

An Investigation of the Psychosocial Impact of an Intense Outdoor Hiking Challenge on Young Adults: Qualitative and Quantitative Outcomes

Anna G. Gallagher¹, Janine V. Olthuis¹, Alex Whynot²

¹ Department of Psychology, University of New Brunswick, Fredericton, New Brunswick

² Faculty of Medicine, Dalhousie University, Halifax, Nova Scotia

ABSTRACT **Background:** Adventure Therapy, which often includes forms of green exercise in addition to traditional psychotherapeutic methods, has been shown to be a moderately effective mental health intervention. Limited research, however, has elucidated the impact of a similar type of experience on the mental health and wellbeing of non-clinical populations.

Method: The present study examined the psychosocial impacts of an intense hiking challenge on a sample of healthy adults, using a mixed-method design. Although the challenge under investigation included traditional therapeutic factors of adventure therapy (e.g., group adventure, nature, challenge, and reflection), it was delivered by a nonprofessional and did not explicitly include the use of therapeutic techniques. Participants (N = 21) were recruited from a group of young adults completing a hiking challenge (M age = 22). Participants completed self-report surveys (pre/post/1-month follow-up) to assess mindfulness, self-concept, resilience, self-efficacy, as well as depression, anxiety, and stress. Qualitative data was collected via photovoice-like interviews, to gain a deeper understanding of the impact of the hike on participants.

Results: Linear mixed models revealed significant quadratic changes in depression symptoms, mindfulness, self-concept, and resilience, generally reflecting a significant improvement pre- to post-hike and subsequent deterioration from post-hike to one-month follow-up. Thematic coding of interviews revealed five key themes capturing participants' experiences: 'social connection,' 'overcoming adversity,' 'appreciation for nature,' 'personal growth,' and 'symbolic significance.'

Conclusions: Quantitative and qualitative results suggest that physical activity-based outdoor experiences may contribute to enhanced wellbeing in the short-term among healthy adults, but that additional work is needed to determine how to extend these benefits for the long-term.

INTRODUCTION

An Investigation of the Psychosocial Impact of an Intense Outdoor Hiking Challenge on Young Adults: Qualitative and Quantitative Outcomes

Research has demonstrated the numerous benefits of connectedness with nature on mental and physical health, including subjective feelings of wellbeing and happiness (McMahan, 2018), life satisfaction (Zhang et al., 2014), stress recovery (Brown et al., 2013), and emotional and cognitive restoration (White et al., 2013). When examining the benefits of contact with nature, however, it is difficult to conceptualize nature as acting separately from other relevant factors. Natural environments are inherently conducive to engagement in physical activity (PA) and may also facilitate positive social interaction via shared experiences (Bowler et al., 2010). As both PA and social interaction are well-established contributors to positive health and wellbeing (e.g., Street et al., 2007), nature's apparent restorative potential is interwoven with other influences in a complex fashion (Gladwell et al., 2013). The present study aims to better understand the psychosocial impact of these interwoven factors—nature, PA, and social connectedness—by studying a sample of healthy young adults who participated in an arduous hiking challenge.

Published online
21 December 2021

Citation

Gallagher, A. G., Olthuis, J. V., & Whynot, A. (2021). An Investigation of the Psychosocial Impact of an Intense Outdoor Hiking Challenge on Young Adults: Qualitative and Quantitative Outcomes. *CJUR*, 6(2), 27-35.

Copyright

© The Authors. This open-access article is licensed under a Creative Commons Attribution 4.0 International Licence.

Address correspondence to Anna Gallagher at agallag1@unb.ca

Adventure therapy (AT), defined as “the prescriptive use of adventure experiences provided by mental health professionals, often conducted in natural settings that kinesthetically engage clients on cognitive, affective, and behavioural levels” (Gass et al., 2012, p. 1), is one approach that aims to capitalize on nature’s restorative potential by incorporating outdoor activity. AT programs have been found to be moderately effective interventions, promoting greater positive psychological, behavioural, emotional, and interpersonal outcomes—in the short- and long-term—as compared to alternative treatments and no treatment controls (Bowen & Neil, 2013). As AT programs are typically delivered in groups (Russell et al., 2017), the benefits of social processes must also be considered as a key component (Bowen & Neill, 2013). Indeed, AT participants have rated group-related aspects (e.g., connectedness with peers) as being more integral to the therapeutic experience than their relationship with the therapist (Revell et al., 2014). Russell et al. (2017) offered a possible explanation for the importance of social dynamics in influencing treatment outcomes, suggesting that “positive attitudes are contagious, whether they be manifest through cognitive, motivational, or affective means, which are all inherent in the adventure therapy experience” (p. 277).

“Green exercise,” defined as PA in natural environments, is often a component of AT due to its potential for combining the restorative effects of nature with the health benefits of PA and social interaction (Mackay & Neill, 2010; Gladwell et al., 2013). PA, which often acts as a common denominator among nature-based activities, is well-recognized for its numerous health benefits including physical and psychological wellbeing, increased quality of life, and reduced risk of disease (Waburton et al., 2006; World Health Organization, 2018). Research has suggested that green exercise may provide additional mental health benefits over similar activities indoors, including larger increases in positive affect (Pasanen et al., 2014), greater perceptions of post-activity restoration (Calogiuri et al., 2016), and significant reductions in state anxiety (Mackay & Neill, 2010).

Hiking is a type of green exercise that combines exposure to nature and engagement in PA, which often includes social interaction. As such, hiking may have important implications for psychosocial wellbeing. Research suggests that hiking could even lead to greater psychological benefits as compared to other forms of exercise (Niedermeier et al., 2017; Mutz & Muller, 2016). For example, Niedermeier et al. (2017) found that three hours of outdoor mountain hiking increased positive affect and reduced fatigue to a greater degree than indoor treadmill walking and a sedentary control condition in healthy samples.

