

## Research Paper

# An Exploratory Study of Adaptive Scuba Diving's Effects on Psychological Well-Being among Military Veterans

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## Abstract

Because many military veterans face mental health issues, it is important to research and practice alternative treatments including therapeutic recreation. The purpose of this study was to examine the effects of a single 45-minute adaptive scuba diving session on veterans' psychological well-being, specifically state-level mindfulness (Brown & Ryan, 2003) and contentment (Taylor, 2015). A one-group pretest-posttest evaluation was conducted with 28 veteran divers. Of them, 16 had mental health issues (e.g., posttraumatic stress disorder), while 11 had physical impairments (e.g., spinal cord injuries). Statistical results indicated that the post-dive mindfulness and contentment levels were significantly higher than their pre-dive counterparts ( $p = .007$  and  $< .001$ , respectively). Moreover, the changes in mindfulness through scuba diving were positively correlated with the changes in contentment. The significant increases in mindfulness were present only among veterans with mental or physical health issues. These findings are discussed in relation to the literature on scuba diving, therapeutic recreation, mindfulness, and contentment.

## Keywords

*Adaptive scuba diving, contentment, mental health, military veterans, mindfulness, therapeutic recreation*

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Military veterans face increased risks of mental health issues (e.g., Hoge et al., 2007; Seal et al., 2009). For instance, Seal et al. found 36.9% of Iraq and Afghanistan veterans received a diagnosis of mental illness, such as posttraumatic stress disorder (PTSD), anxiety disorder, or depression. This number is substantially higher than that in the general population (e.g., 4.3% of United States [U.S.] adults experienced serious mental illness in 2016; National Institute of Mental Health, 2017). Although there are traditional psychiatry treatments (e.g., cognitive behavioral therapy, exposure therapy) for veterans with mental illness, only a quarter to half of them voluntarily seek these services partly due to associated stigma (e.g., Hoge et al., 2004; Schottenbauer et al., 2008). Moreover, roughly 25% of veterans who pursued psychiatric treatments drop out (e.g., Hoge et al., 2014). Further, 30 to 60% of veteran psychiatry patients do not report significant improvements in their mental health (e.g., Bradley et al., 2005; Hoge et al., 2014). Thus, the Veteran Affairs/Department of Defense Clinical Practice Guideline for the Management of Posttraumatic Stress Disorder and Acute Stress Disorder Work Group (2017) recommends the use of and research on complementary treatments including recreation.

Research in the field of therapeutic recreation (TR) has examined what type of recreation activities help veterans cope with mental health issues and improve their psychological well-being (van Puymbroeck & Lundberg, 2011). Many activities studied in the past involve outdoor recreation, such as river running (Dustin et al., 2011) and camping (Lundberg et al., 2016). One outdoor recreation activity that has become increasingly popular among veterans is scuba diving (Miller, 2014), as the activity offers psychological benefits (e.g., positive distraction), physical benefits (e.g., freer movement in water), and social benefits (e.g., camaraderie based on the buddy system) (Morgan et al., 2019).

With regard to mental health, the movements of positive psychology and strengths-based approaches in TR have emphasized the importance of enabling individuals to achieve and maintain positive psychological states, as much as remedying and preventing negative issues (e.g., Anderson & Heyne, 2016; Hood & Carruthers, 2016). A concept consistently noted in these strengths-based TR models is mindfulness or “the state of being attentive to and aware of what is taking place in the present” (Brown & Ryan, 2003, p. 822). A part of mindfulness is acceptance of a situation without judgments, it is naturally linked to contentment or a low-arousal positive emotional state characterized by one’s perception of completeness and satisfaction with current situations (Cordaro et al., 2016). Both mindfulness and contentment seem highly relevant to veterans with mental health issues, because veterans might struggle with, for example, engaging with present experiences due to flashbacks of past traumas and feeling complete because of their impairments. Thus, the purpose of this study was to examine the effects of adaptive scuba diving on psychological well-being outcomes—state-level mindfulness and contentment—among U.S. veterans.

