# Introduction

*Definition and Epidemiology of post-traumatic stress disorder*

According to the 5th edition of Diagnostic and Statistical Manual of Mental Health Disorders (DSM-V), post-traumatic stress disorder is included in the category of “Trauma- and Stressor-Related Disorders” and is defined by the occurrence of stress-related symptoms following exposure to one or more traumatic events. (1) A traumatic event is defined by the occurrence of “actual of threatened death, serious injury or sexual violence”(2), and has to be either experienced or witnessed by an individual. (3) PTSD symptoms are required to last for at least one month (2), and are classified as chronic with a duration of over three months. (4) Even though the majority of individuals have experienced at least one traumatic event in their lifetime (5, 6), the occurrence of post-traumatic stress disorder has been found to vary from 6 to 9 percent, according to literature. (7, 8)

*Alpine environment and injury*

Sports activities in alpine environments, such as hiking or skiing, are increasingly gaining popularity in Austria, as reflected by the strong increment in members of the Austrian Alpine Club in recent years. (9) While outdoor physical activity has been shown to have beneficial effects on mental health (10), mountain sports are also associated with an elevated risk of injury (11).Physical injury is often perceived as a life-threatening experience inducing a response of fear (12), leading to an elevated risk of up to 26% of developing PTSD after traumatic physical injury. (13)

*PTSD and mountains*

Although it is known that accidents can lead to the development of post-traumatic stress disorder symptoms, to date, there is a lack of literature analyzing the correlation between mountain accidents and the development of PTSD symptoms among the general population. However, in recent years, a few studies on the development of PTSD in mountain rescue personnel have been published. The first PTSD prevalence study on mountain guides showed that even though 78 % of the participating guides had experienced a traumatic event, the overall PTSD prevalence amounted to 2.7 %, i.e. lower than in the general population. (14) Similarly, a more recent trial from 2022 conducted on personnel of the Swiss alpine rescue association (ARS) found a higher number of potentially traumatic events experienced (71 %) among the sample, in correlation with a lower prevalence of possible PTSD (1 %). Moreover, resilience after the event was found to be higher as compared to the general population. (15) In contrast, a trial conducted in 2020 found a PTSD prevalence up to 22 % among mountain workers once differentiating between clinical interviews and self-reporting of symptoms for the assessment of PTSD. (16)

Concerning PTSD in correlation with sport accident types, some studies have been conducted on the development of PTSD symptoms following avalanche disasters. A trial from 2021 focusing on avalanches during mountain recreational activities found a prevalence of PTSD comparable to other kinds of trauma (17). A 16-years follow-up trial examining the health status following avalanche disasters found a higher rate of PTSD hyperarousal symptoms and PTSD-related sleep disturbances in avalanche victims as compared to a control group. (18)

*PTSD in correlation with post-traumatic growth and resilience*

Post-traumatic growth is defined as a “positive psychologic change experienced as a result of the struggle with highly challenging life circumstances” and can be interpreted as a mode of adjustment following a traumatic experience. (19) Resilience, similarly, is defined as “the process of adapting well in the face of adversity, trauma, threats, or even significant sources of stress” by the American Psychological Association. (20) However, in other definitions, resilience is described as a pre-existing personality trait, that helps to moderate the outcome of a traumatic event. (21) According to literature, PTSD is positively associated to the presence of post-traumatic growth, while higher resilience levels are negatively correlated to the development of PTSD. (22, 23) This phenomenon may be explained by the fact that post-traumatic growth only occurs if the traumatic event was experienced as threatening enough to lead to a positive sense-making of the negatively experienced. When resilience is pre-existing, however, threat itself is less likely to be experienced and the impact of the event can be mitigated, making the development of post-traumatic growth irrelevant. (23) From these findings, it can be assumed that individuals suffering from symptoms of PTSD, who had experienced an intense reaction to a traumatic event, are more likely to develop post-traumatic growth, as compared to those with higher pre-existing resilience.

*Aim of the current study, hypothesis*

The primary object of the present study was to assess the occurrence of symptoms of post-traumatic stress disorder, as well as signs of anxiety, depression, panic, somatization, quality of life and post-traumatic growth through the identification of three mental health patterns in a sample of individuals of the general population who have experienced an accident during a sports activity in an alpine environment.

The secondary endpoint was to assess demographic, socioeconomic and clinical characteristic of the cohort in order to discern individuals at risk of deteriorated mental health following a sport accident.