Qualitative methods have offered additional insight into the experience and impact of hiking in both healthy and clinical samples. Mutz and Muller (2016) studied the impact of a hiking trip and camping trip on healthy young adults. These experiences were associated with increased wellness, life satisfaction, mindfulness, and self-efficacy, as well as decreased stress (Mutz & Muller, 2016). Along similar lines, Caulkins et al. (2006) examined the psychosocial impacts of a backpacking trip on at-risk adolescent women. Participants reported a range of benefits, such as personal growth, increased confidence, and feelings of accomplishment (Caulkins et al., 2006).

The aim of the present study was to investigate the psychosocial impact of an intense outdoor hiking challenge on a healthy group of young adults. Though existing research supports the therapeutic benefits of outdoor PA on wellbeing, several gaps exist. For example,

traditional AT programs incorporate therapeutic strategies and are delivered by professionals, making it difficult to isolate the impact of the challenging outdoor PA activity. In addition, because the majority of AT studies use clinical samples, it is difficult to separate the impact of the AT intervention from the potential effects of context removal (i.e., being removed from a stressful or negative environment, which could be contributing to mental health problems). Furthermore, there is little existing data on the long-term effects of such outdoor activity experiences. In contrast, we were interested in whether a strictly PA intervention, delivered by a nonprofessional, could still benefit participants. This study aimed to fill the current gaps in the literature by (a) examining an intense outdoor activity (participants completed a 150km hike in seven days), (b) having a nonprofessional (vs. psychological or fitness professional) deliver the outdoor hiking challenge, and (c) omitting the implementation of therapeutic strategies. To do so, we incorporated quantitative and qualitative outcome measurement. First, we assessed changes—between pre- to post-hike, as well as one month later—in participants’ self-reported self-concept, resilience, mindfulness, self-efficacy, depression, anxiety, and stress symptoms via a self-report questionnaire. Second, we conducted qualitative interviews associated with a photovoice-like task to assess participants’ perceptions of the psychosocial benefit derived from the outdoor group hike, thus allowing us to contextualize quantitative findings.

METHOD

Study Design

This study approached data collection using a triangulation (convergence model) mixed methods design, which combines qualitative and quantitative methods to explore a research question (Creswell & Creswell, 2017). The two methods allowed us to capture a deeper understanding of the psychosocial impact of the hike on participants. The quantitative approach allowed us to systematically assess mental health and wellbeing outcomes using reliable tools. The qualitative approach allowed participants to articulate their experience of the hike and its impact on them using rich descriptions that could not be captured numerically. It also allowed us to capture new and original perspectives from participants that we may not have anticipated in our selection of quantitative tools.

Participants

Participants were recruited from a group of young adults completing an intense outdoor challenge that entailed hiking 150 km in mountainous terrain over seven days to raise money for a social cause. The hiking challenge was advertised via student-based social media pages, student unions, and outdoors clubs. The participants were university students. Several weeks before the hike, all hikers were sent an email from the organizer of the hike informing them of the opportunity to participate in the current study. Of the 40 young adults registered for the hike, 21 consented to participate in the current study. Participants were aged 19-25 years (M age = 22.05, SD = 1.53) from thirteen Canadian universities. The majority of participants identified as Caucasian or Euro Canadian (n = 18; 85.7%). Participants reported varying levels of previous hiking experience (e.g., the range of self-reported hiking occasion in the past month was 2-6 times).

Procedure

Ethics approval was obtained from the Research Ethics Board at the University of New Brunswick. Interested participants were emailed a formal invitation to participate by the research team, which included

more information about study participation and an online link to an informed consent form. Those who consented to participate were asked to complete a brief self-report questionnaire one week prior to the hike. The questionnaire was administered via Checkbox, a secure online survey software (a link to the survey was sent to participants via email). Participants completed the same questionnaire both immediately after the hike and one month later (to determine long-term effects of the hike on participants). Post-hike questionnaires were completed in-person, using pen and paper format, and were administered by the organizer of the hike; one month follow-up questionnaires were completed online through a link sent to participants via email. Participants were also invited to participate in a photovoice-like interview at follow-up.

Measures

Five-Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006). The FFMQ, a 39-item self-report questionnaire, was used to measure mindfulness. In the FFMQ, participants are presented with a series of statements (e.g., "I watch my feelings without getting lost in them") and asked to indicate the extent to which each is true for them on a 5-point Likert scale (1 = never or very rarely true to 5 = very often or always true). The FFMQ produces a total score for overall mindfulness, which was used for the present study, and has good internal consistency and convergent validity (Baer et al., 2006). In the current study, the internal validity for the FFMQ was good ($\alpha = .88$).

Connor-Davidson Resilience Scale (CD-RISC; Connor & Davidson, 2003). The CD-RISC, a 25-item self-report questionnaire, was used to measure resilience. In the CD-RISC, participants are instructed to indicate how much they agree or disagree with a series of statements when thinking about the past month (e.g., "I am able to adapt when changes occur"). Items are rated on a 5-point Likert scale (0 = not true at all to 4 = true nearly all the time) and summed to create an overall score, with higher scores reflecting greater resilience. The CD-RISC has good internal consistency, test-retest reliability, and discriminant validity (Connor & Davidson, 2003). The internal validity of the CD-RISC was excellent in the current study ($\alpha = .95$).

Robson Self-Concept Questionnaire (RSCQ; Robson, 1989). Self-concept was assessed using the 30-item RSCQ. In the RSCQ, participants indicate how much they agree or disagree with each item (e.g., "I feel emotionally mature"), using an 8-point Likert scale (0 = completely disagree to 7 = completely agree). Items are summed to create a total score. The RSCQ has good reliability and validity (Robson, 1989). In the current study, the internal validity of the RSCQ was excellent ($\alpha = .94$).