## Literature Review

### Therapeutic Benefits of Scuba Diving

Scuba diving is a recreational activity that is associated with adventure tourism (Fuchs, Reichel, & Shani, 2016). As with many adventure activities, scuba can be perceived as dangerous by those unfamiliar with the activity. The elements which create

perceived danger include pressure, breathing conditions, visibility under water, and participant orientation under water (Patkiewicz, 2015). Having these risk factors noted, it is not necessarily the perceived risks or excitement that drive most scuba divers to continue their participation in this activity (Dimmock, 2009). Scuba diving also has various inherently therapeutic benefits.

### *Psychological Benefits*

Many scuba divers participate to find a sense of peace, tranquility, and calm (Fuchs et al., 2016). Scuba divers must breathe with a steady, slow, and deep breathing technique (Beneton et al., 2017). This type of diaphragmatic breathing is associated with increased heart rate variability and lower levels of stress (Beneton et al., 2017). Once divers control their breathing and maintain a calm state, they are able to remain underwater for longer periods of time (Strandvad, 2018). When underwater, divers will be in an environment that is silent, except for the sound of their own breathing. If divers are breathing with slow and steady breaths, they will produce a rhythmic background noise. This steady sound, absent of other sounds, provides a focus point for a meditative experience (Straughan, 2012). Divers often report that the comfort they experience in the water provides distance from their daily stressors (Dimmock, 2009). This cognitive distance also allows divers to be fully present during their diving activities (Beneton et al., 2017).

### *Physiological Benefits*

The water offers opportunities that are not found anywhere else. Divers are touched by the pressure of the water on every inch of their body. This pressure or texture provides a sense of weightlessness (Dimmock, 2009) or freedom for individuals who may not have much bodily freedom in their daily lives. This immersive experience alters divers' perceptions. They have the freedom to change their body's axis in a variety of ways. One way is to move their body onto a horizontal plane, emulating the feeling of flight (Straughan, 2012). Although unpublished, a pilot study of scuba diving's effects on veterans with spinal cord injuries (SCI) reported that veteran divers felt the improvement in sensing light touch by 10%, and their muscle spasticity decreased by 15% (Miller, 2014).

### *Social Benefits*

Scuba diving provides other opportunities not found in traditional meditation or mindfulness activities. Scuba diving has a unique set of required equipment (e.g., a diving suit, goggles) that serves as a group identifier. For an individual with a disability, this new label of being a scuba diver can be just as freeing as the act of diving itself. Divers become part of a dive community (Dimmock, 2009). Social comfort gained from diving is expressed strongest in the relationship between dive buddies (Dimmock, 2009). Dive buddies look after each other, and ensure mutual safety when diving. This promotes group responsibility that may not be possible outside of the dive experience (Patkiewicz, 2015).

### *Adaptive Scuba Diving*

Adaptive scuba diving allows individuals with various disabilities, such as SCI and amputations, to dive as independently and safely as possible. Although learning of diving-related foundational knowledge remains the same, technical training is ad-

justed depending on individual needs. For example, a veteran with a single-leg amputation would be trained to balance and accelerate the body with the other leg. Someone with paraplegia would be accompanied with a scuba buddy(ies) and might use webbed gloves to efficiently propel and balance the body only with upper limbs. If individuals have limited fine motor control in their hands, they would learn an adaptive version of hand signals to communicate with others under water. For divers with PTSD, diving instructors inform them of potential reminders of their traumatic experiences (e.g., mechanical sounds of a boat, darkness of water) before going on a diving trip. Divers who take medications for their mental conditions receive individualized lists of potential issues (e.g., antidepressants may cause drowsiness and exacerbate decompression sickness). Instructors and buddies should closely monitor divers with mental health issues for potential episodes under water and prepare immediate exit plans. There are nonprofit organizations in the U.S. that provide adaptive scuba diving programs specifically for veterans, such as Lifewaters and Dive Warriors.

