Viewing an alpine environment positively affects emotional analytics in patients with stress-related psychiatric disorders

CURRENT STATUS: UNDER REVIEW

Katharina Hüfner
Medizinische Universität Innsbruck
katharina.huefner@tirol-kliniken.at
ORCiD: https://orcid.org/0000-0002-5453-8792

Cornelia Ower
Medizinische Universität Innsbruck

Georg Kemmler
Medizinische Universität Innsbruck

Theresa Vill
Medizinische Universität Innsbruck

Caroline Martini
Medizinische Universität Innsbruck

Andrea Schmitt
Ludwig-Maximilians-Universität München

Barbara Sperner-Unterweger
Medizinische Universität Innsbruck

DOI: 10.21203/rs.3.rs-15834/v1

SUBJECT AREAS
Psychiatry

KEYWORDS
alpine environment, resilience, self-perceived stress, self-assessment manikin, emotional analytics, psychosomatic disorders
Abstract
Background: Patients with stress-related psychiatric (psychosomatic) disorders often don’t respond well to medical treatment and experience many side effects. It is thus of clinical relevance to identify alternative, scientifically based, treatments. Our approach is based on the recent evidence that urbanicity has been shown to be associated with an increased risk for mental disorders. Conversely green and blue environments show a dose-dependent beneficial impact on mental health.
Methods: Here we evaluate the effect of viewing stimuli of individuals in an alpine environment on emotional analytics in 183 patients with stress-related psychiatric disorders and 315 healthy controls (HC). Emotional analytics (valence: unhappy vs happy, arousal: calm vs excited, dominance: controlled vs in control) were assessed using the Self-Assessment Manikin.
Results: Patients showed significantly lower levels of resilience and significantly higher scores of self-perceived stress. Emotional analytics of patients indicated that they feel less happy, less in control and had higher levels of arousal than HC when viewing neutral stimuli. The comparison alpine>neutral stimuli showed a significant a positive effect of alpine stimuli on emotional analytics in both groups. Patients and HC both felt attracted to the scenes displayed in the alpine stimuli. Emotional analytics correlated positively with resilience and inversely with perceived stress.
Conclusions: Preventive and therapeutic programs for patients with stress-related psychiatric disorders should take benefits of outdoor natural environments into account. Organizational barriers which are preventing the implementation of such programs in clinical practice need to be identified and addressed.
1. Background
Natural environments have been shown to improve physical and mental health: A meta-analysis reported a 8% reduction in all-cause mortality for residents with the highest nature outdoor exposure compared with the lowest exposure group (Gascon et al. 2016). Visit to blue (de Bell et al. 2017) and green (van den Berg et al. 2016) spaces is associated with psychological benefits linked to the nature experience. Stress is an important mediator of the effect of natural outdoor environments and mental well-being (Triguero-Mas et al. 2017). Green spaces have been shown to reduce cortisol levels as a
marker of stress (Twohig-Bennett and Jones 2018). Stress as important marker of mental health is significantly reduced by the exposure to nature and even by only the visual stimulation with nature without physical exposure in a dose-response relationship (Hazer et al. 2018). Visual or auditory nature stimuli can facilitate recovery from psychological stressful events (Brown et al. 2013; Alvarsson et al. 2010) and from physical disease (Ulrich 1984). In mental health, chronic stress is among the strongest risk factors for depression but is also an important pathogenetic factor in anxiety disorders, post-traumatic stress disorders or somatoform disorders (Slavich and Irwin 2014). Another factor through which exposure to natural outdoor environments exerts its positive effect on mental health might be through the strengthening of resilience (Ritchie et al. 2014; Panno et al. 2017). Resilience can be defined as one’s ability to cope with and recover from adverse life events. Resilience is improved by physical activity performed in a natural outdoor environment but is not associated with physical activity performed indoors (Ower et al. 2018). When the natural environment is used to perform physical activity the positive effects of physical activity and natural environments can be combined: there is evidence that exercising outdoors results in greater improvements of mental well-being than exercising indoors with greater feelings of delight, energy and revitalization, as well as decreases in frustration, tiredness and anger (Thompson Coon et al. 2011). The positive effects of the alpine natural environment have rarely been examined. One of the few available studies suggests that watching grand mountain scenes triggers a greater mood improvement than mundane nature. Furthermore participants were feeling significantly more connected to others, more caring, and more spiritual after watching awe-inspiring nature condition (Joye and Bolderdijk 2015). Hikers of alpine wilderness trails reported substantial stress reduction and mental rejuvenation following a day or overnight hike (Cole and Hall 2010). Furthermore in a crossover trial focusing on differences between indoor and alpine activity, mountain hiking showed significantly greater positive effects on affective valence and activation compared to indoor physical activity (Niedermeier et al. 2017a).

