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ORIGINAL RESEARCH

Rock climbing and acute emotion regulation in patients with major depressive disorder in the context of a psychological inpatient treatment: a controlled pilot trial

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Background: Major depressive disorder is characterized by deficits in emotion regulation. This study examined associations between rock climbing and acute emotion regulating effects in patients with major depression.

Patients and methods: In a nonrandomized, controlled study, 40 major depressive disorder inpatients were assigned to either a climbing session (n=20) or a relaxation session (n=20). Positive and negative affect, depressiveness, and coping emotions were assessed immediately before and after the session.

Results: Mixed analyses of variance and covariance revealed significant time × group interaction effects for all assessed outcomes ($p \leq 0.012$): positive affect and coping emotions significantly increased and negative affect and depressiveness significantly decreased after the climbing session ($1.04 \leq$ Cohen's $d \leq 1.30$), in contrast to a relaxation session ($0.16 \leq$ Cohen's $d \leq 0.36$).

Conclusion: The results show that rock climbing is associated with acute emotion regulatory effects. These findings have to be replicated with a randomized design, and future research should pay attention to possible mechanisms of rock climbing in regard to emotion regulation.

Keywords: physical activity, controlled trial, relaxation, inpatient treatment

Introduction

Emotion regulation is defined as "processes by which individuals influence which emotions they have, when they have them, and how they experience and express these emotions" (p. 275).[1] Emotion regulation deficits have been demonstrated to be a significant pathomechanism in one of the most prevalent mental disorders – major depressive disorder (MDD) – which is, beside other symptoms, characterized by sustained negative affect (NA) and diminished positive affect (PA).[2,3] Authors of modern cognitive theories assume that cognitive biases in attention, memory, or interpreting emotion eliciting, ambiguous events underlie these difficulties in emotion regulation in depressive people.[2,4–6] Moreover, it is proposed that deficits in cognitive control and executive functioning impact negatively the ability to cope with the mentioned cognitive biases and result in a more frequent use of maladaptive emotion regulatory strategies.[2]

Results of a longitudinal study showed that applying adaptive emotion regulation strategies predicts lower depressive symptom severity over a 5-year follow-up in patients with MDD.[7] Physical exercise has been demonstrated to have positive acute and long-term emotion regulatory effects and could therefore be considered as a potential successful emotion regulation strategy in depressive individuals.[8–10] In particular, rock climbing is a

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type of sport that combines several features which can probably have an impact on cognitive and emotion regulation deficits in depressive patients. It requires high concentration and high levels of coordination, for example. Studies demonstrated that physical activity connected to high levels of coordination have a positive effect, especially on cognitive control.[11] Moreover, rock climbing can activate intense positive emotions.[12] Since the difficulty level can be flexibly varied according to individual fitness, climbing is particularly suitable to prompt a sense of goal achievement and self-efficacy.[12] Moreover, rock climbing also requires and trains the cooperation between individuals within small groups, as the climbing person always has to rely on safety measures provided by others with switching roles throughout the climbing session.

To date, acute changes in emotions associated with rock climbing in depressive patients have not been researched explicitly. Some case reports and observational studies and one controlled pilot trial demonstrated positive general therapeutic effects of rock climbing on depressive and anxiety symptoms and self-efficacy in depressive patients.[13–18] None of the mentioned studies, however, examined the immediate changes after a single rock climbing experience in different kinds of negative emotional states in depressive individuals. Accordingly, central aims of this nonrandomized, controlled trial were to examine if negative emotional states decrease and positive emotional states or coping emotions (CE; eg, pride, self-confidence) increase in persons with MDD during a 2.5-hour rock climbing session in comparison to an active control condition (relaxation training).

Patients and methods

Participants and study procedure

This pilot trial included a total of 40 adult inpatients receiving a psychologic and psychiatric inpatient treatment in the Department of Psychiatry and Psychotherapy of the University of Tuebingen (Germany). Eligible participants had to fulfil the criteria of an MDD or a bipolar disorder, with most recent episode of depression, according to the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). Patients suffering from a psychotic disorder were excluded. Presence of other comorbid mental disorders such as anxiety disorders, substance use disorders, or posttraumatic stress disorder was, however, not an exclusion criterion.