Morgan et al. (2019) conducted a mixed-methods study with 15 veterans with disabilities (e.g., SCI, amputation) in the United Kingdom (U.K.) who participated in adaptive scuba diving. The quantitative data were derived through retrospective surveys using the General Health Questionnaire-28 (GHQ-28). In terms of psychological benefits, there were, on average, 3.7- and 3.9-point improvements in veterans' anxiety and depression symptoms. Their qualitative interview results suggested the diving experience facilitated feelings of self-confidence, purpose and goal, and emotional calm. With regard to physiological benefits, Morgan et al. observed the average 3-point improvement in the somatic component of the GHQ-28. Specifically, veterans with limb amputation and associated chronic pain perceived absence of pain during diving. Lastly, as to social benefits, Morgan et al.'s study demonstrated that veteran divers reported the average 3.7-point increase in their social functioning through their diving experience. Their interview data also revealed that veterans valued camaraderie among divers as it resembled their military relationships. To the best of our knowledge, Morgan et al.'s study is the first published research regarding adaptive scuba diving's effects on veterans' well-being. However, their study was limited by a very small sample size ( $N = 15$ ) and lack of baseline assessment. Moreover, Morgan et al.'s work was conducted in the U.K., and thus, the applicability of their findings to the U.S. context remains unknown.

## Mindfulness and Contentment among Veterans

### *Mindfulness among Veterans*

Recently, mindfulness has been actively studied within the population of veterans with PTSD (Boyd, Lanius, & McKinnon, 2018; Vujanovic et al., 2011). There are state-level and trait-level mindfulness, and they are distinct from each other. Whereas the former is a momentary state in which individuals attend to their internal stimuli (e.g., thoughts, feelings, breathing, pain) and external stimuli (e.g., nature, others) without judgments, the latter is one's disposition to experience this state over time (Brown & Ryan, 2003). Existing research has utilized a mindfulness intervention that usually integrates behavioral modifications (e.g., breathing, meditation) and psycho-education. This body of knowledge is relevant to this current study because research also suggests that scuba diving involves mindful experiences (e.g., Beneton et al., 2017; Dimmock, 2009; Strandvad, 2018). Boyd et al.'s review summarized 11 studies that consistently showed positive effects of mindfulness interventions among veterans with PTSD, in-

cluding reduced PTSD symptoms (e.g., Kearney et al., 2016), increased mindfulness traits (e.g., Bormann et al., 2014; Stephenson et al., 2017), and improved quality of life (e.g., Polusny et al., 2015). From a neurobiological perspective, Boyd et al. also explained that mindfulness interventions affect activation of brain regions influenced by PTSD, specifically the prefrontal cortex associated with planning complex cognitive behaviors such as executive function and expression of appropriate social behavior. Evidence also suggests that mindfulness-based therapies may be effective in reducing activity in the limbic regions that house the amygdala and play a key role in processing emotions, ergo may effectively mitigate intrusive thoughts and hyper-arousal symptoms (Marchand, 2014).

Colgan et al.'s (2016) study is worth singling out as their qualitative data provided detailed insights into the relationship between PTSD symptoms and mindfulness practices. The researchers conducted an experimental study with veterans with PTSD using two experimental groups with different mindfulness practices (body scan meditation or BS, and mindful breathing or MB) and two control groups. Six themes emerged, with present moment awareness being the first. Participants in the BS group showed the most notable increase in awareness, but those in the MB group also described their enhanced ability to return to the moment when beginning to think about the past or future. Increased emotional non-reactivity, another theme, was evident in the two mindfulness groups (BS and MB), meaning that although PTSD was still present, their reactions to symptoms had changed in a positive manner. Other emergent themes were nonjudgmental acceptance, decreased physiological arousal and stress reactivity, increased active coping skills, and greater relaxation, with BS and MB groups once again showing the most positive outcomes.

