

## FRIENDS ON A POWDER DAY: A PILOT STUDY QUANTIFYING SKI PATROL TRAUMATIC EVENT EXPOSURES AND EVALUATING MENTAL AND PHYSICAL HEALTH LEVELS

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**ABSTRACT:** Ski patrollers are avalanche and snow science experts, in addition to emergency first responders. As they care for ski and snowboard injuries in critical scenarios, they risk exposure to traumatic events in their roles. Exposure to traumatic events has the potential to lead to stress injuries and associated consequences. However, there remains limited scientific evidence surrounding U.S. ski patrollers and the frequency of this exposure. Therefore, the purpose of this study was to quantify the number of traumatic event exposures among a cohort of U.S. ski patrollers and evaluate mental and physical health status. Informed by the Stress Injury Continuum Model, this study followed a non-experimental, descriptive, longitudinal design. Using an online survey, data was collected once a month over three months. The survey was comprised of valid and reliable tools. Convenience sampling was used at one ski resort in the Western United States. Data from 29 participants was used in the analysis. Descriptive statistics were completed. Most participants (n=22, 75.86%) had been exposed to traumatic events at work over the 2023-2024 ski season, ranging from 'some times' (1-3 events; n=16, 55.17%) to 'many times' (>3 events; n=6, 20.69%). Physical symptoms scores (M=6.1, SD=3.09) were moderately concerning at mid-season (Survey 1) but decreased to mild levels by the end of the season (Survey 3). Mental health scores were also at moderate levels at Survey 1 (M=6.14, SD=2.33) and remained moderate throughout the study (Survey 2: M=6.11, SD: 2.33; Survey 3: M=5.72, SD: 2.89). This data has provided insight into ski patroller's exposure to traumatic events, and the moderately severe mental and physical health levels experienced at mid-season. It brings attention to this occupational group and underscores the opportunity to continue exploring how their work exposures specifically impact their health overall.

**KEYWORDS:** occupational health, wilderness first responders, worker wellbeing, national ski patrol, snow science

## 1. INTRODUCTION

Ski patrollers are both emergency first responders providing care for wilderness emergencies across ski resorts, and snow science experts mitigating the risks of avalanches. Avalanche mitigation is a particularly important element in ensuring a ski area is safe for patrons. Patrollers discuss the snow conditions in daily debriefs before starting their workday, and implement techniques, such as the use of explosives, to control avalanches (Bergeron et al., 2014). Explosives purposely set off an avalanche before the area is open to the public so that a skier won't accidentally trigger it and be caught up or buried while on the mountain. While this aspect of the job exposes ski patrollers to a certain level of physical risks, other occupational risks include musculoskeletal injuries, exposure to weather extremes, and also exposure to psychological stress.

Similar to other search and rescue volunteers, ski patrollers may be exposed to traumatic events in their roles (Mundo et al., 2023). In particular, patrollers risk exposure to traumatic events in searching and rescuing victims of avalanches, treating extreme ski or snowboarding accidents in precarious situations on the mountain, or recovering persons from fatal injuries. When experiencing continued psychological stress, they also risk stress injuries (Pietsch et al., 2021).

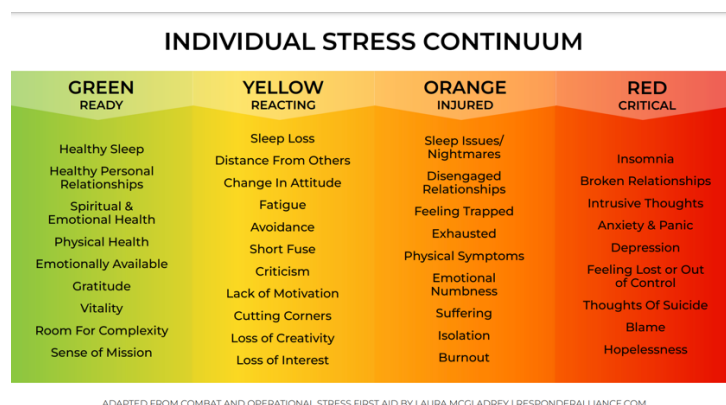
## 2. THEORETICAL FOUNDATIONS

Stress injuries can be understood as the physical and emotional impact of stress (Lazar et al., 2023). These injuries were categorized on a spectrum by the U.S. Marine Corps to reveal one's operational readiness to complete their roles (Headquarters Marine Corps Combat and Operational Stress Control, n.d.). The Stress Injury Continuum Model was adapted for ski patrollers, ranging in colors from green (ready), yellow (reacting), orange (injured) to red (critical) (Responder Alliance, n.d.-b; Southern Division National Ski Patrol, 2023) (See Figure 1).

