

Hiking in Suicidal Patients: Neutral Effects on Markers of Suicidality

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ABSTRACT

BACKGROUND: Regular physical activity promotes physical and mental health. Psychiatric patients are prone to a sedentary lifestyle, and accumulating evidence has identified physical activity as a supplemental treatment option.

METHODS: This prospective, randomized, crossover study evaluated the effects of hiking in high-risk suicidal patients ($n = 20$) who performed 9 weeks of hiking (2-3 hikes/week, 2-2.5 hours each) and a 9-week control period.

RESULTS: All patients participated in the required 2 hikes per week and thus showed a compliance of 100%. Regular hiking led to significant improvement in maximal exercise capacity (hiking period Δ : $+18.82 \pm 0.99$ watt, $P < .001$; control period: $P = .134$) and in aerobic capability at 70% of the individual heart rate reserve (hiking period Δ : $+8.47 \pm 2.22$ watt; $P = .010$; control period: $P = .183$). Cytokines, associated previously with suicidality (tumor necrosis factor- α , interleukin-6, S100), remained essentially unchanged.

CONCLUSIONS: Hiking is an effective and safe form of exercise training even in high-risk suicidal patients. It leads to a significant improvement in maximal exercise capacity and aerobic capability without concomitant deterioration of markers of suicidality. Offering this popular mode of exercise to these patients might help them to adopt a physically more active lifestyle.

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Psychiatric patients tend to lead a less active lifestyle and do not comply with recommendations of regular physical activity.^{1,2} Because exercising in green space has been shown to induce beneficial effects on mental and physical well-being,^{3,4} we designed a hiking program for high-risk suicidal patients and set out to assess its feasibility and effectiveness, as well as its impact on cytokines, which

have been associated with suicidality in depression, schizophrenia, and bipolar disorder.⁵⁻⁹

MATERIALS AND METHODS

This is a prospective, randomized, controlled, 9-week, crossover exercise training study in 20 high-risk suicidal patients (female, 14; male, 6). After baseline assessment, randomization allowed half of the patients to start with the 9-week hiking program followed by a 9-week control period (Hike-Control group) and vice versa (Control-Hike group).

The main inclusion criterion was high-risk suicidality, defined as at least 1 suicide attempt in the past and a current Beck Hopelessness Scale score of >26 . Of the 167 patients in our outpatient clinic who were invited to an informative event, 23 (female, 16; male, 7) met the inclusion criteria,

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gave written informed consent, and were subsequently recruited.

Patients were expected to participate in at least 2 of 3 supervised hikes per week. During each hike (2-2.5 hours), exercise intensity was controlled by heart rate monitors, which were set to 70% of the individual heart rate reserve.¹⁰

All hiking routes had the following in common:

- Altitude difference: 200 to 300 m
- Distance: 6 to 8 km
- Hiking time: 2 to 2.5 hours
- Alpine terrain without dangerous drops or cliffs

At the start, crossover, and end of the study, anthropometric data, exercise capacity, and cytokines (tumor necrosis factor- α , interleukin-6, S100) were assessed.

Data are presented as mean \pm standard deviation and were tested for normal distribution by Shapiro–Wilk. Data of the hiking and the control period were compared by paired *t* tests. Comparisons between groups were tested by 1-way analysis of variance. A *P* value $<.05$ was considered statistically significant. The protocol was approved by the Ethical Committee of the State of Salzburg and registered with Clinical-Trial.gov under the ID of NCT01152086.

RESULTS

Baseline characteristics are shown in **Figure 1**. Of the 20 patients, 17 completed the study (13 women, 4 men) and 3 patients dropped out early: 1 because of complications after shoulder surgery, 1 because of lack of time, and 1 because of an acute suicidal crisis. During the hiking period, all patients participated in the required number of hikes (Hike-Control group: 18.2 ± 5.0 hikes; Control-Hike group: 18.6 ± 4.1 hikes).

Exercise Capacity

Moderate hiking resulted in a highly significant improvement in maximal exercise capacity (Δ : $+18.82 \pm 0.99$ watt, $P < .001$), which remained essentially unchanged during the control period (Δ : -7.88 ± 5.31 watt; $P = .134$; **Figure 2**).

Physical work capacity at a heart rate of 130 beats/min (physical work capacity 130) significantly improved during hiking compared with the control period (after hiking: 1.15 ± 0.36 watt/kg; after control period: 1.04 ± 0.36 watt/kg; $P < .05$). Furthermore, a significant increase also was observed when watts achieved at a heart rate of 150 beats/min (physical work capacity 150) were compared (after hiking: 1.57 ± 0.45 watt/kg; after control: 1.44 ± 0.39 watt/kg; $P < .05$). Patients also showed highly significant improvement in aerobic capability at their individual training

heart rate (70% of heart rate reserve). Moreover, during the hiking period, exercise capacity significantly increased (Δ : $+8.47 \pm 2.22$ watt; $P = .01$), whereas during the control period no significant changes were observed (Δ : -3.82 ± 1.83 watt; $P = .183$).

CLINICAL SIGNIFICANCE

- Hiking is a feasible and well-accepted form of physical exercise training in patients with high-risk suicidality.
- Both maximal exercise capacity and aerobic capability increase with regular hiking.
- Systemic training effects were induced without concomitant increase in cytokines previously associated with suicidality.

Cytokines

Tumor necrosis factor- α remained essentially unchanged during the hiking period (11.83 ± 3.24 pg/mL to 11.88 ± 1.97 pg/mL; $P = .93$) and decreased significantly during the control period (11.94 ± 2.29 pg/mL to 10.87 ± 2.81 pg/mL; $P < .05$). No significant changes were observed for interleukin-6 or S100 during either period (interleukin-6: hiking period: 2.38 ± 1.19 pg/mL to 1.93 ± 0.93 pg/mL, $P = .12$; control period: 1.98 ± 0.91 pg/mL to 2.07 ± 1.09 pg/mL, $P = .78$; S100: hiking period:

0.06 ± 0.03 μ g/L to 0.07 ± 0.04 μ g/L, $P = .32$; control period: 0.07 ± 0.05 μ g/L to 0.07 ± 0.04 μ g/L, $P = .73$; **Figure 3**).

DISCUSSION

This is the first study to investigate the effects of a regular hiking program in high-risk suicidal patients. The main findings are as follows:

- Moderate hiking emerged as a feasible and highly accepted form of exercise training in otherwise rather sedentary patients with high-risk suicidality.
- Regular moderate hiking improves maximal exercise capacity and aerobic capability.
- Moderate hiking induced systemic training effects without increasing cytokines previously associated with deteriorated suicidality.

Recommendations of regular physical activity are not met by the general population and even less by suicidal patients, despite all the known beneficial effects it exerts on general and mental well-being.¹¹ One way to overcome this discrepancy between knowledge and behavior is to identify forms of exercise training that appeal to a large number of people, can be performed almost everywhere, and are effective with regard to improvement of exercise capacity. Hiking might qualify as such a sport, and patients in this study showed impeccable compliance, which resulted in an increased maximal exercise capacity and aerobic capability. The natural environment and group dynamics might have positively influenced patients' motivation.^{3,4,12}

Recent studies suggest tumor necrosis factor- α , interleukin-6, and S100B as potential markers for the

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