BMJ Open Sport & Exercise Medicine

Self-reported chronic injuries in climbing: who gets injured when?

Gudmund Grønhaug

To cite: Grønhaug G. Self-reported chronic injuries in climbing: who gets injured when? *BMJ Open Sport & Exercise Medicine* 2018;**4**:e000406. doi:10.1136/bmjsem-2018-000406

Accepted 22 June 2018

Department of Physical Medicine and Rehabilitation, Østfold Hospital Trust, Grålum, Norway

Correspondence to
Gudmund Grønhaug; gudmund.gronhaug@so-hf.no

ABSTRACT

Objectives To assess self-reported chronic injuries in climbing and possible connections with gender, experience and style of climbing.

Method Retrospective survey.

Setting Web-based questionnaire.

Participants 667 active climbers (385 with chronic injuries, 289 males and 96 females).

Main outcome measure Climbers who had experienced at least one chronic injury during the last 6 months.

Result About 2/3 of male outdoor climbers had experienced a chronic injury. The three most frequent sites of injury were fingers (41.3%), shoulders (19.4%) and elbows (17.7%). The most frequent injury for the females were fingers (29.2%), shoulder (21.9%), wrist (12.5%), elbow (11.5%) and foot/ankle (10.4%). The most frequent injuries for the male were fingers (45.3%), elbow (19.7%) and shoulder (18.7%). Respondents who preferred outdoor climbing were more prone to injury than others.

Conclusion Fingers were the most prevalent site of injury regardless of level of experience, gender and whether level of expertise is reported in terms of bouldering or route climbing. There seems to be a gender difference in respect of site of injury prevalence and a different prevalence of injuries according to style of climbing and different levels of expertise. Furthermore, the use of the suggested way of reporting levels of expertise to compare between bouldering and route climbing seems to be robust with no huge differences in terms of incidence level of different injuries.

What is already known?

- It has been anticipated that fingers and shoulders are the most affected sites of injuries.
- It has been anticipated that all climbers, regardless of gender, are experiencing the same injuries.
- It has been anticipated that experienced climbers are more prone to chronic injury.

What are the new findings?

- Lesser experienced climbers are experiencing more chronic injuries than elite climbers.
- Female climbers' injuries differ from the injuries of male climbers. The most striking difference in prevalence of injury is found in injuries to the foot/ankle and the wrist.
- Male outdoor climbers are most prone to chronic injury.
- Fingers, elbows and shoulders represent about 80% of all chronic injuries in climbing.

BACKGROUND

Climbing as a sport is growing rapidly. The International Federation of Sports Climbing (IFSC) currently states that 25 million people of all ages climb regularly in facilities rapidly increasing in numbers. During the last decade (2001–2012), global numbers of both climbers and climbing venues have increased by approximately 50%.

IFSC organises both senior and junior World Championships, a World Cup and a number of international events, and recently climbing was invited into the Olympics as aspiring sport in 2020. Since climbing is a fairly new sport, training regimes and patterns of injuries are not as well documented as for other sports.

Climbing is divided in three disciplines: route climbing, speed climbing and bouldering. Concerning chronic injuries, an important discriminating feature between lead/speed climbing and bouldering is the relative intensity of movement. Bouldering consists of shorter climbs (termed problems); this type of climbing tends to concentrate all the difficulty of the effort in few moves of the body. For elite climbers, it is common to prepractice climbs for a longer period of time. An important similarity between sport climbing and bouldering is therefore the repetitive movements in training. The tendency to spend longer time 'planning' a route or boulder[1 2] might possibly be a leading factor for chronic injury. The stress on elbows and shoulders is similar or higher than gymnastics in rings, while the stress on fingers in climbing is way higher than in any other activity.

It has been estimated that finger and shoulders are the most frequent anatomic sites of injury,[3–5] but this has not been documented in larger epidemiological studies. Furthermore, it is commonly suggested that more

experienced climbers are more prone to injuries due to higher velocities of stress and higher volumes of training.

Most studies on injuries in climbing are performed on single subjects or on single diagnoses,[6] and so far, no studies have made gender-specific analyses of chronic injury incidence or assessed whether more experienced climbers are more prone to injury than less experienced climbers.

