



Differences between boulderers and top rope climbers in the relationship between anxiety and disordered eating

Shaghayegh Modaberi¹ · Steven van Andel² · Esmaeel Saemi³ · Lanae M. Joubert⁴ · Morteza Taheri¹

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Abstract

Purpose Disordered eating (DE) has been associated with elevated anxiety, high stress, and low self-esteem and occurs often in sports where weight is a limiting factor. Sport climbing in general provides a combination in these aspects but the relevance of a low body weight differs in the different climbing types (e.g., weight supported top rope climbing vs non-supported bouldering). To date, these differences have yet been investigated, while they might provide useful insight into the mechanisms of disordered eating and potential preventative strategies. This study aimed to assess the influence of different types of climbing (bouldering vs top rope) on the relation between anxiety and DE.

Methods 59 rock climbers (male, $n = 38$; female, $n = 21$; mean age = 28.33 ± 7.4 years) completed a survey (including the Dutch Eating Behavior Questionnaire, Mental toughness Questionnaire, Cattell's Anxiety Scale Questionnaire) investigating preferred climbing style, trait anxiety, mental toughness, and eating behavior.

Results Boulderers showed a higher anxiety score compared to top rope climbers. Among boulderers, higher anxiety levels were associated with lower mental toughness. Among top rope climbers, anxiety was associated with emotional and external eating behavior.

Conclusion Findings showed a higher anxiety in boulderers but no greater measures of DE. It is possible that, through their experience in a high anxiety environment, boulderers have been able to develop effective coping strategies that have a protective effect against DE.

Keywords Eating behavior · Sport climbing · Anxiety · Mental toughness

Introduction

Disordered eating (DE) refers to irregular eating behavior, which occurs less frequently or less severe than a diagnosable eating disorder [1]. Among athletes, DE occurs often in sports where weight is a significant factor, for instance in sports that depend on leanness or are weight-dependent [2].

In climbing, more weight means an athlete needs to expand more energy to reach their goal and, in this way, weight is directly related to performance. Perhaps as a result, climbers in general are known to have a relatively low body mass [3–5] and prevalence of DE has been shown to be relatively high, particularly in females (16.5% compared to 6.3% in males [6]). At present, previous research findings describe DE in sports climbing in general, without differentiation between the specific type of climbers. However, considering the different weight demands in different types of climbing, it seems reasonable that the effects on DE might also differ between climbing types.

Rock climbing is an extreme sport that requires considerable physical and mental demands [7, 8]. The climbing sport knows different disciplines, perhaps the most well known are ‘speed climbing’, ‘lead climbing’ and ‘bouldering’, thanks to their recent introduction at the Tokyo Olympic games in 2021. Speed climbing is a discipline where two climbers face off to reach the top of the wall as soon as possible. In

✉ Steven van Andel
Steven.van-Andel@uibk.ac.at

¹ Department of Sport Sciences, Faculty of Social Sciences, Imam Khomeini International University, Qazvin, Iran

² Department of Sport Science, University of Innsbruck, Innsbruck, Austria

³ Department of Motor Behavior and Sport Psychology, Shahid Chamran University of Ahvaz, Ahvaz, Iran

⁴ Exercise Science Laboratory, School of Health and Human Performance, Northern Michigan University, Marquette, MI, USA

lead climbing, athletes attach a rope to anchors in the wall/rockface as they progress through the climb. Boulders do not use tools like a rope or harness and typically perform much lower climbs with a mat underneath to protect against injury in case of a fall.

Research has shown that anxiety is generally higher in experienced climbers in lead climbing, compared to the safer ‘top rope’ discipline (i.e., a climbing style where the climber is secured by a safety rope extended via an anchor at the top of the rockface [9, 10]). Furthermore, Nieuwenhuys and colleagues showed that anxiety levels (and an associated drop in performance) were manipulated by the height of the climbing traverse [11]. Together, these studies show that different demands of climbs have different effects on the psychological strain for an athlete.

It has been well established that psychological factors are associated with problems in eating behavior for athletes [12–14]. Among other factors (e.g., high stress or low self-esteem), anxiety is one leading factor that has been associated with the prevalence of DE [15]. Given the specific anxiety demands inherent to the climbing sport, combined with the demands on the athlete’s weight, this provides a potentially dangerous combination in terms of the development of DE. It should be emphasized here again that both the demands in terms of weight, as well as the psychological demands of climbing are different for different climbing types. In this light, it is interesting that, to the knowledge of the authors, no studies to date have investigated the effects of different types of climbing athletes (e.g., lead, bouldering, top rope) on the interplay between psychological factors and DE. The current study uses a sample of competitive and non-competitive Iranian climbers in the bouldering and top rope discipline and aims to investigate the relationship between DE and climbing type. It is hypothesized that in climbing types that are associated with higher anxiety, we see a stronger relationship to DE.