Depression Anxiety Stress Scales (DASS; Lovibond & Lovibond, 1995). Current mental health symptoms were assessed using the DASS. With the DASS, participants rate the extent to which they have experienced symptoms of depression (e.g., "I felt sad and depressed"), anxiety (e.g., "I found myself in situations that made me so anxious I was most relieved when they ended"), and stress (e.g., "I found it hard to wind down") over the past week, using a 4-point Likert scale (0 = did not apply to me at all to 3 = applied to me very much or most of the time). Separate scores for depression, anxiety, and stress subscales are calculated by summing the scores of relevant items. The DASS has good internal consistency, as well as good convergent, discriminant, and structural validity (Brown et al., 1997; Lovibond and Lovibond 1995). In the current study, the internal

validity for the DASS depression, anxiety, and stress subscales ranged from good to excellent ($\alpha = .92$; $\alpha = .79$; $\alpha = .83$).

General Self-Efficacy Scale (GSE; Schwarzer & Jerusalem, 1995). Self-efficacy was measured using the 10-item GSE. In the GSE, participants are asked to rate how true each of a series of statements (e.g., "I can handle whatever comes my way") is about themselves on a 4-point scale (1 = not at all true to 4 = exactly true). Items are summed to create a total score. The GSE has good internal consistency and criterion-related validity (Schwarzer & Jerusalem, 1995). The internal consistency of the GSE was good in the current study ($\alpha = .79$).

Photovoice-like interview. Participants were invited to participate in an optional photovoice-like interview task. We drew from Palibroda et al.'s (2009) guidelines for photovoice research but deviated from their recommendations in several ways; for instance, we conducted individual (vs. group) interviews. Importantly, our use of photovoice was as a data collection—not analysis—technique. Given that our use of the method strays from its original conceptualization as a tool to convey the experiences of marginalized groups (Wang, 1999), we have labelled our research methodology "photovoice-like." At the outset of the hike, participants were told they would have the option to participate in a photovoice-interview task. They were told that researchers were interested in understanding young adults' experiences with nature, young adults' experiences with physical and mental challenges, and how the challenging experience might impact mental health and wellbeing. Participants were asked to take pictures during the hike documenting their experience and send 3-8 pictures to the research team. The participants understood that when they returned from the hike, they would complete an interview with a member of the research team to describe their experiences in relation to the photos they took; subsequently, semi-structured interviews (guided by McIntyre, 2003) were conducted. Interviews began with questions specific to 2-3 photos selected by participants (e.g., What is the meaning of this photo? Do you think others would connect with this picture?) and concluded with broader questions about the hike (e.g., How did you feel during the hike/after the hike was over?). Interviewers encouraged participants to expand upon discussion subjects, to best capture their experience. Interviews were conducted via Skype, except in three cases in which the research team was unable to coordinate a time for the interview with participants. In those cases, interviewers sent questions to participants via email with answers returned in the same format. Researchers audio-recorded and transcribed the interviews to facilitate thematic coding. Information about the psychosocial impact of the hike on participants was extracted from the interviews.

Data Analytic Plan

Data were analyzed using linear mixed models with the lme4 package in R software (R Core Team, 2019). Specifically, we ran six separate models, one each for FFMQ, DASS-A, DASS-D, DASS-S, RSCQ, GSES, and CD-RISC as outcomes. In these models, time was entered as a predictor with orthogonal polynomial contrast coding, random intercepts, and fixed slopes. There were too few time points to employ random slopes for time. The polynomial contrast coding produces two test statistics: (a) linear contrasts, which examine whether there is linear change from pre-test to retention and (b) quadratic contrasts, which examines whether there is a bend in the line for the rate of change over time. Diagnostics of the distributions of our data with plots suggested that DASS-D had a very positively

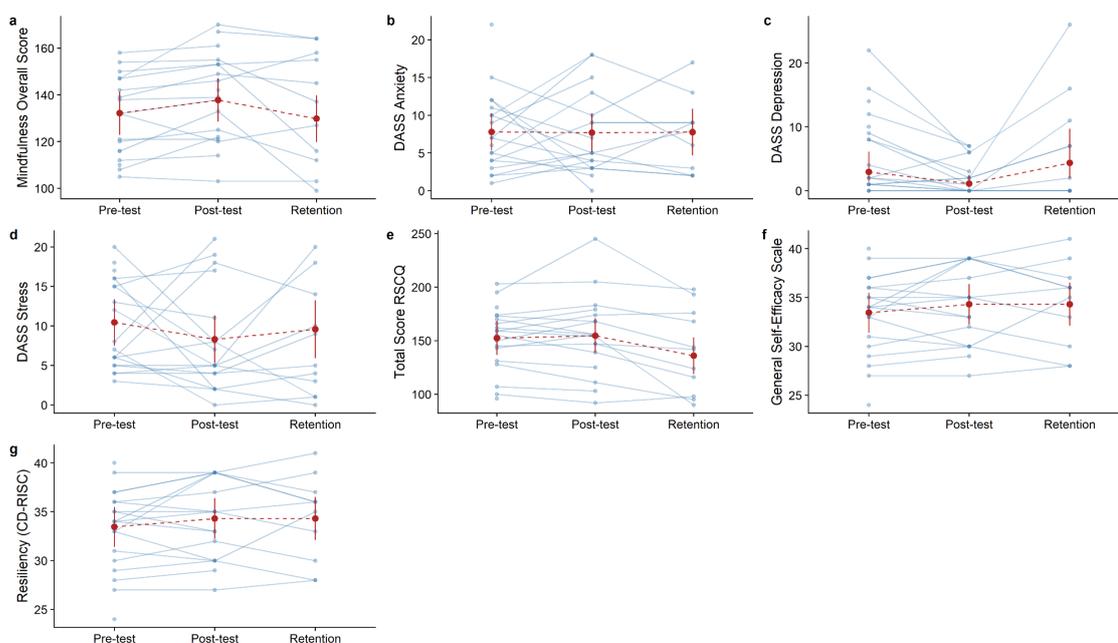


Figure 1 Change in psychosocial outcomes over time (pre, post, follow-up) for each individual. Model-derived estimated marginal means and 95% confidence intervals shown in red.

skewed distribution, so a generalized linear mixed model assuming a negative binomial distribution was employed for this variable. For all other variables, a normal distribution was assumed. Conditional and marginal R^2 values are presented as effect sizes; conditional R^2 values include the random effects, whereas marginal R^2 values include only the effect of time (Nakagawa, Johnson, & Schielzeth, 2017). Alpha was set at .025 given that an overall omnibus test was not conducted and there are two contrasts per analysis.