The consequences of stress injuries include the negative impact on work performance and relationships, in addition to mental and physical health (Antony et al., 2020; Bergen-Cico et al., 2020). In particular, continued exposure to stressful events may lead to depression, anxiety, post-traumatic stress disorder (PTSD), and impact one's body with elevated cortisol levels, leading to inflammation, hypertension, weight gain, pathological fractures, and cardiac injuries (Antony et al., 2020; Southern Division National Ski

Patrol, 2023).

The psychological toll of traumatic events among first responders is well documented, particularly among paramedics, firefighters, and police officers (Antony et al., 2020; Bergen-Cico et al., 2020; Lewis-Schroeder et al., 2018). Among patrollers specifically, stress injuries may lead to sleep disturbances, irritable behavior, difficulty concentrating, and destructive behavior (Southern Division National Ski Patrol, 2023). To reduce the consequences of stress injuries, it is important to first understand how often patrollers are exposed to traumatic events, and better understand their baseline levels of health.



**Figure 1.** The Stress Continuum, publicly available online from the Responder Alliance (n.d.-b).

## 3. AIMS

This study aimed to quantify the number of traumatic event exposures among a cohort of U.S. ski patrollers and determine mental and physical health levels. The long-term goal of this research is to leverage the preliminary data to complete a larger national study that determines the potential relationship between traumatic events and overall wellbeing.

## 4. METHODS

This pilot study followed a non-experimental, descriptive, longitudinal design using an online REDCap survey with repeated measures. Participants were sampled from ski patrollers working at one ski resort in the Western U.S. Participants were included if they were 18 years of age or older and currently working as a patroller at the participating ski resort. The University of California, Los Angeles Institutional Review Board (IRB) approved this study (#24-000098).

### 4.1 Study Procedures

Participants were recruited both onsite at the resort and through an email that linked to the REDCap survey. The 55-question survey measured variables of traumatic events, wellbeing, perceived work stress, mental and physical health, resilience, and socio-demographic characteristics. Traumatic events were

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evaluated with a yes/no question and a write-in answer for the number of events. Wellbeing was evaluated with questions from the Employee Wellbeing Scale (Zheng et al., 2015). Perceived work stress was measured with the Workplace Stress Scale (The Marlin Company and the American Institute of Stress, 1978). Somatic symptoms were captured with the PHQ-15 (Kroenke et al., 2002), and depression and anxiety with the PHQ-4 (Kroenke et al., 2009). Resilience was measured with questions from the Brief Resilience Scale (Smith et al., 2008). Data collection began in February 2024, and surveys were completed once a month for a total of three months. Participants were given a \$100 gift card as a token of appreciation for their participation.

## 5. DATA ANALYSIS

Collected survey data was exported from REDCap and was cleaned, coded, and checked for any outliers or missing data. Participants missing data for any follow-up survey were removed for analysis. Data was explored for patterns, trends, and distributions using SAS software. Descriptive statistics were used to summarize participant responses and characteristics of the sample.

## 6. RESULTS

Seventy-nine potential participants were sent the opportunity to participate in the study. Of these, 38 participants completed the first survey. Twenty-nine ski patrollers completed at least one follow-up survey and comprised the analytic sample. This sample consisted of males (n=19, 65.52%) and females (n=10, 34.38%), who were non-Hispanics or Latino (n=27, 93.1%) and Hispanic or Latino (n=2, 6.90). Participants described their race as White (n=27, 93.1%) and multi-racial or other (n=2, 6.9%). They were either never married (n=15, 51.72%), were married (n=12, 41.38), or were divorced (n=2, 6.9%). Many worked at this resort for 11 or more years (n=11, 40.74%), 1 to 5 years (n=9, 33.33%), or 6 to 10 years (n=7, 25.93%). Most reported working more than 40 hours per week (n=24, 82.76%), although some reported working less than 30 hours per week (n=4, 13.79%), or 30 to 40 hours per week (n=1, 3.45%).

Most participants (n=22, 75.86%) had been exposed to traumatic events at work over the 2023-2024 ski season, with an average of 3.14 events. After categorizing traumatic events, they ranged from 'some times' (1-3 events; n=16, 55.17%) to 'many times' (>3 events; n=6, 20.69%). At the baseline survey, some participants even noted exposure to over 10 events over the season so far (n=4, 13.8%). Please refer to Table 1 for traumatic event exposure details.