Although these studies report an improvement on various psychological measures, they do not refer to a possible therapeutic effect in mental health. There are only few studies investigating therapeutic
alpine interventions as treatment for patients in mental health care. In a mountain hiking program for suicidal patients, participants reported significant reduction in depression, hopelessness and suicidal ideation (Sturm et al. 2012). In another study adults and youth with mental illness experienced significant improvements in self-esteem, mastery and resilience following activities like mountain biking and raft building (Bowen et al. 2016).

In the present study, we assessed emotional analytics upon viewing neutral and alpine stimuli in patients with stress-related psychiatric disorders and controls. The alpine stimuli depicted one or several individuals while engaged in physical activity in an alpine environment. Furthermore we evaluated self-perceived stress, resilience and the amount of self-performed physical activity in an alpine environment. Our main aim was to explore if emotional reactions to pictures of individuals in an alpine environment would differ between patients with stress-related psychiatric disorder and controls.

2. Methods
2.1. Study design
The current data is part of a larger cross-sectional observational study investigating the effect of physical activity in an alpine environment on mental health in 2016 over a 4 month period. Parts of this study have been published (Ower et al. 2018). The institutional review board (ethics commission of the Medical University of Innsbruck) reviewed and approved the study protocol. After being informed in detail about the study aims and procedures, participants provided informed written consent online by clicking on the consent statement and manually adding the date of consent, prior to study participation. This method of consent was approved by the ethics commission of the Medical University of Innsbruck.

Participants
Participants and recruiting are described in Ower et al. 2018, participant numbers vary slightly compared to the previous publication due to missing data in individual participants. In brief, a total of 1029 participants were recruited to participate in an open online survey. This included healthy participants as well as patients treated at the Department for Psychosomatic Medicine at Innsbruck.
Medical University. Participants who terminated the questionnaire early (missing data n = 436) who reported implausible values, who screened positively for alcohol abuse only or for an eating disorder only (using physical activity for losing weight) were excluded from the present analysis (Fig. 1). There were 4–13% missing values for individual SAM ratings. The 498 participants included in the present analysis consisted of a group of patients (defined by positive screen on the Patient Health Questionnaire (PHQ, n = 183)) and a group of healthy participants (HC, negative PHQ screening; n = 315).

2.2. Stimuli
Stimuli were alternating neutral pictures (re-staged to official International Affective Picture System (IAPS) pictures (slide no. 6150, 7009, 5661, 5500, 7150)) and alpine stimuli (Fig. 2). Alpine stimuli displayed alpine environments with individuals performing some sort of physical activity therein (e.g. hiking, biking, skiing). Two picture stimuli had to be excluded due to statistical outliers in the ratings. Pictures were displayed for 5 seconds before the page with the emotional analytic ratings appeared. Each stimulus could only be observed once.