The aim of this study is to assess self-reported chronic injuries in climbing and possible connections of gender, experience and style of climbing.

METHODS

Design

This study is based on a cross-sectional survey using a web-based questionnaire.

The survey was launched in association with the national climbing federation and the national climbing magazine and was promoted via Facebook pages and webpages during the time of inclusion. The questionnaire was open for respondents from 21 March 2017 to 02 May 2017.

Sociodemographics and experience level

The questionnaire included questions about age (<-10, 11–15, 16–20, 21–25, 26–30, 31–40, 41–50, 51–60 and ->60) and gender.

To assess level of experience, it was asked about the highest achieved grade during the last year for a prepracticed climb (red point) in both bouldering and route climbing and for how long the participants had been climbing. Experience levels were grouped as suggested in Grønhaug and Norberg.[6] It was asked about what kind of climbing the respondents preferred (indoor, outdoor, following the season and do not know).

Self-perceived injuries

The questionnaire included two questions on injuries:

During the past 6 months, have you experienced climbing-related chronic injuries? (Yes, no).

If yes was ticked off, another question was asked: where did you experience this injury? (Toe, foot/ankle, calf, knee, thigh, hip, lower back, shoulder, elbow, wrist, fingers, neck and head).

Statistics

SPSS V.25 for Mac was used to perform descriptive statistics.

RESULTS

Participant characteristics

Most of the respondents were male (72.1%), 58.7% were 26–40 years of age (28.3%: 26–30 years and 30.4%: 31–40 years) and had been climbing for at least 3 years (3–5 years: 30.1%, 6–10 years: 22.3%, 11+ years: 29.1%, respectively).

Of the respondents, 49% was intermediate (6b+–7a+) and 34% was experienced (7b–8b). The experience level was higher among the males than females with 36.3% experienced males and 27.4% experienced females. There were 3.5% elite and 0.2% international elite climbers among all the respondents. Chronic injuries was reported by 58% of the respondents.

Table 1 Site of chronic injury

	All (N=385)	Male (n=289)	Female (n=96)
	Number (%)		
Toe	1 (0.2)	1 (0.3)	
Foot/ankle	21 (6)	11 (3.8)	10 (10.4)
Calf	2 (0.5)	2 (0.7)	
Knee	15 (4)	8 (2.8)	7 (7.3)
Thigh	3 (1)	1 (0.3)	2 (2.1)
Hip	3 (1)	2 (0.7)	1 (1)
Lower back	11 (2.9)	8 (2.8)	3 (3.1)
Shoulder	75 (19.5)	54 (18.7)	21 (21.9)
Elbow	68 (17.7)	57 (19.7)	11 (11.5)
Wrist	24 (6.2)	12 (4.2)	12 (12.5)
Fingers	159 (41.3)	131 (45.3)	28 (29.2)
Neck	2 (0.5)	2 (0.7)	1 (1)
Head	1 (0.2)		1 (1)

Comparison of male and female injury incident rate for different anatomical sites.

Reported injuries

Of the 667 respondents, 385 reported to have sustained an injury during the last 6 months (table 1). There were 289 males and 96 females among the ones who reported an injury (75% and 25% of the injured, respectively). The three most frequent sites of injury were fingers (41.3%), shoulders (19.5%) and elbows (17.7%). The most frequent injuries for the females were fingers (29.2%), shoulder (21.9%), wrist (12.5%), elbow (11.5%) and foot/ankle (10.4%). The most frequent injuries for the males were fingers (45.3%), elbow (19.7%) and shoulder (18.7%).

Injuries versus experience level

When experience level was measured using level of performance in route climbing, the highest incident rate of injuries was found among the international elite (100%) and intermediate climbers (61%), followed by experienced (58%), elite (56%) and beginners (47%) (table 2).