For thematic analysis of the interviews, a codebook was drafted based on the 6-step framework established by Braun and Clarke (2006). To create the codebook, researchers read over the interviews several times, looking for significant, re-occurring concepts. Significance was understood as similar references by two or more participants. Codes were developed by applying labels and definitions to significant concepts. Once codes were created, and to maximize the validity of the analysis, two researchers worked through the interviews separately, using the codebook to code statements. From these results, the research team developed key themes by expanding upon the codes and contextualizing them within the hike. We then wrote detailed descriptions of the themes and selected exemplar quotes to illustrate their essence. Potentially identifying information was removed to protect participant anonymity. In instances of direct quotation in this article, participants were given pseudonyms.

RESULTS

Quantitative Results

Test statistics, R^2 values, estimated marginal means, and confidence intervals are located in Tables 1 and 2. Overall, results for the linear contrasts suggest that self-concept (RSCQ) had a statistically significant decrease from pre-test to retention. Participants decreased their scores on the RSCQ by about 16 units and time explained about 4.6% of the variance in self-concept. The significant quadratic trend for RSCQ reflects the lack of change from pre-post on this variable. There were also significant quadratic trends for mindfulness (FFMQ), depression (DASS-D), and resilience (CD-RISC). In the case of mindfulness and depression, the therapeutic improvements were short-lived, and were no longer detectable at retention. In the case of CD-RISC, there was a small (~1 unit) improvement pre-post, and no change from post to retention. Raw data and trends over time are

displayed in Figure 1. These plots reveal the general quadratic trends found for most variables, but also demonstrates a wide range of heterogeneity across individual participants. Broadly, results should be interpreted cautiously given the small sample size and heterogeneity of participant trajectories.

Qualitative Results

Through photovoice interviews, participants reflected on the hike and discussed meaningful aspects of their experiences. Thematic analysis of participant responses led to the identification of five main themes, which we have labeled 'social support/connection,' 'overcoming adversity,' 'appreciation for nature,' 'personal growth,' and 'symbolic significance.' Below, we describe the essence of each theme. Sample quotes from participants to illustrate the themes are presented in Table 3.

Social connection. This theme reflects participant references to social relationships as an important aspect of the hiking experience. Participants emphasized the importance of working with others during the hike, processing the experience through group discussion, and forming meaningful, lasting friendships.

Overcoming adversity. This theme captures references to overcoming physical and emotional challenges during the hike. Participants reported facing many forms of adversity, including fatigue, soreness, injury, and negative mood. In overcoming adversity, participants endorsed feelings of pride and accomplishment. Avenues for overcoming adversity included individual coping strategies (e.g., mindfulness, determination, gratitude), social support (e.g., mutual encouragement, collective identity), and connectedness with nature (e.g., scenery as a reward for challenging hikes).

Appreciation of nature. This theme includes references to nature, such as natural views, landscapes, and features. Participants reported experiencing feelings of 'calmness,' likened to a sense of presence or mindfulness, which they attributed to being in nature. Participants also drew a sense of awe and inspiration from the grandeur of nature. It was suggested that spending time in nature offered perspective, which could be applied to everyday life.

Personal growth. This theme encompasses participants' reflections of positive personal change experienced during and after the hike. As a result of the experience, participants reported positive changes in confidence, sense of self, and perspective on life, as well as newfound knowledge and abilities. In addition, participants reported experiencing mental health benefits, such as positive mood and the accrual of new emotion regulation strategies, along with decreased stress, anxiety, and negative affect. Participants suggested that these gains were relevant to numerous areas of their life (e.g., work, school, friendships), particularly during times of stress.

Symbolic significance. This theme alludes to participants' use of symbolism in describing their hiking experience. Predominantly, participants employed symbolism to draw comparisons between the hiking challenge and the Terry Fox Run (the students were fundraising for cancer research). Many participants drew inspiration from Terry Fox's story for motivation to persevere through difficult treks.

Sentiments permeating identified themes. While five primary themes were identified, we also noted that two broader themes seemed to pervade all five of these primary themes. First, it was evident that participants viewed completing the hiking challenge as a significant accomplishment. As such, sentiments of pride and accomplishment permeated across the main themes and were particularly prominent in the themes of 'overcoming adversity' and 'social support/connection.' Second, a sense of nostalgia pervaded participants' reflections of the experience and appeared throughout the five primary themes. Participants expressed a longing to return to the hike, an interest in spending more time in nature, a feeling of missing their fellow hikers, and a desire to have additional transformative experiences such as this one.

DISCUSSION

The present study examined the psychosocial impact of an intense hiking challenge on a sample of healthy young adults by using a mixed-method design. Overall, findings showed improvements in mental health and wellbeing from pre- to post-hike (increase in mindfulness and resilience, and decrease in depressive symptoms) but subsequent deteriorations in functioning (i.e., return to baseline) from post-hike to one-month follow-up (decrease in mindfulness and self-concept, and increase in depressive symptoms), suggesting that most changes were not maintained. Notably, several outcomes (self-efficacy, anxiety, and stress) did not change significantly over the course of the hike. This may be because participants' anxiety and stress levels were already quite low pre-hike (in the normal, non-clinical range; Lovibond & Lovibond, 1995), and because measuring general self-efficacy precluded us from noticing any changes in exercise-specific self-efficacy, which may have been more likely to emerge. Results suggest that participation in intense green exercise can be a deeply meaningful experience, which may contribute to short-term increases in perceived mental health and wellbeing for healthy individuals. Interestingly, participant trajectories show significant heterogeneity, suggesting that there are likely other factors (e.g., individual characteristics) individualizing the impact of the hiking challenge on participants' mental health and wellbeing.