Methods

Participants

Adult (≥ 18 years) participants were recruited from local climbing gyms in Iranian cities by soliciting climbing coaches to help the research team reach the local climbing population. Coaches supplied 80 climbers’ email addresses, which were used to deliver an email with study information. Informed consent was received by 59 volunteers who were then sent four digital web-based questionnaires. Fifty-nine participants (male, $n = 38$; female, $n = 21$; mean age = 28.33 ± 7.4 years) completed all questions. Ethical approval was obtained from the

Qazvin University of Medical Sciences ethics committee (IR.QUMS.REC.1400.514) and the researchers adhered to the Declaration of Helsinki.

Protocol

All questionnaires were instrumented using EPOLL software (<https://epoll.pro/>) and sent via email to the participants of whom informed consent was obtained. Sociodemographic questions included gender, age, weight, height, and rock climbing experience were recorded separate from any formal questionnaire to assure anonymity of the sample.

Climbing Ability Questionnaire

This set of questions assessed years of climbing experience, the number of climbing competitions in the past year, hours of rock climb training per week, identified types of climbers (i.e., boulderer, top rope climber or both. The International Rock Climbing Research Association (IRCRA) Reporting Scale [16] was employed to distinguish five climbing ability levels: lower grade, intermediate, advanced, elite, higher elite, based on the climber’s reported ability level. In the current study, we distinguished three types of climbers by groups. Group 1 included those that only identified themselves as boulderers ($n = 18$). Group 2 were top rope climbers only ($n = 27$) and group 3 identified themselves as both boulderers and top rope climbers ($n = 14$).

Dutch Eating Behavior Questionnaire

The 33-item Dutch Eating Behavior Questionnaire (DEBQ) was used to assess three distinct eating behaviors in the participants: (1) emotional eating, (2) external eating, and (3) restrained eating [17, 18]. Emotional eating implies an inclination to eat in response to negative emotions such as depression, disappointments, and feelings of loneliness; external eating means eating more in response to external food cues such as the sight, smell, and taste of food; and restrained eating implies conscious determination and efforts to restrict food intake and calories to control body weight [19]. The DEBQ was validated and deemed reliable for measuring emotional eating in individuals with and without an eating disorder diagnosis, as well as in obese populations. Cronbach’s alpha coefficient for the eating disorder group and the control group were 0.95 and 0.96, respectively [20].

Mental Toughness Questionnaire

A Mental Toughness Questionnaire [21] was used to assess participants’ mental toughness. Participants responded to 48 items on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). This instrument provided an

overall mental toughness (MT) score. Higher scores indicate a higher mental toughness.

Cattell's Anxiety Scale Questionnaire

Anxiety levels were assessed based on 40 questions [22]. Three raw scores were computed for each individual and then converted into normal scores according to standard tables which are part of Cattell's anxiety scale. The final scores included the total anxiety level of the participants.

Data analysis

The statistical analyses were carried out using the SPSS software (version 24, 2019). For comparing means of psychological traits between types of climbers (bouldering, top rope, and bouldering + top rope). One-way ANOVAs with Tukey Post Hoc tests were used to determine significant differences between groups. Pearson correlation coefficient was applied to determine the relationships among the three psychological traits: mental toughness, anxiety, and eating behavior, and their relationships with the climbing ability and the type of climbing. The strength of these relationships was interpreted as $r > 0.1$: small effect; $r > 0.3$: medium effect; and $r > 0.5$: large effect [23]. Results were reported as mean \pm standard deviation and frequency, the significance level was established at $\alpha = 0.05$.

Results

Participant demographics

The demographics are shown in Tables 1 and 2, which illustrate that 52.5% of our 59 rock climbers participated in climbing competitions at least once per year (35.6% female). Our sample of climbers were reasonably experienced at the sport, as 50.8% had more than 5 years of climbing experience.