Physical symptom scores (M=6.1, SD=3.09) and mental health scores (M=6.14, SD=2.33) were both considered at moderate severity levels at baseline

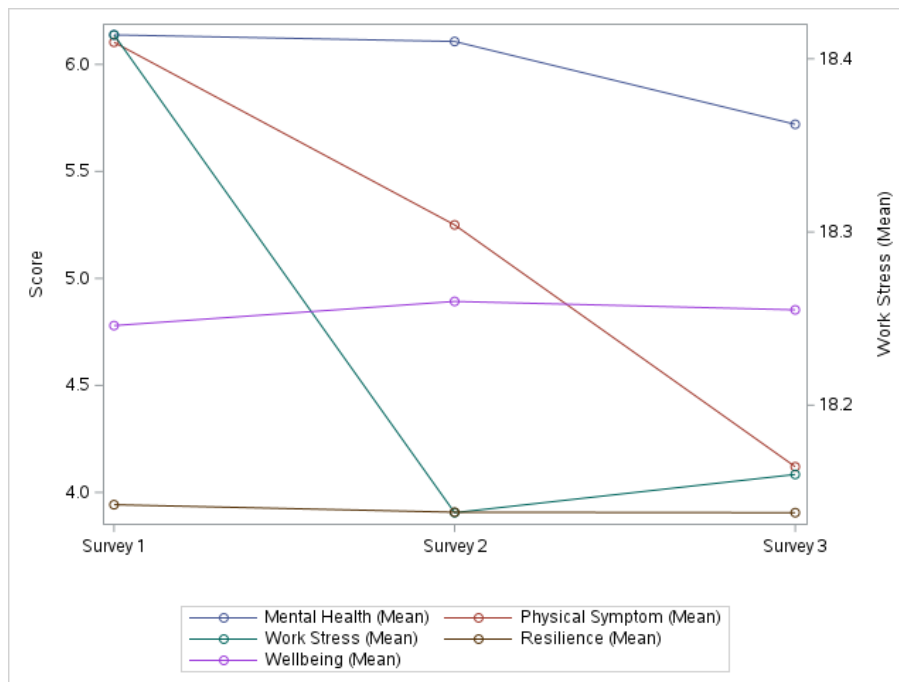
(or Survey 1). Mental health scores remained consistent throughout the study and mainly stayed in the moderate severity range between 6-8 (Kroenke et al., 2009). Specifically, Survey 2 scores were M=6.11, SD: 2.33, and Survey 3 scores were M=5.72, SD: 2.89. However, physical symptoms decreased and improved to the mild level range of 3-5 (Kroenke et al., 2002) as the season ended. Scores at Survey 2 were M=5.25, SD=2.82, and Survey 3 were M=4.12, SD=2.44.

Wellbeing scores were consistent throughout the study. Survey 1 scores: M=4.78, SD=0.36; Survey 2: M=4.89, SD=0.38; and Survey 3: M=4.85, SD=0.46, indicating more positive wellbeing levels (Zheng et al., 2015). Resilience levels also remained consistent throughout the study. Survey 1 scores: M=3.94, SD=0.63; Survey 2: M=3.91, SD=0.60; and Survey 3: M=3.90, SD=0.53, indicating fairly high resiliency among patrollers (Smith et al., 2008). Finally, perceived work stress was considered in the fairly low range from 16-20 (The Marlin Company and the American Institute of Stress, 1978). Levels at Survey 1: M=18.41, SD=4.99; Survey 2: M=18.14, SD=4.73; and Survey 3: M=18.16, SD=5.13

Please refer to Figure 2 for a depiction of the mean scores of the variables across the three survey time points.

**Table 1.** Traumatic event exposure among a sample of U.S. ski patrollers

	N	%
<b>Exposure over the 2023-2024 season (Survey 1) (N=29)</b>		
No times (0 events)	7	24.14
Some times (1-3 events)	16	55.17
Many times (>3 events)	6	20.69
<b>Over the previous month (Survey 2) (N=29)</b>		
No times (0 events)	13	44.83
Some times (1-3 events)	16	55.17
Many times (>3 events)	0	0
<b>Over the previous month (Survey 3) (N=25)</b>		
No times (0 events)	22	75.86
Some times (1-3 events)	3	12.00
Many times (>3 events)	0	0



**Figure 2.** Mean scores of variables from mid-season (Survey 1) to end of the season (Survey 3) among a sample of U.S. ski patrollers