For the females, incident rates among the different levels of experience in route climbing were 100% among the elite and international elite, 58% among the intermediate, 49% among the experienced and 41% among the beginners group. When using level of performance in bouldering as a measure of experience, the incidence rate of injuries for females was 67% among the elite, 63%

Table 2 Most difficult route last year and incidence rate of chronic injuries

	All		Female		Male	
	N=385	Injured past 6 months, n (%)	n=96	Injured past 6 months, n (%)	n=289	Injured past 6 months, n (%)
Recreational 4–6b	91	43 (47)	42	17 (41)	49	26 (53)
Intermediate 6b+–7a+	324	196 (61)	90	52 (58)	234	144 (62)
Experienced 7b–8b	226	132 (58)	51	25 (49)	175	107 (61)
Elite 8b+–8c+	25	14 (56)	2	2 (100)	23	12 (52)
International elite 9a–>	1	1 (100)	1	1 (100)	0	

Comparison of level of experience using route climbing as descriptor for the level of experience.

among the experienced, 55% among the beginners and 43% among the intermediate (table 3).

For the males, the incident rate among different levels of experience in route climbing were 62% among the intermediate, 61% among the experienced, 53% among the beginners and 52% among the elite. For male bouldering, the incident rate was 67% among international elite, 66% among the elite, 63% among the experienced, 58% among the intermediate and 57% for the beginners.

In respect of where the respondents are climbing, 49% reports to be following the season (indoors in winter and outdoors in summer), 39% prefers indoor climbing, 8% prefers outdoors and 0.5% do not know what they prefer the most (table 4). Of the respondents that prefer outdoor climbing, 69% reports to have sustained an injury during the last 6 months, while 62% of the seasonal respondents and 57% of the respondents preferring indoor climbing report injuries during the last 6 months.

DISCUSSION

This is the first study of chronic injuries among climbers that is reporting prevalence of injuries with respondents sorted by gender, what kind of climbing the respondents prefer and level of experience. Furthermore, with 667 respondents, it is the largest survey of climbing injuries performed so far. In this study, it is found that the fingers are the most prevalent site of injury. Together with elbows and shoulders, they represent almost 80% of all reported chronic injuries due to climbing. Furthermore, the present study shows that there are gender differences, different prevalence of injuries according to style of climbing, different levels of expertise in terms of reported injuries and that the climbers who focus more on outdoor climbing are more prone to chronic injuries than the ones who focus more on indoor climbing.

Gender differences in reported injuries

Fingers represented 41.3% of the reported injuries among all respondents (45.3% of the males and 29.2% of the females). Shoulder injuries were reported by 19.5% of the respondents (18.7% of the males and 21.9% of the females). Elbow injuries were reported by 17.7% of the respondents (19.7% of the males and 11.5% of the females). Foot/ankle was reported by 6% of the respondents (3.8% of the males and 10.4% of the females) (table 1)

The reason for the differences in prevalence of injuries of the fingers and shoulders are unclear and needs further investigation. Concerning the reported difference in injuries of the wrist, it may be at least partially explained by a higher prevalence of carpal tunnel syndrome among the females.[7] Anatomical differences in the ankle may explain the difference in reported injuries of the ankle and foot. Climbing shoes are mainly produced for the male ankle, making a tighter, more stressing pressure point on the female Achilles' tendon. This suggestion is supported by the high prevalence of foot/ankle injuries among the route climbers in this study (tables 5 and 6).

Table 3 Most difficult boulder last year and incidence rate of chronic injuries

	All		Female		Male	
	N=385	Injured past 6 month, n (%)	n=96	Injured past 6 month, n (%)	n=289	Injured past 6 month, n (%)
Recreational 4–5+	145	81 (56)	75	41 (55)	70	40 (57)
Intermediate 6A–6C+	291	158 (54)	76	33 (43)	215	125 (58)
Experienced 7A–7C	187	117 (63)	32	20 (63)	155	97 (63)
Elite 7C+–8A+	38	25 (66)	3	2 (67)	35	23 (66)
International elite 8B–>	6	4 (67)			6	4 (67)

Comparison of level of experience using bouldering as descriptor for the level of experience.

Table 4 Prevalence of chronic injuries and preferred place of climbing

	N (%)	Injured past 6 month n (%)
Indoors	260 (39)	148 (57)
Outdoors	52 (8)	36 (69)
Season dependent	325 (49)	200 (62)
Do not know	3 (0,5)	1 (33)

Prevalence of injuries and level of experience

The previous findings of a higher incidence rate of injuries among the experienced athletes due to higher volume of training and more extreme movements when climbing[8] is only supported for the male boulderers in this study. For the females, the relationship between levels of experience and injuries are more complex with a higher prevalence among the recreational climbers (55%) than the intermediate (43%).