### *Contentment among Veterans*

Compared to mindfulness, contentment has been less studied in the general population (Cordaro et al., 2016) as well as among veterans. However, contentment as one's perception of completeness and satisfaction with current situations *despite* ongoing issues including disabilities, may have strong theoretical and practical implications in the veteran population (Cordaro et al., 2016). Indeed, Segal and Lane (2016) proposed a conceptual model of well-being designed for female service members, in which they recognized the importance of contentment. Contentment has also been theoretically linked to mindfulness, because the non-judgmental acceptance and present moment orientation within mindfulness principles help people be aware and appreciative of what they have in their daily life rather than pursuing what they do not have (Cordaro et al., 2016). Taylor (2015) provided empirical support for this claim in the general population. At trait-level, mindfulness and contentment were positively correlated with each other, while participants in a meditation experimental group reported significantly improved state-level contentment. There are also a few studies that examined impacts of outdoor activities on contentment among veterans. Anderson, Monroy, and Keltner (2018) noted that veteran participants in their rafting-based experiment reported a high level of contentment ( $M = 7.55$  on the scale of 0 to 10). Greenleaf and Roessger (2017) documented an increase in life contentment among veterans who engaged in care farming, which is a therapeutic use of farms, farm animals, and agricultural landscapes.

## Summary, Gaps, and Hypotheses

The above literature review suggests that scuba diving may be a recreation activity that has a broad range of therapeutic outcomes (e.g., Beneton et al., 2017; Dimmock, 2009; Patkiewicz, 2015). Moreover, both mindfulness and contentment have been recognized as integral parts of veterans' psychological well-being (e.g., Boyd et al., 2018; Segal & Lane, 2016). However, to the best of our knowledge, no study except for Morgan et al.'s (2019) work in the U.K. has examined the therapeutic effects of adaptive scuba diving on veterans' mental health. Moreover, Morgan et al.'s study was limited by its use of retrospective data collection and a small sample. The current study was aimed at filling this gap in the literature. The purpose was to examine the effects of adaptive scuba diving on state-level mindfulness and contentment among U.S. veterans. Specifically, the following hypotheses were tested:

- H<sub>1</sub>: Participating in adaptive scuba diving increases state-level mindfulness among veterans.
- H<sub>2</sub>: Participating in adaptive scuba diving increases state-level contentment among veterans.
- H<sub>3</sub>: Changes in state-level mindfulness through adaptive scuba diving are positively correlated with those in state-level contentment among veterans.
- H<sub>4</sub>: The positive effects of adaptive scuba diving on state-level mindfulness and contentment are heightened among veterans with disabilities compared with their able-bodied counterparts.

## Method

To test these hypotheses, a study with the one-group pretest-posttest design was conducted (Riddick & Russell, 2015). Participants went through only one scuba session for this study that took on average 45 minutes, and pre- and post-assessments occurred within 15 minutes before the beginning and after the end of the session, which made total session time range from 55 to 75 minutes. Using the pretest-posttest design meant we did not have a control group, which limits causal implications; however, we did so because it remains unknown what in the scuba diving experience causes the hypothesized changes in psychological well-being and we could not determine what would make a meaningful control activity. For instance, if it was conscious breathing through a regulator that increased mindfulness, a control activity could be to watch a scene of underwater environment on a television screen. Contrarily, if it was an intriguing underwater environment that improved mindfulness, the control activity of watching the underwater scene on a screen would be problematic. The one-group pretest-posttest design has been considered suitable for exploratory studies (Patten, 2012; Riddick & Russell, 2015), like the current project. Moreover, the one-group design had an advantage in terms of maximizing a sample size rather than splitting it into experimental and control groups. Research ethics approval was obtained.

## Sampling and Intervention

Between June and September 2018, a paper-and-pencil survey was conducted with 28 veterans before and after an adaptive scuba diving session offered by Lifewaters, a nonprofit scuba diving organization focused on veterans with disabilities. To be included, participants had to self-identify as a U.S. military veteran. The first author

collected data over nine diving sessions during five data collection trips, where he explained the study's purpose including mention of mindfulness and obtained written consent from veterans who agreed to participate in this study. He is a Certified Therapeutic Recreation Specialist (CTRS), certified open water diver, as well as Scubility Dive Buddy certified by the Scuba Diving International. He is also a veteran himself, which may have helped in forming rapport with potential participants.