Eligible participants were not randomized, but had free choice of joining either the experimental intervention – climbing therapy (climbing group [CG]; n=20) – or the control condition (relaxation group [RG]; n=20) – progressive muscle relaxation (PMR) by Jacobson.[17] The study procedure was the same for both interventions. Participants were asked to fill in the self-report questionnaire on depression and different emotional states, 30 minutes before the intervention started (T1) and immediately after the end of the intervention (T2). All subjects participated in the intervention for the first time during their hospitalization. A written informed consent was obtained from each participant at T1. The study was approved by the ethics commission of the Medical Faculty of the Eberhard Karls University and the University Hospital Tübingen. Data were collected between March 2013 and September 2013.

Materials

In order to assess PA and NA, the Positive and Negative Affect Scale (PANAS) was administered.[19] The PANAS consists of a list of words describing different emotions and feelings (eg, upset). Participants were instructed to rate on a 5-point Likert scale if they had experienced these emotional states over the last week. The PANAS contains two subscales, PA and NA. The internal consistency of the PANAS subscales (PA: Cronbach's α=0.89; NA: Cronbach's α=0.85) has been proven and was sufficient in the current sample at both pre- and post-assessment (PA: Cronbach's α=0.90–0.95; NA: Cronbach's α=0.83–0.91).[19] In order to assess depressiveness and CE, the authors of this article created further items which were rated on the same answering scale (5-point Likert scale: 1=very slightly or not at all, 5=extremely) and had the same instruction ("Indicate the extent you have felt this way over the past week") as the PANAS items. Depressiveness was assessed with the following three emotion words: worthless, depressed, and hopeless. CE were measured with the following 11 items: confident, optimistic, brave, strong, determined, proud, interested, valuable, safe, secure, and grateful. For both scales – depressiveness and CE – the internal consistency was analyzed at the pre- and post-assessment in order to check if the items could be summarized in a scale mean score. Cronbach's α values appeared to be satisfactory (depressiveness: α=0.77–0.88; CE: α=0.90–0.95).

Interventions

The climbing session took place once a week in a private climbing hall and lasted 2.5 hours. It included 8–12 participants who were guided by at least two specialized nurses trained in climbing therapy. Every session followed the same agenda: After warming up exercises, the climbing equipment was presented. Games were played at the climbing wall in jump height to familiarize the patients with certain kinds of movement. The patients were taught the safety knots before they started climbing with a nurse as belay partner. At the end,

the patients and the therapists shared their thoughts and feelings concerning the intervention. The control condition was based on PMR. The intervention took place in the hospital and was implemented by a psychologist. After explaining the principles of PMR to the participants, the relaxation exercise was conducted, lasting between 25 and 35 minutes. After the relaxation exercise, patients were invited to share their feelings about the relaxation exercise and their experiences.

Statistical analyses

Data analyses were conducted using SPSS 21.0. Independent *t*-test and chi-square test were applied in order to check for between-group differences in demographic and outcome variables at baseline. Due to mainly significant moderate and large intercorrelations between the outcomes at pre-assessment ($0.45 \leq r \leq 0.88$) and at post-assessment ($0.38 \leq r \leq 0.93$), we decided for a mixed 2 (intervention: CG vs RG)×2 (time: pre- vs post-intervention) multivariate analysis of variance. In order to break up the interaction effects on depressiveness, CE, NA, and PA, Bonferroni-corrected post hoc univariate mixed 2×2 analyses of covariance (ANCOVAs; according to Bonferroni correction and number of analyses=4, α error level was 0.0125) and pairwise comparisons of cell means were conducted. Significant between-group differences in sociodemographic variables or outcomes were entered as covariates in the univariate ANCOVAs. Within-subject and between-group effect sizes were estimated by calculating Cohen's *d* and Hedges' *g*.