To complement quantitative findings, photovoice interviews were analyzed. Thematic coding revealed five themes, reflecting key aspects of the hike as articulated by participants: (1) 'social connection,' reflecting participants' perception of the importance of

friendship and social support to their enjoyment and success on the hike; (2) 'overcoming adversity,' encapsulating participants' success persevering through a variety of challenges; (3) 'personal growth,' encompassing acquisition of new skills, knowledge, or beliefs through learned experience; (4) 'appreciation for nature,' reflecting participants' appreciation of nature's importance and acknowledgment of beauty in the natural environment; and (5) 'symbolic significance,' conveying the use of symbolism to represent and communicate the meaningfulness of participants' experiences. A sense of pride and accomplishment permeated the identified themes. In addition, a theme of nostalgia (for the experience and associated positive affect) was found throughout the primary themes, perhaps capturing the lack of maintenance of quantitative mental health and wellbeing gains from post-hike to follow-up.

Qualitative data suggest that quantitative reductions in depressive symptoms from pre- to post-hike could be a product of experiences during the hike, such as friendships formed ('social connection'), a sense of accomplishment in overcoming challenges ('overcoming adversity'), enjoying time spent outdoors ('appreciation for nature'), and perceived self-improvement ('personal growth'). Previous research has linked increased social connection (Steger & Kashdan, 2009), exposure to nature (Beyer et al., 2016), and opportunities for growth of self-efficacy (Pu et al., 2017) to reduced depression. Indeed, behavioural activation, a common intervention for depression, is theorized to work via these mechanisms (Kellett et al., 2017). Mood improvements were not retained over time. "Post-hike depression" is a common term among the online hiking community (Parris, n.d.), and is used to describe negative mood swings purported to accompany the completion of a long-distance hike. Again, qualitative data offers insight into this phenomenon, as participants alluded to feelings of nostalgia, in that their everyday lives were marked by a desire for additional transformative experiences. In this study, no steps were taken to promote maintenance of positive mood post-hike. Future work may want to explore how to extend improvements in affect beyond the activity period.

An increase in mindfulness was observed from pre- to post-hike; however, this observation was not maintained at follow-up. A meta-analytic review by Schutte and Malouff (2018) suggests that connectedness with nature may be related to trait mindfulness in a reciprocal manner, in such a way that mindfulness may promote a connectedness to nature and exposure to/experiences in nature may foster mindfulness. Qualitative results of the current study support a relation between mindfulness and connectedness with nature. Participants alluded to being especially present throughout the hike, in the form of being attuned to their surroundings, thoughts, and feelings. A lack of maintenance of gains in mindfulness may be due to a separation between participants and nature at the end of the hike, or because the length of exposure to nature was not long enough to result in long-term change.

Resilience showed a small quantitative increase from pre- to post-hike. This change is reflected in qualitative themes of 'overcoming adversity' and 'personal growth.' Results suggest that overcoming a challenge may increase an individual's confidence in their ability to overcome future challenges. This finding aligns with previous research, suggesting that when experienced in moderate amounts, some lifetime adversity may foster greater resiliency in the long-term (Seery, 2011). PA has been identified as an influential factor in the relation between resilience and mental wellbeing. Based on data from

healthy adolescents, Gerber et al. (2012) demonstrated that resilience-related traits (e.g., mental toughness) interacted with levels of PA to mediate the relation between negative life events and mental health. It was suggested that PA may strengthen stress-response systems, increasing resilience.

Finally, considering the complexity of self-concept in both definition and development, it is difficult to determine why we see a decrease in self-concept from post-hike to the one-month follow-up interview. Researchers have theorized that aspects of self-concept may be state-dependent, influenced by numerous contextual factors (Ghorpade, 2009). Within the context of the hike, it is possible that participants developed positive self-representations specific to the hike. Perhaps the hike was not long enough for these changes to fully emerge (hence, the lack of significant change pre- to post-hike), but participants still experienced a change in self-concept when they resumed their daily activities.

Limitations of the current study include characteristics of the sample, method, and research design. First, participants were young adults selected on the basis of interest in participating in a challenging outdoor hiking experience. Compared to the general population, participants in this study may have had higher confidence regarding their ability to complete and enjoy a 150 km hike. Results may not generalize to clinical populations or to populations unable to complete such an intensive outdoor hiking experience. Second, due to a relatively small sample size, quantitative analyses are underpowered and so some effects may not have been detected. Third, there was no control condition; we cannot completely rule out the effects of the passage of time on participant outcomes. Nevertheless, given the pattern of results (an increase and decrease in mood symptoms coinciding with the hike and its conclusion), it seems likely that changes in outcomes correspond with the hiking experience. Future work might consider examining the effects of a hiking challenge via a randomized design with a control condition. It could also be beneficial for future research to compare the effects of participating in more traditional PA programs to the effects of participating in an intense outdoor challenge, both with and without therapeutic components.

Results of the present study suggest that short-term benefits to resilience, mood, and mindfulness may be gained among healthy young adults, following strenuous group outdoor exercise that combines PA, time spent in nature, and social interaction. This is promising in terms of understanding how one might enhance or maximize mental wellness through an activity that is relatively accessible, as well as physically beneficial. This type of activity could be better integrated into wellness strategies and should be further studied in clinical populations. Importantly, however, most of the benefits accrued from this type of strenuous green exercise may not be retained over time. Additional components (e.g., professional delivery, incorporation of therapeutic techniques, follow-up contact with fellow participants, journaling to consolidate gains, and/or incorporation of regular PA into the follow-up period) may need to be added to extend its benefits longer term. Considering the benefits of PA, time spent in nature, and social connection, further research is needed to understand the interacting and independent contributions of these factors in outdoor adventure experiences.

CONFLICTS OF INTERESTS

The authors declare no conflicts of interest.