When level of experience is measured for route climbing, there are no relationship between levels of difficulty and prevalence of injuries among either of the genders. However, it may seem that the intermediate and the elite climbers are more prone to injuries than the beginners and the international elite (tables 2 and 3).

Preferred place of climbing

The highest prevalence of injuries in this study is found among the male outdoor climbers (74%). This may be explained better by psychological differences and differences in inner pressure among the climbers to perform when climbing outside. For several decades, it has been a culture among the climbers to view a fulfilled climb outside to be ranked as a higher achievement than a climb indoors. This may increase the inner pressure to perform when climbing outside on rock, making the climbers more prone to keep on climbing in spite of pain. Historically, male climbers have been more dedicated outdoor climbers than the females. This is only partly reflected in this study (8.7% male vs 5% female preferring outdoors).

Strengths and limitations

This study is a cross-sectional, open, online survey on chronic injuries in climbing. This may have inflicted on the nature of the respondents. It is likely that the climbers responding to the survey used in this study are more prone to have sustained an injury than the average climber. Still, almost 42% of the respondents report that they had no injury the last 6 months.

The time of the survey may have had impact on the reported injuries. Since the survey was open from 21.03.17 to 02.05.17, most of the climbers may have been climbing more indoors than usual due to the cold weathers. Since the seasonal climber and the outdoor climbers often use indoor climbing in winter as a period of harder training than usual, this may have had an impact on injury rates during the last 6 months.

A weakness of the study is the lack of medical examination of the reported injuries. Although the questionnaire specified that the study was about chronic injuries. Still, it is not guaranteed that the respondents only reported chronic injuries; some may have reported acute injuries.

A strength of the study is the number of participants, the wide range of experience among the respondents and the high number of female respondents. The generalisability of a study relies on the participants. Apart from the under-representation of the beginners who usually quit climbing or do not climb regularly, the composition of the respondents in this study is in line with the climbing

Table 5 Comparison of level of experience and prevalence of site of injury for route climbing

	Recreational 4–6b N=91			Intermediate 6b+–7a+ N=324			Experienced 7b–8b N=226			Elite 8b+–8c+ N=25		
	All n (%)	Female n (%)	Male n (%)	All n (%)	Female n (%)	Male n (%)	All n (%)	Female n (%)	Male n (%)	All n (%)	Female n (%)	Male n (%)
Toe				1 (0.5)		1 (0.7)						
Foot/ankle	1 (2.3)	1 (5.9)		12 (6.1)	7 (13.5)	5 (3.5)	7 (5.3)	2 (8)	5 (4.7)	1 (7.1)		1 (8.3)
Calf				2 (1)		2 (1.4)						
Knee		2 (11.8)		7 (3.6)	2 (3.8)	5 (3.5)	5 (3.8)	3 (12)	2 (1.9)	1 (7.1)		1 (8.3)
Thigh	2 (4.7)	2 (11.8)		1 (0.5)		1 (0.7)						
Hip	1 (2.3)		1 (3.8)	2 (1)	1 (1.9)	1 (0.7)						
Lower back	4 (9.3)	3 (17.6)	1 (3.8)	2 (1)		2 (1.4)	4 (3)		4 (3.7)	1 (7.1)		1 (8.3)
Shoulder	12 (27.9)	4 (23.5)	8 (30.8)	29 (14.8)	13 (25)	16 (11.1)	31 (23.5)	4 (16)	27 (25.2)	3 (21.4)		3 (25)
Elbow	4 (9.3)		4 (15.4)	39 (19.9)	6 (11.5)	33 (22.9)	21 (15.9)	5 (20)	16 (15)	4 (28.6)		4 (33.3)
Wrist	5 (11.6)	1 (5.9)	4 (15.4)	13 (6.6)	7 (13.5)	6 (4.2)	6 (4.5)	4 (16)	2 (1.9)			2 (16.7)
Fingers	12 (27.9)	4 (23.5)	8 (30.8)	86 (43.9)	15 (28.8)	71 (49.3)	57 (43.2)	7 (28)	50 (46.7)	4 (28.6)	2 (100)	
Neck				1 (0.5)		1 (0.7)	1 (0.8)		1 (0.9)			
Head				1 (0.5)	1 (1.9)							

International elite (n=1) is not in the table due to low number of respondents.

