect muscles to bone and this tendon is particular allows you to bend your hand and flex your fingers. An injury to this tendon will generally result in pain being felt between the palm and wrist. If a complete rupture occurs, surgery is necessary as it will not heal on its own (Fox, 2012).

The third injury is in the collateral ligaments; these ligaments surround each finger joint. This injury usually occurs when a sideways loading is exerted on the finger, pain will be felt at the side of the joint- most commonly the middle joint of the middle finger. Again, of severe enough this injury will require a corrective surgery (Fox, 2012).

After the injury occurs, cease climbing immediately and if you can’t see a doctor right away it is recommended that you assess your injury over the next few days. Also ice baths and some range-of-motion exercises are recommended. Icing is crucial in the first 72 hours and should be continued as long as there is pain associated with movement. If there is immediate bruising or if the joint feels unstable you should see a doctor right away however if no bruising occurs but there is no improvement after a week of icing you should also seek medical advice. Generally, an MRI or ultrasound of the affected area will be conducted to assess the injury and a treatment plan will be put in place. Recovery times are generally four to six weeks and once healed an easy approach back into climbing is recommended through the use of big holds, easy routes and stopping if pain continues (Fox, 2012).
The next article is a web page Finger Tendon Pulley Injury which was written by Nicros but references Training for Climbing, a book written by Eric J. Horst. This page only covers this one specific injury so it is in a lot of detail (Nicros, 2008). The author opens by saying “considering the incredible mechanical loading we place on our fingers when climbing, it should be no surprise that they are a most common site of injury” (Nicros, 2008). Climbers see one injured finger as a small injury as they have nine more healthy fingers however continued climbing with an injured finger can increase the severity of the injury resulting in more time needed to recover. As there are no muscles in the fingers, flexion of the fingers and wrist is produced by the muscles in the forearm that originate from the medial elbow and terminate via tendons which attach to the middle knuckle and end of each finger. The flexor tendon and sheath are held to the bone by five annular (A) pulleys which act like a brake. (see diagram below)

As the title would suggest there is in depth information on finger tendon pulley injuries. In most cases only a partial tear will occur however in some cases one or more pulleys may completely rupture resulting in visible bowstringing (deformity) of the finger, it is generally an injury which can only be confirmed through an MRI scan (Nicros, 2008).

The A2 pulley is the most commonly injured as when performing a crimp grip there is near ninety-degree flexion of the middle joint in the finger which puts a tremendous load on this pulley. Injuries of the
A2 pulley can range from a microscopic tear through to a complete rupture, a small tear can be quite insidious as it will develop through regular climbing, some climbers may also hear a pop like sound when climbing which can be an indication of a serious tear or rupture. Depending on severity, pain and swelling at the base of the finger can range from only slight to so bad that everyday tasks such as writing cannot be undertaken. A small tear may show no symptoms at rest but may cause pain when pressing on the base of the fingers or during an isometric contraction (Nicros, 2008).

Treatment of an injury like this begins by the cessation of climbing so that healing may begin. Control of inflammation is the first step so anti-inflammatory medication and icing is crucial. Buddy taping of the finger can be great for support and naturally you should avoid stressful finger training for healing to continue. However, some exercises are good to aid in healing such as pull ups, wrist curls and hand strength tools. Pain will typically subside in two to ten weeks but it is recommended to wait a further two weeks after you become pain free before you start climbing again. A slow return to climbing is recommended so that you do not further injury the newly healed tissue. In the case of a complete tear of one or more pulleys a surgical reconstruction is necessary. For these a surgeon will harvest tendon grafts from the back of the wrist or forearm and sew these in loops to affectively replace the torn pulley (Nicros, 2008).
Chapter III – Procedures

Methodology:

I received ethical approval on the 21\textsuperscript{st} of July and proceeded to produce my survey online using survey monkey. I then passed the survey link onto representatives at the New Zealand Alpine Club (NZAC), New Zealand Outdoor Instructors Association (NZOIA) and also Adventure Southland. The survey only took a few minutes to complete and to my benefit all of the results were collected by survey monkey. So being able to collect my surveys back off people was not an issue as it was done electronically.

This means the vast majority of New Zealand’s climbing community will be possible subjects for my research meaning my sample size may range from a minimum of 50 right through to the thousands (preferably not that big). These subjects remain anonymous and a digital copy of my research will be provided to the organisations which are participating as remuneration for their aid in my research.