The authors would like to thank Sean Mackinnon "who conducted the quantitative data analysis and created tables and figures" and Kevan Kostynski "who assisted with qualitative analysis and development of the codebook".

REFERENCES

- Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment, 13*, 27–45. <https://doi.org/10.1177/1073191105283504>
- Beyer, K. M. M., Szabo, A., & Nattinger, A. B. (2016). Time spent outdoors, depressive symptoms, and variation by race and ethnicity. *American Journal of Preventive Medicine, 51*, 281–290. <https://doi.org/10.1016/j.amepre.2016.05.004>
- Bowen, D. J., & Neill, J. T. (2013). A meta-analysis of adventure therapy outcomes and moderators. *The Open Psychology Journal, 6*, 28–53. <https://doi.org/10.2174/1874350120130802001>
- Bowler, D. E., Buyung-Ali, L. M., Knight, T. M., Pullin, A. S. (2010). A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health, 10*, 1–10. <https://doi.org/10.1186/1471-2458-10-456>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*, 77–100. <https://doi.org/10.1191/1478088706qp0630a>
- Brown, D. K., Barton, J. L., & Gladwell, V. F. (2013). Viewing nature scenes positively affects recovery of autonomic function following acute-mental stress. *Environmental Science & Technology, 47*, 5562–5569. <https://doi.org/10.1021/es305019p>
- Brown, T. A., Chorpita, B. F., Korotitsch, W., & Barlow, D. H. (1997). Psychometric properties of the Depression Anxiety Stress Scales (DASS) in clinical samples. *Behaviour Research and Therapy, 35*, 79–89. [https://doi.org/10.1016/S0005-7967\(96\)00068-X](https://doi.org/10.1016/S0005-7967(96)00068-X)
- Calogiuri, G., Evensen, K., Weydahl, A., Andersson, K., Patil, G., Ihlebæk, C., & Raanaas, R. K. (2016). Green exercise as a workplace intervention to reduce job stress: Results from a pilot study. *Journal of Prevention, Assessment & Rehabilitation, 53*, 99–111. <https://doi.org/10.3233/WOR-152219>
- Caulkins, M. C., White, D. D., & Russell, K. C. (2006). The role of physical exercise in wilderness therapy for troubled women. *Journal of Experiential Education, 29*, 18–32. <https://doi.org/10.1177/105382590602900104>
- Connor, K. M., & Davidson, J. R. (2003). Development of a new resilience scale: The Connor-Davidson Resilience Scale. *Journal of Depression and Anxiety, 18*, 76–82. <https://doi.org/10.1002/da.10113>
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.
- Gass, M. A., Gillis, H. L. L., & Russell, K. C. (2012). *Adventure therapy: Theory, research, and practice*. Routledge/Taylor & Francis Group.
- Gerber, M., Kalak, N., Lemola, S., Clough, P. J., Pühse, U., Elliot, C., Holsboer-Trachsler, E., & Brand, S. (2012). Adolescents' exercise and physical activity are associated with mental toughness. *Mental Health and Physical Activity, 5*, 35–42. <https://doi.org/10.1016/j.mhpa.2012.02.004>
- Ghorpade, A. (2009). State-dependent self-representations: a culture-bound aspect of identity. *The American Journal of Psychoanalysis, 69*, 72–79. <https://doi.org/10.1057/ajp.2008.40>
- Gladwell, V. F., Brown, D. K., Wood, C., Sandercock, G. R., & Barton, J. L. (2013). The great outdoors: How a green exercise environment can benefit all. *Extreme Physiology & Medicine, 2*. <https://doi.org/10.1186/2046-7648-2-3>
- Kellett, S., Simmonds-Buckley, M., Bliss, P., & Waller, G. (2017). Effectiveness of group behavioural activation for depression: A pilot study. *Behavioural and Cognitive Psychotherapy, 45*, 401–418. <https://doi.org/10.1017/S1352465816000540>
- Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy, 33*, 335–343. [https://doi.org/10.1016/0005-7967\(94\)00075-U](https://doi.org/10.1016/0005-7967(94)00075-U)
- Mackay, G. J., & Neill, J. T. (2010). The effect of "green exercise" on state anxiety and the role of exercise duration, intensity, and greenness: A quasi-experimental study. *Psychology of Sport and Medicine, 11*, 238–245. <https://doi.org/10.1016/j.psychsport.2010.01.002>
- McIntyre, A. (2003). Through the eyes of women: Photovoice and participatory action research as tools for reimagining place. *Gender, Place and Culture, 10*(1), 47–66. <https://doi.org/10.1080/0966369032000052658>
- McMahan, E. A. (2018). Happiness comes naturally: Engagement with nature as a route to positive subjective well-being. In E. Diener, S. Oishi, & L. Tay (Eds.), *Handbook of well-being* (pp. 1–63). DEF Publishers.