2.3. Measures
Socio-demographic parameters included information on age, sex, education and marital status. Mental health was assessed using the German version of Patient Health Questionnaire (Gräfe et al. 2004). Additionally, open text fields were provided for entering psychiatric diagnoses. Resilience was measured using the Brief Resilience Score (BRS) (Smith et al. 2008), self-perceived stress using the Perceived Stress Scale (PSS) (Cohen et al. 1983) and Physical activity using the Global Physical Activity Questionnaire (GPAQ-2) (Bull et al. 2009).

To measure emotional response we used the Self-Assessment Manikin (SAM) 9-point Likert-scale. This scale measures emotional analytics in the three dimensions valence, arousal and dominance (J Lang et al. 2008). The valence scale ranges from a frowning, unhappy (adjectives used in the SAM manual: unhappy, annoyed, unsatisfied, melancholic, despaired, bored; lower values) to a smiling, happy figure (happy, pleased, satisfied, contented, hopeful). The arousal scale displays the lowest value with a calm, eyes-closed figure (relaxed, calm, sluggish, dull, sleepy, unaroused), whilst the highest value
is represented by an excited figure (stimulated, excited, frenzied, jittery, wide-awake, aroused). The lowest values in the dominance scale are symbolized by a controlled small figure (controlled, influenced, cared-for, awed, submissive, guided.) whilst highest values are represented by a dominant and oversized figure (controlling, influential, in control, important, dominant, autonomous). After presenting a picture for five seconds participants were asked to rate their emotional reaction in the three dimensions. For alpine stimuli, we added a fourth dimension asking about ones attraction to the situation, labelled motivational direction. The 9 point Likert-scale ranged from “I don’t want to be in this situation” to “I want to be in the situation”.

2.4. Statistical methods
Metric variables were analyzed for normal distribution prior to applying further statistical tests by assessing their skewness, considering values > 0.5 or < -0.5 as deviations from a symmetric distribution requiring non-parametric testing. To compare emotional reactions between overall neutral and alpine pictures we created a mean score for each category. In each category one picture was excluded due to statistical outliers (paraglide in alpine pictures; red wall in neutral pictures). Mean score were calculated for each emotional dimension per person if at least three scores were completed. Group comparisons (patients vs. HC) were performed using t-test, Mann-Whitney U-test and Chi-square test, depending on the variable type and distribution. The relationship between resilience, self-perceived stress, PA and emotional analytics was investigated on a descriptive level by means of correlation analysis. Spearman rank correlation coefficients were used as most the variables involved showed deviations from a normal distribution.

3. Results
3.1. Sociodemographic characteristics and clinical features
The sociodemographic characteristics of patients and HC are displayed in Table 1. Patients’ diagnoses according to PHQ were in decreasing frequency: somatoform disorder (n = 101, 55.2%), major depressive syndrome (n = 67, 36.6%), other anxiety syndrome (n = 45, 24.6%), panic syndrome (n = 36, 19.7%), other depressive syndrome (n = 34, 18.6%), alcohol abuse (n = 31, 16.9%), binge eating disorder (n = 23, 12.6%), bulimia nervosa (n = 10, 5.5%) and others (n = 2, 1.1%). More than half of the patients (n = 100, 51.9%) were diagnosed with more than one mental health disorder, the most
The prevalent combination was somatoform disorder and major depressive syndrome (n = 42, 23.0%).

Table 1

Sociodemographic characteristics of patients and healthy controls (adapted with participant numbers for the current analysis from Ower et al. 2018)