The overall background of the research was to shed light on the development of PTSD symptoms and further mental changes after alpine accidents. Characterization of mental reaction to the accident might help to identify individuals at risk of mental pathology.

1. Howie H, Rijal CM, Ressler KJ. A review of epigenetic contributions  to post-traumatic stress disorder . Dialogues Clin Neurosci. 2019;21(4):417-28.

2. Association AP. Diagnostic and statistical manual for mental disorders. DSM-IIIR 精神障害の分類と診断の手引. 1987:3-24.

3. Bryant RA. Post-traumatic stress disorder: a state-of-the-art review of evidence and challenges. World Psychiatry. 2019;18(3):259-69.

4. Seedat S, Stein DJ, Carey PD. Post-traumatic stress disorder in women: epidemiological and treatment issues. CNS Drugs. 2005;19(5):411-27.

5. Breslau N, Wilcox HC, Storr CL, Lucia VC, Anthony JC. Trauma exposure and posttraumatic stress disorder: a study of youths in urban America. J Urban Health. 2004;81(4):530-44.

6. Benjet C, Bromet E, Karam EG, Kessler RC, McLaughlin KA, Ruscio AM, et al. The epidemiology of traumatic event exposure worldwide: results from the World Mental Health Survey Consortium. Psychol Med. 2016;46(2):327-43.

7. Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. Arch Gen Psychiatry. 2005;62(6):593-602.

8. Van Ameringen M, Mancini C, Patterson B, Boyle MH. Post‐traumatic stress disorder in Canada. CNS neuroscience & therapeutics. 2008;14(3):171-81.

9 <https://www.alpenverein.at/portal/service/presse/2022/2022_02_03_mitgliederstatistik-2021.php>.

10. Niedermeier M, Einwanger J, Hartl A, Kopp M. Affective responses in mountain hiking-A randomized crossover trial focusing on differences between indoor and outdoor activity. PLoS One. 2017;12(5):e0177719.

11. Faulhaber M, Pocecco E, Posch M, Ruedl G. Accidents during mountain hiking and Alpine skiing—Epidemiological data from the Austrian Alps. Ger J Sports Med. 2020;71:293-9.

12. Segal DL. Diagnostic and statistical manual of mental disorders (DSM‐IV‐TR). The Corsini Encyclopedia of Psychology. 2010:1-3.

13. Joseph NM, Benedick A, Flanagan CD, Breslin MA, Simpson M, Ragone C, et al. Prevalence of posttraumatic stress disorder in acute trauma patients. OTA Int. 2020;3(1):e056.

14. Sommer I, Ehlert U. Adjustment to trauma exposure: prevalence and predictors of posttraumatic stress disorder symptoms in mountain guides. J Psychosom Res. 2004;57(4):329-35.

15. Mikutta C, Schmid JJ, Ehlert U. Resilience and Post-traumatic Stress Disorder in the Swiss Alpine Rescue Association. Front Psychiatry. 2022;13:780498.

16. Traber D, Le Barbenchon E, Hot P, Pellissier S. Perspectives about the PTSD prevalence rate in the case of multiple traumatic events exposure among mountain workers. European Journal of Trauma & Dissociation. 2020;4(4):100109.

17. Léonard C, Charriau-Perret A, Debaty G, Belle L, Ricard C, Sanchez C, et al. Survivors of avalanche accidents: posttraumatic stress disorder symptoms and quality of life: a multicentre study. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine. 2021;29(1):96.

18. Thordardottir EB, Valdimarsdottir UA, Hansdottir I, Resnick H, Shipherd JC, Gudmundsdottir B. Posttraumatic stress and other health consequences of catastrophic avalanches: A 16-year follow-up of survivors. Journal of Anxiety Disorders. 2015;32:103-11.

19. Tedeschi RG, Calhoun LG. " Posttraumatic growth: conceptual foundations and empirical evidence". Psychological inquiry. 2004;15(1):1-18.

20. Association AP. The road to resilience. <http://helping> apa org/resilience/. 2004.

21. Agaibi CE, Wilson JP. Trauma, PTSD, and Resilience: A Review of the Literature. Trauma, Violence, & Abuse. 2005;6(3):195-216.

22. Bensimon M. Elaboration on the association between trauma, PTSD and posttraumatic growth: The role of trait resilience. Personality and Individual Differences. 2012;52(7):782-7.

23. Levine SZ, Laufer A, Stein E, Hamama-Raz Y, Solomon Z. Examining the relationship between resilience and posttraumatic growth. J Trauma Stress. 2009;22(4):282-6.