- [21] Mutz, M., & Muller, J. (2016). Mental health benefits of outdoor adventures: Results from two pilot studies. *Journal of Adolescence*, *49*, 105–114. <https://doi.org/10.1016/j.adolescence.2016.03.009>
- [22] Nakagawa, S., Johnson, P. C., Schielzeth, H. (2017). The coefficient of determination R² and intra-class correlation coefficient from generalized linear mixed-effects models revisited and expanded. *Journal of the Royal Society Interface*, *14*, 1–11. <https://doi.org/10.1098/rsif.2017.0213>
- [23] Niedermeier, M., Einwanger, J., Hartl, A., & Kopp, M. (2017). Affective responses in mountain hiking: A randomized crossover trial focusing on differences between indoor and outdoor activity. *PLOS ONE*, *12*, 1–17. <https://doi.org/10.1371/journal.pone.0177719>
- [24] Palibroda, B., Krieg, B., Murdock, L., & Havelock, J. (2009, March). *A practical guide to photovoice: Sharing pictures, telling stories and changing communities*. The Prairie Women's Health Centre of Excellence. http://www.pwhce.ca/photovoice/pdf/Photovoice_Manual.pdf
- [25] Parris, A. (n.d.). Life after the PCT: Post-hike depression. *REI Co-op Journal*. <https://www.rei.com>
- [26] Pasanen, T. P., Tyrväinen, L., & Korpela, K. M. (2014). The relationship between perceived health and physical activity indoors, outdoors in built environments, and outdoors in nature. *Applied Psychology: Health And Well-Being*, *6*, 324–346. <https://doi.org/10.1111/aphw.12031>
- [27] Pu, J., Hou, H., & Ma, R. (2017). Direct and indirect effects of self-efficacy on depression: The mediating role of dispositional optimism. *Current Psychology: A Journal for Diverse Perspectives on Diverse Psychological Issues*, *36*, 410–416. <https://doi.org/10.1007/s12144-016-9429-z>
- [28] R Core Team (2019). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. <https://www.R-project.org/>.
- [29] Revell, S., Duncan, E., & Cooper, M. (2014). Helpful aspects of outdoor therapy experiences: An online preliminary investigation. *Counselling and Psychotherapy Research*, *14*, 281–287. <https://doi.org/10.1080/14733145.2013.818159>
- [30] Robson, P. J. (1989). Development of a new self-report questionnaire to measure self-esteem. *Psychological Medicine*, *19*, 513–518. <https://doi.org/10.1017/S003329170001254X>
- [31] Russell, K., Gillis, H. L., & Kivlighan, D. M. (2017). Process factors explaining psychosocial outcomes in adventure therapy. *Journal of Psychotherapy*, *54*, 273–280. <https://doi.org/10.1037/pst0000131>
- [32] Schutte, N. S., & Malouff, J. M. (2018). Mindfulness and connectedness to nature: A meta-analytic investigation. *Personality and Individual Differences*, *127*, 10–14. <https://doi.org/10.1016/j.paid.2018.01.034>
- [33] Schwarzer, R., & Jerusalem, M. (1995). Generalized Self-Efficacy scale. In J. Weinman, S. Wright, & M. Johnston (Eds.), *Measures in health psychology: A user's portfolio* (pp. 35–37). NFER-NELSON.
- [34] Seery, M. D. (2011). Resilience: A silver lining to experiencing adverse life events. *Psychological Science*, *20*, 390–394. <https://doi.org/10.1177/0963721411424740>
- [35] Steger, M. F., & Kashdan, T. B. (2009). Depression and everyday social activity, belonging, and well-being. *Journal of Counselling Psychology*, *56*, 289–300. <https://doi.org/10.1037/a0015416>
- [36] Street, G., James, R., & Cutt, H. (2007). The relationship between organised physical recreation and mental health. *Health Promotion Journal Of Australia*, *18*, 236–239. <https://doi.org/10.1071/HE07236>
- [37] Waburton, D. E. R., Nicol, C. W., & Bredin, S. S. D. (2006). Health benefits of physical activity: The evidence. *Canadian Medical Association Journal*, *174*, 801–809. <https://doi.org/10.1503/cmaj.051351>
- [38] Wang, C. (1999). Photovoice: A participatory action research strategy applied to women's health. *Journal of Women's Health*, *8*(2), 185–192. <https://doi.org/10.1089/jwh.1999.8.185>
- [39] White, M. P., Pahl, S., Ashbullby, K., Herbert, S., & Depledge, M. H. (2013). Feelings of restoration from recent nature visits. *Journal of Environmental Psychology*, *35*, 40–51. <https://doi.org/10.1016/j.jenvp.2013.04.002>
- [40] World Health Organization (2018). *New active people for a healthier world: The global action plan on physical activity 2018-2030*. <http://www.who.int>
- [41] Zhang, J. W., Howell, R. T., & Iyer, R. (2014). Engagement with natural beauty moderates the positive relation between connectedness with nature and psychological well-being. *Journal of Environmental Psychology*, *38*, 55–63. <https://doi.org/10.1016/j.jenvp.2013>

TABLES

Table 1 Linear and Polynomial Contrasts from Linear Mixed Models for Psychosocial Outcome Data (Pre, Post, Follow-up)

Predictor	FFMQ		DASS-A		DASS-D		DASS-S		RCSQ		GSES		CD-RISC	
	z	P	z	P	z	P	z	P	z	P	z	P	z	P
time.poly.L	0.66	0.510	-0.02	0.987	1.26	0.208	-0.46	0.648	-2.90	0.004	1.22	0.223	-0.54	0.588
time.poly.Q	-2.49	0.013	0.06	0.949	4.38	<0.001	1.17	0.244	-2.45	0.014	-0.81	0.416	-3.06	0.002
Marginal R ² / Conditional R ²	0.028 / 0.813		0.000 / 0.428		0.119 / 0.828		0.022 / 0.450		0.046 / 0.844		0.009 / 0.850		0.051 / 0.758	

Note: FFMQ = Five Factor Mindfulness Questionnaire; DASS-D = Depression Anxiety Stress Scales – Depression Subscale; DASS-A = Depression Anxiety Stress Scales – Anxiety Subscale; DASS-S = Depression Anxiety Stress Scales – Stress Subscale; GSES = General Self-Efficacy Scale; RCSQ = Robson Self Concept Questionnaire; CD-RISC = Connor-Davidson Resilience Scale.