Table 6 Comparison of level of experience and prevalence of site of injury for bouldering

	Recreational 4–5+ N=145			Intermediate 6A–6C+ N=291			Experienced 7A–7C N=187			Elite 7C+–8A+ N=38		
	All n (%)	Female n (%)	Male n (%)	All n (%)	Female n (%)	Male n (%)	All n (%)	Female n (%)	Male n (%)	All n (%)	Female n (%)	Male n (%)
Toe				1 (0.6)		1 (0.8)						
Foot/ankle	5 (6.2)	3 (7.3)	2 (5)	6 (3.8)	3 (9.1)	3 (2.4)	10 (8.5)	4 (20)	6 (6.2)			
Calf	1 (1.2)		1 (2.5)	1 (0.6)		1 (0.8)						
Knee	4 (4.9)	4 (9.8)		4 (2.5)	2 (6.1)	2 (1.6)	6 (5.1)	1 (5)	5 (5.2)			
Thigh	2 (2.5)	2 (4.9)					1 (0.9)		1 (1)			
Hip				3 (1.9)	1 (3)	2 (1.6)						
Lower back	5 (6.2)	3 (7.3)	2 (5)	2 (1.3)		2 (1.6)	2 (1.7)		2 (2.1)	2 (8)		2 (8.7)
Shoulder	26 (32.1)	12 (29.3)	14 (35)	25 (15.8)	8 (24.2)	17 (13,6)	17 (14.5)	1 (5)	16 (16.5)	7 (28)		7 (30.4)
Elbow	11 (13.6)	3 (7.3)	8 (20)	33 (20.9)	5 (152)	28 (22,4)	20 (17.1)	3 (15)	17 (17.5)	3 (12)		3 (13)
Wrist	6 (7.4)	4 (9.8)	2 (5)	8 (5.1)	3 (9.1)	5 (4)	10 (8.5)	5 (25)	5 (5.2)			
Fingers	20 (24.7)	10 (24.4)	10 (25)	74 (46.8)	10 (30.3)	64 (51.2)	50 (42.7)	6 (30)	44 (45.4)	13 (52)	2 (100)	11 (47.8)
Neck	1 (1.2)		1 (2.5)				1 (0.9)		1 (1)			
Head				1 (0.6)	1 (3)							

International elite (n=4) is not in the table due to low number of respondents.

community in Norway, both in terms of level of expertise and representation of the genders.

Sorting the respondents by level of experience and gender is a strength of the study that makes it more generalisable and therefore easier to use to make guidelines for injury prevention.

Another strength of the study is that it is a national survey and not limited to a city or just a few climbing gyms. Due to the support from the national federation and the national climbing media, this survey has respondents from all over Norway; this gives the study a higher level of generalisability. Furthermore, it is the study with the highest number of participants performed among climbers so far.

Another strength of the study is a high proportion of the participants did not report an injury. With 58% of the climbers reporting an injury, numbers are probably still a bit higher than it would be in a prospective study. This is due to a selection bias making those who have sustained an injury far more likely to reply to a study on chronic injuries than those who have never experienced a chronic injury.

In previous studies on injuries in climbing, there are differences in with respect to what kind of injuries that are reported and the prevalence of the different injuries.[4 9–14] These differences are probably due to different methods used in the studies, aims of the studies and the population of the studies.

Some of the findings from previous studies are supported by the present study, such as Rohrbough *et al*,[14] Wright *et al*,[5] Logan *et al*[9] and Jones *et al*,[11] who found that 25%–405% of the climbers had experienced a finger injury. The respondents in these studies differed in terms of experience where the less experienced had the lowest incidence of injuries. Results from other epidemiological studies reporting that 90% of climbers have experienced a shoulder injury[15] or 86% of the climbers suffer from a chronic foot injury[16] are not supported in the present study and are furthermore most likely biased findings by either recall bias or methodological weaknesses. Most of the research about stress-related or chronic injuries in climbing have been performed on single diagnoses or with a preset purpose of exposing the prevalence of an injury or set of injuries.