Differences between boulderers, top rope climbers and combined athletes

The results of the one-way ANOVA (Table 3) revealed that there were not any significant differences among the three climbing groups in mental toughness ($F(56,2) = 1.84$, $p = 0.16$), emotional eating behavior ($F(56,2) = 0.46$, $p = 0.62$), restrained eating behavior ($F(56,2) = 1.12$, $p = 0.33$), external eating behavior ($F(56,2) = 0.36$, $p = 0.69$) or BMI ($F(56,2) = 2.93$, $p = 0.06$). However, total anxiety scores were significantly different between the three climbing groups ($F(56,2) = 6.01$, $p < 0.01$). Tukey Post Hoc test determined that boulderers had significantly higher anxiety

Table 1 Descriptive and demographic details of rock climbers

Variables	All (N=59)	Male (N=38)	Female (N=21)
Age (year)	28.3 \pm 7.4	29.9 \pm 7.2	25.4 \pm 7.1
Height (cm)	170.3 \pm 13.3	175.4 \pm 6.8	160.8 \pm 16.9
Weight (kg)	61.0 \pm 10.5	66.4 \pm 7.8	50.9 \pm 6.8
Body mass index (kg/m ²)	21.3 \pm 4.8	21.6 \pm 2.0	20.5 \pm 7.7
Competition level			
Competitive	(N=31)	(N=20)	(N=11)
Non-competitive	(N=28)	(N=18)	(N=10)
Type of climbing			
Boulderer	(N=18)	(N=10)	(N=8)
Top rope	(N=27)	(N=20)	(N=7)
Comined	(N=14)	(N=8)	(N=6)
All bouldering climbers ability (IRCRA)			
Lower grade	(N=8)	(N=2)	(N=6)
Intermediate	(N=12)	(N=6)	(N=6)
Advanced	(N=20)	(N=15)	(N=5)
Elite	(N=13)	(N=11)	(N=2)
Higher elite	(N=6)	(N=4)	(N=2)
All top rope climbers ability (IRCRA)			
Lower grade	(N=7)	(N=2)	(N=5)
Intermediate	(N=17)	(N=10)	(N=7)
Advanced	(N=24)	(N=17)	(N=7)
Elite	(N=4)	(N=4)	(N=0)
Higher elite	(N=7)	(N=5)	(N=2)
Sports experience (years)			
> 10	(N=18)	(N=14)	(N=4)
5–10	(N=12)	(N=8)	(N=4)
< 5	(N=29)	(N=16)	(N=13)

Table 2 Discriptive statistics of sex differences in dependent variables

Variable	Female	Male
Mental toughness score	168.0 \pm 15.4	172.9 \pm 17.3
Eating behavior type		
Emotional eating	25.9 \pm 7.2	29.5 \pm 9.7
Restrained eating	18.4 \pm 9.4	23.1 \pm 9.3
External eating	30.0 \pm 7.9	27.2 \pm 8.5
Anxiety level		
Total anxiety	33.6 \pm 9.6	32.5 \pm 9.2
Body mass index (kg/m ²)	20.5 \pm 7.7	21.7 \pm 2.1

Note: separate *t* tests on each of these variables have not identified differences between groups

scores than the top rope climbers ($p < 0.01$), with no other differences between groups. No significant difference was found in mental toughness between the groups and similarly, no significant differences were found in eating behavior.

Table 3 Dependent variable differences between boulderers, top rope climbers and combined athletes, mean \pm SD

Variable	Bouldering ($N=18$)	Top rope ($N=27$)	Combined ($N=14$)	Main effect for group: p value
Mental toughness score	165 \pm 21.1	174.33 \pm 13.37	174.33 \pm 15.11	0.16
Eating behavior type				
Emotional eating	29.3 \pm 8.4	27.0 \pm 9.2	29.2 \pm 9.8	0.62
Restrained eating	22.5 \pm 9.5	22.6 \pm 9.6	18.1 \pm 9.1	0.33
External eating	27.7 \pm 5.9	27.7 \pm 9.9	29.9 \pm 8.1	0.69
Anxiety level				
Total anxiety	38.5 \pm 9.7	29.2 \pm 7.4	33.9 \pm 9.4	<0.01 ^a
Body mass index (kg/m ²)	20.3 \pm 2.4	22.8 \pm 6.4	19.4 \pm 2.07	0.06

^aIndicates significant one-way ANOVA at $\alpha=0.05$

Table 4 Pearson correlation among mental toughness, anxiety and eating behavior

Variables	Mental toughness		Anxiety	
	r	p value	r	p value
Boulderers ($N=18$)				
Mental toughness			-0.78	<0.01*
Emotional eating	-0.32	0.18	0.06	0.80
Restrained eating	0.18	0.45	-0.22	0.37
External eating	-0.2	0.42	0.19	0.45
Top rope ($N=27$)				
Mental toughness			-0.23	0.23
Emotional eating	0.14	0.47	0.53	<0.01*
Restrained eating	0.16	0.39	0.07	0.70
External eating	0.07	0.72	0.52	<0.01*
Combined ($N=14$)				
Mental toughness			-0.4	0.15
Emotional eating	0.03	0.91	0.26	0.36
Restrained eating	-0.26	0.35	0.31	0.27
External eating	0.1	0.71	0.26	0.36

*Indicates significant Pearson correlation at $\alpha=0.05$

Relationships among the three psychological traits

The correlations among mental toughness scores, anxiety levels and eating behavior type in climbers are illustrated in Table 4. This table reveals a significant negative relationship between mental toughness and anxiety among boulderers ($r=-0.78$, $p<0.01$). Two large effects were found in top rope climbers: anxiety was positively correlated to both emotional eating ($r=0.53$, $p<0.01$) and external eating behavior ($r=0.52$, $p<0.01$).