## 6.1 Discussion

This study found ski patrol's traumatic event exposure to be primarily 'some of the time' over the season and highlights moderately severe levels of mental and physical health at mid-season. The mental health concerns found among this sample are aligned with the literature on avalanche professionals. For example, one qualitative study highlighted the long-lasting psychological effects related to avalanche work, including prevalent anxiety, depression, acute stress, and PTSD (Dolan & Tedeschi, 2018). In addition to experiencing strained personal relationships and feelings of isolation, the professionals in that sample reported commonly using alcohol to self-medicate (Dolan & Tedeschi, 2018). Such coping mechanisms were also found in a large cohort study of search and rescue volunteers in Colorado, where the total binge drinking rate was 51% – a rate much higher than their state rate of binge drinking (Mundo et al., 2023). In order to reduce the use of potentially detrimental coping mechanisms like substance use, organizations may continue fostering a culture that supports positive mental and physical health choices. For example, organizations may promote healthy personal coping strategies such as self-care and physical activity, which have been found to reduce stress, improve mental health, and reduce chronic disease risk (Anderson & Durstine, 2019; Bozym, 2023; Hector et al., 2018; McKeon et al., 2021). Future research could further explore how stressors and traumatic events particu-

larly affect the overall wellbeing of ski patrollers, exploring elements like their sleep, nutrition, and physical activity levels.

Despite the stress that has been found to accompany traumatic event exposure (Lazar et al., 2023), perceived work stress remained relatively low and manageable among the current sample of patrollers. Fluctuations in stress levels were found in a previous study of ski patrollers, where things like avalanche mitigation was not a particularly significant source of stress (Bergeron et al., 2016). Instead, their stress was influenced more by operational responsibilities, highlighting the individualized nature of stress, and the need to offer more personalized stress reduction programs. Conversely, another study of search and rescue volunteers found high levels of traumatic stress and burnout in their sample (Mundo et al., 2023). Therefore, continued investigation with tools tested and created for this occupational group is warranted to ensure that scales are capturing work stress levels adequately.

There have been some notable efforts thus far towards implementing positive practices and policies to mitigate against the stressors of ski patrolling. For example, the Eastern Division of the National Ski Patrol has shared patroller stress awareness resources and training videos on their website (Patroller Stress Awareness Team, 2021). One study has also identified the importance of trauma and stress injury screening periodically, and has encouraged peer support groups and having periodic supervisor check-ins (Lazar et al., 2023). Additional research has highlighted the opportunity to increase

available post-incident support and present educational opportunities regarding the psychological risks of the job to better prepare patrollers for these roles (Dolan & Tedeschi, 2018). Future research endeavors could focus on systematically evaluating what is being done across U.S. ski resorts to support the health of patrollers, how stress reduction education is being delivered, and how wellbeing is being promoted.

Resilience scores in this sample were similar to cardiac rehabilitation patients (Smith et al., 2008), and considered within normal limits. This may be due to the continued efforts to promote resiliency among avalanche working groups. For example, the Responder Alliance offers a curriculum to increase resilience due to exposure to traumatic events, providing a resource hub with tools to reduce stress injuries (Responder Alliance, n.d.-a). Findings from one previous study support the advantages of offering resiliency programs in avalanche-centered work environments, and such programs were found to be easily manageable for ski patrollers and avalanche professionals (Lazar et al., 2023). Further, the level of resiliency found in this sample may be because patrollers have a passion for the ski community and many find a lot of joy and purpose in their work (Helly Hansen, 2018; Williams, 2024).

## 6.2. Limitations

Limitations of this study include a smaller sample size representative of individuals at only one U.S. ski resort. However, results from this pilot are encouraging for the purpose of completing a larger study across multiple sites in the U.S. to capture the various levels of health and traumatic event exposures more fully among patrollers. The timing of the study was also a limitation, as the study began mid-season without the ability to gather data from the start of the season. Data from earlier in the season may have revealed different levels of mental and physical health, resilience, perceived job stress, and wellbeing. Finally, the design of this study required participants to recall their answers to survey questions over the previous month, risking recall bias.

## 7. CONCLUSION

This data has provided insight into ski patroller's exposure to traumatic events, and the moderately severe mental and physical health levels at mid-season. Steps should be taken to ensure pre- and post-incident supports are in place (i.e., peer support), along with appropriate training for professionals on the risks of this work, and continued screening for stress and overall health levels.

## 8. ACKNOWLEDGMENTS

We would like to thank and acknowledge the participants for their time and efforts in completing this study, along with the invaluable work they continue to do as patrollers. Thank you to the ski resort site for supporting research that endeavors to promote the health of these essential workers. Finally, thank you to the American Association of Avalanche Professionals, for the award funding Dr. Keller received to assist in the completion of this work.

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