Previous studies have reported that higher levels of expertise and thereby larger volumes of training are making the climbers more prone to injuries.[8] These suggestions are not supported by the present study. In the present study, it is found that the injury prevalence is highest among the experienced and elite climbers compared with the international elite and recreational climbers (tables 2 and 3). The number of participants in the international elite group are very small, so this result is uncertain. Still, it may be that the international elite climbers as well as the most experienced climbers in the elite group have more knowledge of how to train and know their body well enough to train hard without getting injured. Furthermore, this may be due to a selection bias; the climbers who get injured early in their climbing career will not be able to reach the international elite level.

CONCLUSION

Fingers are the most prevalent site of injury regardless of level of experience, gender and whether level of expertise is reported in terms of bouldering or route climbing. There seem to be a gender difference with respect to site of injury prevalence and different prevalence of injuries according to style of climbing and different levels of expertise.

Furthermore, the use of the suggested way of reporting levels of expertise to compare between bouldering and route climbing seems to be robust with no huge differences in terms of incidence level of different injuries.

Clinical relevance

The findings in the present study of gender differences in injury sites should be considered by the national federations in terms of preventative training programmes. Due to the findings of the high prevalence of foot/ankle injuries, this needs to be taken into account by the climbing shoe industry to enable female climbers to quit using male shoes for climbing.

Collaborators Marius Norberg.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement There are additional data on other aspects of the respondents injuries, training habits, time out of sport and use of healthcare services. All data are in Norwegian. All data may be shared upon request.

REFERENCES

1. Bayer T, Schweizer A. Stress fracture of the hook of the hamate as a result of intensive climbing. *J Hand Surg Eur Vol* 2009;34:276–7.
2. Schweizer A. Lumbrical tears in rock climbers. *J Hand Surg Br* 2003;28:187–9.
3. Peters P. Nerve compression syndromes in sport climbers. *Int J Sports Med* 2001;22:611–7.
4. Schweizer A. Sport climbing from a medical point of view. *Swiss Med Wkly* 2012;142:w13688.
5. Wright DM, Royle TJ. Indoor rock climbing: who gets injured? *Br J Sports Med* 2001;35:181–5.
6. Grønhaug G, Norberg M. First overview on chronic injuries in sport climbing: proposal for a change in reporting of injuries in climbing. *BMJ Open Sport Exerc Med* 2016;2:e000083.
7. Atroshi I, Gummesson C, Johnsson R, *et al*. Prevalence of carpal tunnel syndrome in a general population.. *JAMA* 1999;282:153–8.
8. Neuhof A, Hennig FF, Schöffl I, *et al*. Injury risk evaluation in sport climbing. *Int J Sports Med* 2011;32:794–800.
9. Logan AJ, Makwana N, Mason G, *et al*. Acute injuries in the hand and Wrist. *Br J of Sports Med* 2004;38:545–8.
10. Logan AJ, Makwana N, Mason G. Can rock climbing lead to Dupuytren's disease? *Br J Sports Med* 2005;39:639–44.
11. Jones G, Asghar A, Llewellyn DJ. The epidemiology of rock-climbing injuries. *Br J Sports Med* 2008;42:773–8.
12. Wright DM, Royle TJ, Marshall T. Indoor rock climbing: who gets injured? *Br J Sports Med* 2001;35:181–5.
13. Pieber K, Angelmaier L, Csapo R, *et al*. Acute injuries and overuse syndromes in sport climbing and bouldering in Austria: a descriptive epidemiological study. *Wien Klin Wochenschr* 2012;124(11-12):357–62.
14. Rohrbough JT, Mudge MK, Schilling RC. Overuse injuries in the elite rock climber. *Med Sci Sports Exerc* 2000;32:1369–72.
15. Nelson CE, Rayan GM, Judd JI, *et al*. Survey of hand and upper extremity injuries among rock climbers. *Hand* 2017;12:389–94.
16. Buda R, Di Caprio F, Bedetti L, *et al*. Foot overuse diseases in rock climbing: an epidemiologic study. *J Am Podiatr Med Assoc* 2013;103:113–20.