Discussion

This study aimed to investigate the relationship between climbing types disordered eating (DE). Given the established relationship between DE and psychological traits in the general population, it was hypothesized that climbing types associated with higher anxiety scores would show stronger relationships between psychological traits and DE behavior. This hypothesis could not be confirmed by the current study. Whilst the ANOVA analysis did identify a type of climber with higher anxiety scores (boulderers), this group did not show elevated values in any of the eating disorder questionnaires.

Among top rope climbers, we found some results that could be interpreted as support for our hypothesis. A positive correlation was established between anxiety and emotional eating and external eating behavior. It is interesting that this pattern was not found in the boulderers, who showed the highest anxiety levels overall or in the between group analysis (i.e., that the highest anxiety group would also show the highest levels of DE behavior). This is perhaps related to the negative correlation that was established between mental toughness and anxiety among boulderers. The correlations shown in Table 4 show that, while top rope athletes with high anxiety levels show elevated values for DE, these correlations are insignificant among boulderers. Instead, boulderers with high anxiety show lower levels of mental toughness. This might indicate a difference in coping strategies between these groups, where boulderers might be less likely to develop DE as their coping strategy more so affects mental toughness. It is noteworthy however, that our between group analysis did not identify significant differences in mental toughness between groups. So even though it seems that this high-anxiety group used a coping strategy that might affect mental toughness, the group mean mental toughness score was not significantly affected. It would suggest that boulderers have developed an effective coping strategy against DE, without too severe side effects on mental toughness. In the lower anxiety-top rope climbers,

athletes are less practiced with coping with high anxiety, and athletes might not develop these strategies to cope with anxiety. This would make these athletes more prone to DE if they do experience high anxiety. This explanation would add to the growing body of work showing psychological benefits of bouldering, for instance the research showing bouldering to be an effective intervention to combat symptoms of depression [24–26].

Whilst some studies exist comparing the psychophysiological demands of lead vs top rope climbing [27], not much is known about the anxiety levels associated with bouldering. We have found higher anxiety levels reported by boulderers. It is a slight limitation that this was a general measure of anxiety [22] and not an in situ measure during or straight after a climb, it does however give some indication that anxiety might be higher in the bouldering compared to the top rope condition. Future studies could investigate whether this effect can also be established during or directly after climbs.

The current study has some limitations. The sample size used in the current study is relatively low compared to other recent studies investigating DE in athlete populations (e.g., $N=225$ in [28], 2021 and $N=406$ in [29]) and the sample is quite diverse (e.g., incorporating professional and non-professional climbers). However even with these limitations, we were able to discover significant relationships among the variables of interest, which shows that this study is sufficiently powered to discover the strongest effects within the data. Second, it should be noted that this study is based on measures of trait anxiety and not necessarily climbing-specific anxiety. As such, we can only make inferences on how the climbing type might influence anxiety and DE, but a causal relationship cannot be established. Together, these limitations underscore the preliminary nature of this study and emphasize the relevance for further studies in this field using indicators of anxiety during the climbs rather than trait anxiety.

Considering the different weight and anxiety demands in different climbing types, the current study assessed differences between bouldering, top rope or combined bouldering and top rope athletes on the relationship between anxiety and DE. It could not be confirmed that specific climbing types directly lead to the occurrence of DE, however, based on our results it seems plausible that climbers that have more experience in coping with high anxiety (boulderers) might have better coping strategies, weakening a potential relationship between anxiety and disordered eating (which was present in the top rope group). If future studies can confirm these mechanisms, then it might have significant implications for future prevention of DE. Bouldering (or anxiety-inducing exercise) could be hypothesized to be an adequate intervention to develop better coping strategies against anxiety and have a protective effect against DE.

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Declarations

Conflict of interest The authors declare no conflicts of interest.

Ethical approval Ethical approval was obtained from the Qazvin University of Medical Sciences ethics committee (IR.QUMS.REC.1400.514) and the researchers adhered to the Declaration of Helsinki.

Informed consent Informed consent was obtained from all participants.

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