Results

Participants' characteristics

The sample of 40 patients was on average 40.56 years (SD=12.82) old and included 19 women (47.5%). In the total sample, 50.0% had a secondary school degree, 20.0% had a high school degree, 22.5% had a university degree, and 7.5% did not specify their educational level. The average body mass index of the total sample was 25.54 (SD=5.42). There were no differences between the CG and the RG regarding age, $t(37)=-1.35$, $p=0.187$; gender, $\chi^2(1, N=40)=0.10$, $p>0.999$; educational level, $\chi^2(5, n=37)=6.87$, $p=0.231$; and body mass index, $t(36)=0.17$, $p=0.865$. In the CG, 85% (n=17) suffered from a major depression, whereas 15% (n=3) had a bipolar disorder. The distribution of the main diagnosis of an affective disorder was similar in the RG (major depression: n=18, 90%; bipolar disorder: n=2, 10%). The following comorbid disorders were found in the CG: substance use disorder (n=2, 10%), anxiety disorder (n=1, 5%), adjustment disorder (n=1, 5%), personality disorder (n=1, 5%), and posttraumatic disorder (n=1, 5%). In the RG, anxiety disorders were the only comorbid disorders (n=1, 5%). Regarding the Patient Health Questionnaire-9 as a measure of the severity of depressive symptoms, participants of the CG reached a sum score of 15.10 (SD=5.42) and participants of the RG reached a sum score of 13.53 (SD=5.68) on average.[20] Both groups did not differ in regard to the Patient Health Questionnaire-9 score, $t(37)=0.89$, $p=0.382$. There were also no significant differences between the CG (n=5, 25%) and the RG (n=9, 45%) regarding a comorbid medical condition, χ^2 (df=1, N=40)=1.26, $p=2.62$. Furthermore, there were no significant baseline between-group differences regarding the scales' depressiveness, $t(38)=1.15$, $p=0.256$; CE, $t(38)=1.48$, $p=0.149$; and NA, $t(32)=0.56$, $p=0.578$. Regarding the scale PA, the two groups showed a significant difference, $t(38)=2.31$, $p=0.026$, at baseline, which indicated a higher PA in the CG.

Effects of climbing vs relaxation on affect and CE

The mixed 2×2 multivariate analysis of variance revealed a significant effect of time, $F(4,35)=12.09$, $p<001$; intervention, $F(4,35)=5.80$, $p=0.001$; and a significant interaction time × intervention, $F(4,35)=5.18$, $p=0.002$. Post hoc univariate mixed 2×2 univariate analysis of variance (ANOVA) were calculated for CE, depressiveness, and NA. Regarding PA, a univariate mixed 2×2 analysis of covariance (ANCOVA) with PA values at baseline as covariate was conducted. The covariate reached significance, $F(1,37)=219.44$, $p<0.001$. After Bonferroni correction, the post hoc mixed 2×2 ANOVAs/ANCOVA demonstrated significant effects of time and significant time × intervention interaction effects for all dependent variables. For PA and CE, but not for NA and depressiveness, even the effect of group reached significance in the 2×2 ANOVAs/ANCOVA. Bonferroni-corrected post hoc pairwise comparisons of mean cells were conducted in order to break up these mean and interaction effects. They revealed a significant decrease of NA ($p<0.001$) and depressiveness ($p<0.001$), and a significant increase of PA ($p<0.001$) and CE ($p<0.001$) in the CG, but not in the RG ($0.093<p<0.574$). In regard to all dependent variables, post hoc pairwise comparisons revealed no significant between-group differences before the intervention ($0.149<p<0.578$), but depressiveness ($p<0.010$) was significantly lower and PA ($p<0.001$) and CE ($p<0.001$) were significantly higher in the CG in comparison to the RG. In regard to NA, the difference between CG and RG failed to reach significance ($p=0.079$).

Moderate to large between-group effect sizes in favor of the climbing intervention were found for each dependent variable (Table 1). In regard to the difference between pre- and post-assessment in the CG and RG, small to very small effect sizes were identified (Table 2).

Table 1 Test statistics of main and interaction effects of univariate mixed 2×2 analyses of variance/covariance for all dependent variables and effect sizes with 95% confidence intervals

Outcome	Effect	*F*	df_{num}/df_{den}	*p*-value	Hedges' g (95% CI)[a]
Depressiveness	Group × time	8.99*	1/38	0.005	
	Group	5.41	1/38	0.025	1.03 (0.62; 1.98)
	Time	24.47*	1/38	<0.001	
Positive affect[b]	Group × time	26.55*	1/37	<0.001	
	Group	26.55*	1/37	<0.001	0.74 (0.10; 1.38)
	Time	25.33*	1/37	<0.001	
Negative affect	Group × time	6.90*	1/38	0.012	
	Group	0.49	1/38	0.487	0.57 (–0.07; 1.20)
	Time	25.66*	1/38	<0.001	
Coping emotions	Group × time	18.39*	1/38	<0.001	
	Group	8.63*	1/38	0.006	1.30 (0.62; 1.90)
	Time	36.80*	1/38	<0.001	