| Variable                        | Groups                          | Comparison | Test statistics | D.f.  | p-value |
|---------------------------------|---------------------------------|------------|----------------|-------|---------|
| Age in years<sup>a</sup>        | Patients (n = 183)              | Controls (n = 315) | Z = 2.42        | 0.016 |         |
| Female gender<sup>b</sup>       | 117 (63.9)                      | 187 (58.4) | χ² = 1.02       | 1     | 0.313   |
| Education<sup>b</sup>           | -                               | -          | χ² = 30.989     | 3     | < 0.001 |
| University                      | 41 (22.4)                       | 111 (35.2) |                | -     | -       |
| Secondary school                | 62 (33.9)                       | 133 (42.2) |                | -     | -       |
| Vocational training             | 53 (29.0)                       | 34 (10.8)  |                | -     | -       |
| Compulsory school and other     | 27 (14.8)                       | 37 (11.7)  |                | -     | -       |
| Marital status<sup>b</sup>      | -                               | -          | χ² = 13.699     | 2     | 0.001   |
| Single                          | 105 (57.4)                      | 194 (61.6) |                | -     | -       |
| Married                         | 56 (30.6)                       | 110 (34.9) |                | -     | -       |
| Separated/divorced/widowed      | 22 (12.0)                       | 11 (3.5)   |                | -     | -       |
| Employment<sup>b</sup>          | -                               | -          | χ² = 66.81      | 2     | < 0.001 |
| Full-/part-time employment      | 75 (41.0)                       | 177 (56.2) |                | -     | -       |
| In education/study/vocational training | 49 (26.8) | 122 (38.7) |                | -     | -       |
| Unemployed                      | 59 (32.2)                       | 16 (5.1)   |                | -     | -       |

<sup>a</sup> mean ± standard deviation
<sup>b</sup> absolute number (percent)

3.2. Comparison of resilience, self-perceived stress and emotional analytics in patients and HC

The mean score of the Brief Resilience Scale (BRS) was significantly lower in patients than in HC (Mann-Whitney U Test-Test, p < 0.001; Table 2). Furthermore the total score of the PSS was significantly higher in patients than in HC (Mann Whitney U Test, p < 0.001; Table 2).

Comparing the mean emotional analytics score in neutral and alpine stimuli, patients reported significantly lower values for valence (both ps < 0.001) indicating that they felt less happy than HC, and dominance (neutral: p = 0.021, alpine: p < 0.001; Table 2) indicating that they felt less in control than HC. Arousal when viewing neutral stimuli was significantly higher (p < 0.001) for patients indicating that they felt more aroused or jittery than the HC at baseline. In alpine pictures the
difference in arousal was not significant between patients and HC (p = 0.223; Table 2). In the fourth dimension asking about attraction to the displayed alpine situation, the mean score was significantly lower in patients as in HC (p < 0.001 Table 2) although both groups showed a high attraction to the alpine stimuli.

To measure the effect of the alpine stimuli normalized to the neutral baseline, we evaluated the difference of each emotional dimension between alpine and neutral pictures. The comparison alpine > neutral stimuli was significantly greater than 0 for both patients and HC indicating a positive effect of alpine stimuli on emotional analytics. For valence and dominance this comparison of alpine > neutral stimuli did not differ significantly between patients and HC (Table 2). For arousal the difference was significantly smaller in patients than in HC due to higher baseline arousal values in patients (p < 0.001; Table 2).

| Variable | Group | Comparison | Test statistics | p-value\(^b\) |
|----------|-------|------------|----------------|-------------|
| Resilience (BRS mean score) | Patients (N = 183) Mean ± SD | Controls (N = 315) Mean ± SD | Z=-11.84 | < 0.001 |
| Stress (PSS score) | 9.53 ± 3.61 ↑ | 4.73 ± 2.50 | Z=-13.47 | < 0.001 |
| SAM Rating Neutral pictures | | | |
| Valence | 5.09 ± 1.06 ↓ | 5.65 ± 1.21 | Z=-4.696 | < 0.001 |
| Arousal | 4.13 ± 1.31 ↑ | 3.38 ± 1.23 | Z=5.848 | < 0.001 |
| Dominance | 4.78 ± 1.08 ↓ | 5.13 ± 1.35 | Z=-2.312 | 0.021 |
| Alpine pictures | | | |
| Valence | 6.99 ± 1.68 ↓ | 7.85 ± 1.12 | Z=-5.661 | < 0.001 |
| Arousal | 5.01 ± 1.76 | 5.17 ± 1.94 | Z=-1.218 | 0.223 |
| Dominance | 5.85 ± 1.52 ↓ | 6.42 ± 1.58 | Z=-3.655 | < 0.001 |
| Attraction | 6.62 ± 2.10 ↓ | 7.52 ± 1.48 | Z=-4.106 | < 0.001 |
| Comparison (Alpine > Neutral) | | | |
| Valence | 1.91 ± 1.80 *** | 2.19 ± 1.42 *** | Z=-4.66 | 0.143 |
| Arousal | 0.87 ± 2.11 ↓** | 1.79 ± 1.91 *** | Z=-4.741 | < 0.001 |
| Dominance | 1.09 ± 1.61 *** | 1.29 ± 1.67 *** | Z=-1.465 | 0.143 |