Informed consent for my research was implied if individuals complete my survey, this is because the survey is not compulsory therefore if they choose to complete it, that is their consent given. This information is explained at the top of my survey as to avoid any deception. Also I consider my survey to be straightforward so no information sheet was required as any necessary information was put in my email. The Alpine Club also included a small write up on what the survey was about to include on Facebook.

Also finding adequate previous research into the topic was necessary for me to properly understand climbing injuries. Another important aspect of my research is as I mentioned the prevention of these injuries, this meant I must take my understanding of previous research and combine it with my knowledge of injury prevention to come up with appropriate methods to minimise or eliminate the chances of injuries occurring.
Once all of the above fell into line we were able to do the hard work with my research which was to analyse all of the surveys online and then work out the pattern of injuries and how they affect the climbers. It is my goal to be able to aid the New Zealand climbing community and this is also of benefit to my work placement so I do hope to please a lot of people with the research.

*Outcome Measures:*

Climbers outlined any injuries they had received whilst climbing in the past 12 months and also how many days they had to be excluded from climbing as a result of these injuries. They also, where applicable included where and from whom they may have received medical attention. The companies which helped us were given 4 weeks with the survey before we closed it as we required adequate time to interpret the results.

We also collected information for what sort of climbing the participants have been doing and also how long they have been climbing for. This is because those who have been climbing longer and more dangerous climbing are the most likely to receive an injury. A traditionally protected climb is where the climber has to place their own protection on the rope and pass their rope through this device until they reach the top of the climb. Bolted climbing is where there are pre-established bolts in the wall which a person will place a quick draw in and then pass their rope through (very similar to traditional climbing but less gear to carry). Top rope climbing is most commonly seen at indoor facilities with the rope already anchored at the top of the climb, this method has no need for extra gear and is what all beginners start with. Finally there was also bouldering, this is where participants climb problems that are not very high off the ground so no harness is used and generally the only gear will be a chalk bag. Bouldering is excellent for practicing moves and showing skill.
Chapter IV - Results and Discussion

Results

This first graph is a collection of the results which outlines what gender each respondent is. It is also a very clear indication that even in this modern age of equality, men still dominate what is considered extreme sports. This comes as no surprise however it is believed that more women are climbing so these results must only be take with a grain of salt.
This graph was also another used to indicate where the respondents fall under, in this case their age group. The 25-34 age group dominates in term of numbers however there is quite a range of ages which shows it is a sport both old and young people can participate in. It is also important to note that as you get older you will be more aware of your climbing and therefore climb more safely. Also the more you climb, no matter the age you will be more likely to injure yourself.
This graph takes into account the 389 days (SurveyMonkey Results Appendix page 15/25) which between 42 people were spent away from climbing as a result of fall injuries. 14.4 percent of these days were as a result of torso injury, with 13.67 percent being a result of an injury to the head (most likely concussion) and 13.25 percent a result of finger injuries. These are just the three highest injuries and from the graph one can see that injuries were located all over the body.
Again this graph takes into account a large number of injury days, 575 total days from 38 people (SurveyMonkey Results Appendix page 20/25) who spent time away from climbing as a result of overuse injuries. As expected, the highest number belonged to fingers with 28.1 percent of the days, second was the wrist with 27.4 percent of days, and finally the elbow with 26.2 percent. All of these results are as expected because as we have seen with previous studies and an understanding of anatomy, overuse injuries affecting the arms (fingers, forearm, wrist, elbow etc.) are some of the most common detrimental injuries in climbing (Jones, 2008). It is also important to note that multiple injuries may have occurred, hence such high percentages for most body parts.
Between the 36 people who indicated they had received an injury from a strenuous/challenging move, 519 total days were spent away from climbing as a result (SurveyMonkey Results Appendix page 22/25). We again find that the highest percentage of days belong to the upper extremities with 2.7 percent belonging to fingers, elbows were second highest with 27.1 percent and shoulders were close behind with 25.2 percent. It is interesting to see that much like overuse injuries, the arms and hands tend to be the most affected areas when it comes to climbing. Proving that an understanding of these injuries is necessary so that these injuries can be reduced.
There was altogether, 37 people who responded to this question with a lot of individuals needing to seek out multiple avenues of medical advice. Naturally most people went to the physio as this is always a safe location to receive a range of medical rehabilitation options. It is also of no surprise that the second highest sought after advice was from fellow climbers, which makes sense as in such a small country anyone in the climbing community is bound to know someone else who has received a similar injury. There was a surprisingly high number of people who indicated other, most chose to specify this other avenue. We had two people who had to see orthopaedic surgeons for ligament tears in shoulders, two who had to see hand specialists (again reaffirming the hypothesis of hand injuries) and there was also two who had to see surgeons for fracture, one of whom fractured their hip and also one who fractured their ankle and tore ligaments (refer to raw data on flash drive, individual responses).
Discussion:

Climbing is by nature a dangerous sport and subsequently injuries are more common in this sport. This was apparent as only 21.43% of participants indicated that they had no received an injury, which left 78.57% of the 56 respondents having received an injury and by this having to spend days away from climbing (SurveyMonkey Results Appendix page 9-14/25). Of these who were injured most sought the help of a physiotherapist for rehabilitation of their injuries, fellow climbers was the second highest and individuals General Practitioners was the third most regular source for rehab/treatment.