Notes: df_{num}/df_{den}= degrees of freedom of numerator/denominator. [a]Positive values indicate effects in favor for the climbing intervention. [b]For positive affect, a mixed 2×2 analysis of covariance with baseline values of positive affect as the covariate was conducted. *Statistical significance after Bonferroni correction (p=0.0125).
Abbreviation: CI, confidence interval.

Table 2 Mean values, SDs, and Cohen's *d* separately for each dependent variable and study group

	Climbing group, N=40			Relaxation group, N=40		
	Pretreatment	Posttreatment		Pretreatment	Posttreatment	
	M (SD)	M (SD)	Cohen's *d* (95% CI)	M (SD)	M (SD)	Cohen's *d* (95% CI)
Depressiveness	1.52 (0.98)	0.63 (0.72)	1.04 (0.34; 1.73)	1.90 (1.11)	1.68 (1.25)	0.19 (–0.44; 0.81)
Negative affect	1.40 (0.94)	0.53 (0.66)	1.07 (0.37; 1.77)	1.25 (0.61)	0.98 (0.91)	0.36 (–0.27; 0.99)
Positive affect	1.94 (0.75)	2.91 (0.74)	1.30 (0.56; 2.04)	1.36 (0.84)	1.52 (0.83)	0.19 (–0.43; 0.81)
Coping emotions	1.82 (0.72)	2.64 (0.69)	1.16 (0.45; 1.88)	1.45 (0.87)	1.59 (0.91)	0.16 (–0.46; 0.78)

Abbreviations: CI, confidence interval; SD, standard deviation.

Discussion

The aim of this study was to examine if a single rock climbing session is associated with acute changes in PA and NA states in a group of inpatients with MDD. Results showed that rock climbing was significantly more related to a positive emotion regulatory effect regarding depressiveness, NA and PA, and CE, in contrast to a relaxation intervention. These findings are in accordance with general mood-improving effects of physical activity as well as the results of a pilot trial which explicitly examined the therapeutic effect of a rock climbing intervention on depressive symptomatology.[8–10,18,21,22]

Different mechanisms through which rock climbing could probably act on emotional states in depressive patients are discussed subsequently. First, high levels of concentration and coordination which are required by this type of sport can counteract the cognitive deficits and biases in depressive patients, for example, by helping them to overcome difficulties in disengaging from negative stimuli.[5] Second, in this trial, the rock climbing intervention was supervised and took place in a group. Thus, it provided a setting of interpersonal experiences. According to a model of the role of social support in depression by Marroquin, interpersonal influences can function as emotion regulation strategy by effects on attentional deployment (eg, encouraging reorientation to positive features of a situation) and on cognitive changes (eg, supplying information which is inconsistent to cognitive schema).[23] Third, Beck defines in his cognitive theory of depression the cognitive triad comprising a negative view on the self, the world, and the future.[24] Since rock climbing can foster experiences of self-efficacy and goal achievement, it could act as emotion regulatory strategy by targeting negative cognitive schemas about the self.[12]

To our knowledge, this is the first controlled study that examined acute changes of emotions after rock climbing in patients with MDD. Results, however, have to be interpreted cautiously due to several limitations such as a nonrandom assignment of patients to study groups, significant between-group difference in PA at baseline, a small sample size, a missing no-intervention control group, lack of control for participants' previous climbing experiences, lack of an objective measure of physical fitness, missing follow-up assessments, the use of scales that were not sufficiently validated, and differences in the duration between the interventions.

However, in summary, our findings demonstrate that types of sport requiring high levels of concentration and coordination and being associated with an early experience of goal achievement are probably associated with short-term emotion regulatory effects. Our results should be replicated with a randomized study design which overcomes all limitations of the current pilot trial. In the context of a randomized allocation to the study conditions, it should be especially examined if the effects we found can be attributed to the climbing activity and how long the effects endure. Furthermore, more attention should be paid to potential mechanisms of action of rock climbing in regard to emotion regulation.

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