\(^b\) p-values were calculated with Chi Square Test for categorical variables and Mann Whitney U Test for continuous variables

↑ Significantly higher scores in patients than in healthy controls
↓ Significantly lower scores in patients than in healthy controls
** Difference “alpine – neutral” significantly greater than 0, Z = 3.25, p < 0.01
*** Difference “alpine – neutral” significantly greater than 0, always Z ≥ 4.5, p < 0.001

Abbreviations: BRS: Brief Resilience Scale 13, PSS: Perceived Stress Scale

3.3 Correlation between resilience, self-perceived stress, physical activity in an alpine environment and emotional analytics
For the correlation analysis between resilience, self-perceived stress and emotional response, we combined the patient and HC group to one total sample. Resilience correlated positively in both neutral and alpine stimuli with the emotional analytics for valence, dominance and attraction (all ps < 0.001, Table 3) indicating that greater resilience was associated with higher emotional ratings. Self-perceived stress correlated negatively with valence, dominance and attraction in both categories (all ps < 0.05; Table 3) demonstrating that higher stress levels were associated with lower emotional ratings (Table 3).

Arousal while viewing neutral pictures correlated in an inverse way: negatively with resilience and positively with perceived stress. Subanalyses demonstrated that this was mostly due to patients’ values (not shown). This demonstrates that individuals with low resilience and high levels of stress feel more aroused or jittery at baseline compared to resilient individuals who feel calmer when viewing neutral stimuli. Physical activity in an alpine environment correlated positively with all four emotional analytics in alpine stimuli (all p < 0.001), whilst there was no significant correlation with neutral stimuli (Table 3).

Table 3
Correlation of emotional analytics (SAM) with resilience, self-perceived stress and PA in alpine environment
|                         | Total sample (n = 498) | BRS         | PSS         | PA in alpine environment (MET) |
|-------------------------|------------------------|-------------|-------------|--------------------------------|
| Neutral pictures       |                        |             |             |                                |
| Valence                | \( r_s \) 0.188**     | -0.249**    | 0.081       |                                |
|                         | \( p \) 0.000          | 0.000       | 0.078       |                                |
| Arousal                | \( r_s \) -0.183**    | 0.187**     | -0.091      |                                |
|                         | \( p \) 0.000          | 0.000       | 0.051       |                                |
| Dominance              | \( r_s \) 0.227**     | -0.150**    | -0.021      |                                |
|                         | \( p \) 0.000          | 0.002       | 0.656       |                                |
| Alpine pictures        |                        |             |             |                                |
| Valence                | \( r_s \) 0.303**     | -0.276**    | 0.440**     |                                |
|                         | \( p \) 0.000          | 0.000       | 0.000       |                                |
| Arousal                | \( r_s \) 0.073       | -0.096*     | 0.225**     |                                |
|                         | \( p \) 0.121          | 0.040       | 0.000       |                                |
| Dominance              | \( r_s \) 0.209**     | -0.172**    | 0.277**     |                                |
|                         | \( p \) 0.000          | 0.000       | 0.000       |                                |
| Attraction             | \( r_s \) 0.222**     | -0.172**    | 0.413**     |                                |
|                         | \( p \) 0.000          | 0.000       | 0.000       |                                |
| Comparison (Alpine > Neutral) |             |             |             |                                |
| Valence                | \( r_s \) 0.125**     | -0.043      | 0.316**     |                                |
|                         | \( p \) 0.007          | 0.358       | 0.000       |                                |
| Arousal                | \( r_s \) 0.175**     | -0.188**    | 0.266**     |                                |
|                         | \( p \) 0.000          | 0.000       | 0.000       |                                |
| Dominance              | \( r_s \) 0.043       | -0.025      | 0.278**     |                                |
|                         | \( p \) 0.368          | 0.604       | 0.000       |                                |