It is seen from the results that of those who indicated they received an injury, fall injuries were comparatively uncommon when viewed next to injuries from strenuous moves or overuse. Although strenuous moves and overuse injuries cover the greatest amount of injuries, fall related injuries can often be more serious. This is apparent with one climber who suffered a fractured hip and another who suffered a fractured ankle.

There are also some methodological limitations which need to be considered when reviewing the findings. This study does provide a fresh insight into the relationship between difficult and more regular climbing both resulting in a higher chance of injury. However Without being able to talk face to face with the participants we were not able to gather a full understanding of how these injuries truly affected them and their ability to climb. Another limiting factor was that we only allowed 4 weeks for individuals to respond to my survey, we had initially intended on having 8 weeks or more for this however due to an issue with ethics going through this was significantly reduced. The result being that with only half the time we may have only got half of the potential responses, more responses would equal more solid results.
The participants were drawn from a wide range across New Zealand including a mix of men (67.86%) and women (32.14%) as well as a range of age groups (see figure 4). The result of these ranges meant the results were able to capture the variation in climbing abilities and styles and subsequently any pattern of injuries, as men are more likely to injure themselves which is supported by a higher number of male participants (Jones, 2008). Unfortunately with the nature of New Zealanders being tough do it yourself sort of people, showing weakness or seeking help is something which we by nature do not wish to do. Therefore it was expected that those who indicated they had received an injury may not be particularly eager to approach a medical professional. This is apparent as out of the 44 who spent days off with injuries, 15.9% did not seek any medical advice at all, and 51.53% sought advice from their fellow climbers.

There was also potential for participants to struggle in recalling injury or even over exaggerate. To limit the chance of forgetfulness we outlined that injuries must have occurred in the past 12 months, with this we were able to reduce recall inaccuracies. However naturally people like to over exaggerate injuries or events that have happened so therefore we were just hoping that the participants will stay honest especially as they will remain anonymous.

A range of factors will influence if a climber falls or not, these range from poor hand/foot placement through to safety equipment being in poor condition. Therefore even though it is of importance when interpreting the results, fall based injuries are injuries which cannot be reduced through anything other than being aware of your gear and the environment you are using it in. This is reinforced by the fact that of the 42 whom indicated they had received an injury from falling, only 3 (12.5%) received a fracture and of these 3 we know that only 2 were serious fractures. However with 38 respondents indicating they had received an injury from overuse, and 36 indicating they had received an injury from doing a challenging/strenuous move
it would seem apparent that methods need to be employed to reduce the chance of these injuries occurring. Climbers staying within their comfort range of difficulty when climbing is a great way to reduce these injuries as they will not be pushing their bodies excessively. Another method could be partaking in sufficient warm ups, such as stretching the risk areas (such as fingers, elbows and shoulders), and also doing a few climbs on easier routes before taking on a more challenging route. These two methods should be an excellent and achievable method in reducing the chances of such injuries happening to climbers.
Chapter V - Conclusion

In conclusion we believe that yes climbing is by nature a dangerous sport, but this is why people partake in it as the adrenaline rush is phenomenal. However just because it is an extreme sport does not mean that injuries need to happen as regularly as they apparently do. With this in mind though as the number of climbers continue to grow with the development of the sport internationally we believe that clubs should better educate their climbers in methods of warming up and ways to reduce the chance of injury so that climbers can continue to chase their dreams of climbing and not be limited by the risk of injuring themselves.

It is also recommended that future research should be undertaken to understand the difference between higher level and lower level climbers. This would need to be done over a much longer timeframe (for example a longitudinal study over a few years) so that we can understand if there is a correlation between a person’s developing climbing abilities, and their potential to receive more injuries.
References


Appendices

Attached are a draft of my survey (was slightly changed for survey monkey as apparent on flash drive) a copy of the paragraph which was at the top of my survey and a copy of the total combined results from the survey. A flash drive has been provided with all raw data due to the vast amount of printing which would have been required for this task.