Table 2 Estimated Marginal Means and Confidence Intervals for Psychosocial Outcome Data (Pre, Post, Follow-up)

Variable	Timepoint	Mean	SD	EMM	SE	95% CI Lower	95% CI Upper
FFMQ	Pre-test	130.4	17.2	132.2	4.5	122.9	141.4
	Post-test	139.5	19.0	137.8	4.5	128.5	147.1
	Retention	134.5	24.5	129.8	4.9	119.7	139.8
DASS-A	Pre-test	7.7	5.3	7.8	1.2	5.3	10.2
	Post-test	7.4	5.5	7.7	2.3	5.2	10.2
	Retention	7.3	4.9	7.8	1.5	4.7	10.8
DASS-D	Pre-test	5.9	6.5	2.9	1.1	1.4	6.1
	Post-test	2.1	2.6	1.1	0.4	0.5	2.4
	Retention	6.3	8.5	4.4	1.8	2.0	9.7
DASS-S	Pre-test	10.3	5.7	10.4	1.4	7.5	13.4
	Post-test	7.9	6.5	8.3	1.5	5.3	11.3
	Retention	7.7	7.0	9.6	1.8	5.9	13.2
RSCQ	Pre-test	152.5	29.8	152.4	7.7	136.5	168.3
	Post-test	156.0	36.4	154.7	7.8	138.7	170.7
	Retention	140.4	39.2	136	8.4	118.8	153.1
GSES	Pre-test	33.3	4.2	33.4	1.0	31.4	35.5
	Post-test	34.4	4.1	34.3	1.0	32.3	36.4
	Retention	34.5	4.3	34.3	1.1	32.1	36.5
CD-RISC	Pre-test	73.1	12.2	33.4	1.0	21.4	35.5
	Post-test	79.2	13.8	34.3	1.0	32.2	36.4
	Retention	70.5	16.1	34.3	1.1	32.1	36.5

Note. EMM = Estimated Marginal Mean. SE = Standard Error. 95% CI = 95% Confidence Interval around the mean. FFMQ = Five Factor Mindfulness Questionnaire; DASS-D = Depression Anxiety Stress Scales – Depression Subscale; DASS-A = Depression Anxiety Stress Scales – Anxiety Subscale; DASS-S = Depression Anxiety Stress Scales – Stress Subscale; GSES = General Self-Efficacy Scale; RSCQ = Robson Self Concept Questionnaire; CD-RISC = Connor-Davidson Resilience Scale.

Table 3 Themes Extracted from Qualitative Interviews

Themes	Essence	Sample questions
PRIMARY THEMES		
Social connection	Reflects references to social relationships as an important aspect of the hiking experience. Participants referenced the importance of working with others during the hike ('teamwork'), processing the experience through group discussion ('group reflection'), and forming meaningful, lasting friendships ('friendship').	"Being able to push yourself through this last section here was really hard, but you were able to lean on the people hiking beside you." -Xavier "The most enjoyable part was being able to share it with other people because it was just so interesting to see everyone else's perspectives on it, what it meant to them, what they were learning from it . . . it just made it more meaningful to be able to talk about it." - Cassandra "I think it's a good feeling when you start connecting with people and especially when you've just met them, but you already feel so close . . . going through a physical challenge like this helps speed up that connection." -Nick
Overcoming adversity	Captures references to overcoming physical and emotional challenges during the hike. Participants reported facing many forms of adversity, including fatigue, soreness, injury, and negative mood. In overcoming adversity, participants endorsed feelings of pride and accomplishment. Avenues for overcoming adversity included individual coping strategies (e.g., mindfulness, determination, gratitude), social support (e.g., mutual encouragement, collective identity), and connectedness with nature (e.g., scenery as a reward for challenging hikes).	"That one particular segment, we're climbing way up, it was extremely tough. Again, a lot of people struggled with it. So, once we got up to the top, we got to that view and you could just see all the peaks in the distance. You could see how high we were, how far we'd come." -Jonathan
Appreciation of nature	Includes references to nature, such as natural views, landscapes, and features. Participants reported experienced feelings of 'calmness,' likened to a sense of presence or mindfulness, which they attributed to being in nature. Participants also drew a sense of 'awe and inspiration' from the grandeur of nature. It was suggested that spending time in nature offered perspective, which could be applied to everyday life.	"It makes me feel calm . . . Reminds me about how day to day stress and stuff like that isn't as significant." -Louisa "Anything I do or suffer will be insignificant compared to the beauty and power of nature." -Francis
Personal growth	Encompasses participants' reflections of positive personal change experienced during and after the hike. Participants reported positive changes in confidence, sense of self, and perspective on life, as well as newfound knowledge and abilities. In addition, participants reported experiencing mental health benefits, such as positive mood and the accrual of new emotional regulation strategies, as well as decreased stress, anxiety, and negative affect. Participants suggested that these gains were relevant to numerous areas of their life (e.g., work, school, friendships), particularly during times of stress.	"Every trek I go on I end up learning something about myself. Sometimes it's hard to pin down exactly or put exactly into words what it is but . . . I can use it as a tool, my own toolbox of getting through everyday stress." -Nick
Symbolic significance	Alludes to participants' use of symbolism in describing the hiking experience. Predominantly, participants employed symbolism to draw comparisons between the hiking challenge and the Terry Fox Run (the students were fundraising for cancer research). Many participants drew inspiration from Terry Fox's story for motivation to persevere through difficult treks.	"I think the marathon day, the whole experience of that was the most important because it was more symbolic of what we were trying to do and why we were doing it, in terms of Terry Fox's original goals and how we were trying to mirror that." -Cassandra
SENTIMENTS PERMEATING THEMES		
Pride and accomplishment	Participants viewed completing the hiking challenge as a significant accomplishment. As such, sentiments of pride and accomplishment permeated across the main themes and were particularly prominent in the themes 'overcoming adversity' and 'social support/connection.'	"What a proud, but at the same time, humble moment. We'd accomplished something great.. as a small piece to a giant picture. The grandeur of it all moves me." -Isaac
Nostalgia	Nostalgia pervaded participants' reflections on the experience and appeared throughout the five primary themes. Participants expressed a longing to return to the hike, an interest in spending more time in nature, a feeling of missing fellow hikers, and a desire to have additional transformative experiences.	"During the hike, like this is awesome! Every day wake up, make food on a tiny stove, head out on the trail, come back and chill. That lifestyle I guess, is just so cool. After it's just like I want to do more of this. Just put me back there. Just leave me there." -Aubrey