Abbreviations MET: metabolic equivalents, BRS: brief resilience scale, PSS: perceived stress scale. \( r_s \): Spearman rank correlation coefficient, \( p \): p-value, *\( p < 0.05 \), **\( p < 0.01 \), ***\( p < 0.001 \).

4. Discussion

In the present study we evaluated the relationship of emotional analytics, resilience and perceived stress when viewing alpine and neutral stimuli in patients with stress-related psychiatric disorders and healthy controls. Major findings were: 1) Patients with stress-related psychiatric disorders had lower values in resilience and higher levels of perceived stress than HC, 2) the emotional analytics valence and dominance were significantly lower in patients compared to HC for both alpine and neutral stimuli. Baseline arousal when viewing neutral stimuli was significantly higher in patients, 3) the emotional analytic scores were significantly higher for alpine compared to neutral pictures for patients as well as for HC, 4) Emotional analytics of alpine pictures correlated positively with resilience and physical activity in an alpine environment and inversely with perceived stress.

4.1. Resilience and psychosomatic stress in patients with psychosomatic disorders

In patients with stress-related psychiatric disorders we observed lower levels of resilience and higher levels of perceived stress compared to HC. These findings are in line with previous studies showing
that patients with mental disorders often lack strategies of a resilient mindset, which can improved during recovery (Lee et al. 2017). Likewise perceived stress has been shown to be elevated in states of emotional-ill being (Kadzikowska-Wrzosek 2012). Impaired resilience and higher perceived stress, are part of the current vulnerability-stress-model of psychosomatic disorders (Fava et al. 2017).

4.2 Emotional analytics in response to neutral and alpine stimuli in patients with stress-related psychiatric disorders

We found lower levels of valence and dominance in patients than in HC over all (neutral and alpine) stimuli. The lower levels of valence (i.e. more unhappy) reflect the fact that our largest subgroup in our patient group was „depressive disorders“ (55,2%). This confirms previous studies showing that patients suffering from depression tend to show lower levels of valence as they describe a feeling of numbness und joylessness in their lives (Dai et al. 2016). A dysfunction in emotional processing might be the underlying pathophysiological concept (Kemmis et al. 2017). Viewing alpine stimuli lead to a comparable increase in valence (feeling happier) and dominance (feeling more in control) in patients and controls. Baseline arousal was higher in the patients than HC a finding previously described in individuals with depressive symptoms (Gilbert et al. 2019). This led to a significantly smaller increase in arousal between neutral and alpine stimuli for patients than controls.

4.3. Association of resilience, perceived stress and emotional analytics

The association of resilience and perceived stress with emotional analytics was found not only in patients with stress-related psychiatric disorders but also in healthy controls. This underlines the theory that there is a continuum of health and disease also for stress-related psychiatric disorders, and that mechanisms of overtly ill patients are also present in individuals with sub-syndromal forms of psychosomatic disorders pointing towards general mechanisms of mental health (Keyes 2007).

4.4. The effect of alpine stimuli on emotional analytics

The effect the alpine environment on mental health has rarely been researched to date, most studies where performed on other natural environments. In the present study we found that both patients and HC reacted to alpine stimuli in form of a significant increase in valence, arousal and dominance compared to neutral stimuli. This finding of a positive impact on emotional analytics is in line with previous studies evaluating psychological and physical reactions to visual natural stimuli. Comparing
reactions to urban with those to natural scenery a significant increased positive affect in emotional response could be found in nature condition only using virtual reality stimuli (Valtchanov et al. 2010). The restorative effect of the natural environment, even if only present within visual stimuli, might be explained by a reduction in stress levels induced by exposure to views of nature (Valtchanov et al. 2010). Patients and HC showed higher emotional analytics for valence and dominance, but we also detected an increase in arousal in response to the alpine stimuli. This is in contrast with several studies pointing towards relaxation and tranquility felt while viewing natural environment (Davis 2004). One possible explanation of our diverging finding is that most of the alpine pictures shown in this study displayed physically active persons (e.g. downhill skiing). Comparable data were published by IAPS showing high arousal ratings in the SAM scale when viewing stimuli of physically active persons in alpine surroundings (J Lang et al. 2008).

4.5. The effect of physical activity in an alpine environment on mental health

Physical activity by itself and especially when performed in an outdoor/green/alpine environment is known to improve mental health. Few pilot studies could confirm the positive effect of the alpine environment when performing physical activity (Sturm et al. 2012; Niedermeier et al. 2017a; Ower et al. 2018). This is in line with our finding that self-performed physical activity (METs) correlates with higher valence and dominance felt by participants after viewing alpine but not neutral stimuli. Conversely some studies did not detect any differences in affective response when comparing alpine to indoor physical exercise (Niedermeier et al. 2017b). Furthermore no effect of anthropogenic elements in the alpine environment on acute stress-related physiological responses was found (Niedermeier et al. 2019). Importantly the latter studies as well as the present one showed a beneficial effect of outdoor physical activity on parameters of mental well-being. In most previous studies healthy controls and not patients with psychosomatic disorders were investigated.

4.6. Limitations

The main limitation of the study is that in a survey study no causal relationship between the emotional analytics and mental health can be obtained. Furthermore the exposure in our study was applied in form of visual stimuli instead of actually spending time in an alpine environment. The
present study does not allow the differentiation which components of viewing alpine environment lead to the observed positive effects on the emotional analytics.

4.7. Conclusion and consequences for clinical practice
Therapeutic programs for patients with stress-related psychiatric disorders should contain physical activity and according to our results, also take the effect of nature into account. The results from the current study indicate that patients with stress-related psychiatric disorders have a positive attitude towards physical activity in an alpine environment and that emotional analytics such as valence and dominance increase in patients and HC in a comparable manner. Practical strategies to implement such programs should be discussed. Obvious practical barriers to the implementation of such programs are primarily of a financial origin, since in our medical system money for medications and inpatient hospital stays is readily available while therapeutic programs including physical activity in an alpine environment are not financed by public healthcare.

Declarations
Ethics approval and consent to participate
The study was approved by the ethics committee of Innsbruck Medical University (AN2014-0243). After being informed in detail about the study aims and procedures, participants provided informed consent prior to study participation.

Consent for publication
Not applicable.

Availability of data and materials
Data are available from the first author upon request.

Competing interests
The authors report no conflict of interest.

Funding
This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' contributions
Study design: K.H., C.O., C.M., G.K., B.S-U.

Data Collection: K.H, C.O., C. M.

Data analysis: K.H., C.O., G.K., T.V.,

Data interpretation: all authors

Writing and review of manuscript: all authors

Acknowledgements

We thank Dr. Thomas Post, Dr. Ulrike Weber-Lau, Dr. Barbara Mangweth-Matzek, for help with patient recruitment and Dr. Christian Widschwendter for helpful discussion. This study is part of the doctoral thesis of Cornelia Ower.

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Figures
Figure 1

Flowchart of patient and healthy control recruitment.
Examples of alpine stimuli depicting individuals performing physical activity in an alpine environment. Neutral stimuli are not depicted since this is not considered good scientific practice for the IAPS picture collection (J Lang et al. 2008).