The sessions for data collection took place in three distinct types of environments: open ocean, quarry, and large-scale aquarium tank. Each scuba dive group consisted of a certified Divemaster instructor and three to five veteran divers (and buddies if the veterans had a major physical impairment). All of the participants had minimum 8 to 16 hours of scuba diving experience in controlled pool setting and/or open water prior to the data collection. During the approximately 45-minute diving session, each group practiced and checked several diving skills while exploring underwater attractions (e.g., fish, coral, sunken airplane in a quarry). The first author administered the survey within 15 minutes or less before and after the dives. The paper questionnaire and pens were circulated among a group of several veteran divers, while they were waiting on their boat or beside an aquarium tank, and were collected as they completed the survey. Additionally, the first author also assisted divers before (e.g., wearing a tank) and after (e.g., coming up on a boat) and waited during the diving session, except for the ocean setting in which he also dove.

## Instruments

### *State-Level Mindfulness*

The current study focused on state-level mindfulness because (a) trait-level mindfulness is more stable over time and would not be substantially impacted by a 45-minute activity and (b) changes in state-level mindfulness were found to carry over into their trait-level counterparts in the long run (Kiken et al., 2015). Brown and Ryan's (2003) 5-item scale was used, given its brevity and focus on measuring mindfulness during daily activities. All five items were reverse-coded or written to indicate the absence of mindfulness (e.g., "I was preoccupied with the future or past"). Brown and Ryan provided evidence for internal consistency and construct validity of the scale. Specifically, 92 college students reported state-level mindfulness randomly three times a day for 14 consecutive days. When the data were collapsed over time, Cronbach's alpha was .92, while their multi-level modeling analysis revealed a strong positive relationship ( $B = .46$ ,  $t = 4.57$ ,  $p < .0001$ ) between state-level and trait-level mindfulness. In this study, the measure was administered with a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The scores were reversed and summed before main analyses. Pre-dive scores ranged from 5 to 23, while post-dive scores ranged from 5 to 20.

### *State-Level Contentment*

Six of Taylor's (2015) 10-item scale of state-level contentment (e.g., "I feel content"; "I feel fulfilled in what I am achieving in my life") were used, with the same 5-point Likert scale. Across five samples Taylor described, Cronbach's alpha ranged from .84 to .96. Before and after 1-week meditation and physical activity interventions, the correlations were  $r = .69$  and  $.89$  ( $p < .01$ ), respectively, which indicated the scale's test-retest reliability. The state-level contentment was strongly and positively correlated with an existing life contentment scale ( $r = .83$ ,  $p < .01$ ), which suggested convergent validity,

while its correlations with other related variables, such as mindfulness ( $r = .50, p < .01$ ) and depression ( $r = -.64, p < .01$ ) supported discriminant validity. In the current study, pre-dive scores ranged from 13 to 24, while post-dive scores ranged from 16 to 26.

## Results

### Descriptive Statistics and Preliminary Analyses

Table 1 summarizes the demographic characteristics of our sample. The vast majority of study participants were male ( $n = 25, 89.3\%$ ), which reflects the gender balance in the U.S. veteran population (Bialik, 2017). The majority was also Caucasian ( $n = 22, 78.6\%$ ), which is also congruent with the veteran population's characteristics (Bialik, 2017). The mean age was 45.58 years, ranging from 26 to 75. A sub-total of 16 veterans (57.1%) had a diagnosis of a mental health issue(s) (major depression, PTSD, and/or anxiety disorder), while 11 people (39.3%) experienced a physical impairment(s) (SCI, traumatic brain injuries [TBI], and/or amputation). As to military branch, 11 were formerly affiliated with Army, followed by six with Air Force and another six with Marines.

**Table 1**  
*Demographic Characteristics of the Sample (N = 28)*

		<i>n</i>	%
Sex	Male	25	89.3
	Female	2	7.1
	Not reported	1	3.6
Race	Caucasian	22	78.6
	Other	4	14.3
	Not reported	2	7.1
Marital status	Single	11	39.3
	Married	6	21.4
	Divorced/separated/widowed	10	35.7
	Not reported	1	3.6
Mental health issues (a subtotal of 16)	Major depression	11	39.3
	Posttraumatic stress disorder (PTSD)	10	35.7
	Anxiety disorder	9	32.1
Physical health issues (a subtotal of 11)	Spinal cord injuries (SCI)	9	32.1
	Traumatic brain injuries (TBI)	2	7.1
	Amputation	1	3.6
Military branch	Army	11	39.3
	Air force	6	21.4
	Marines	6	21.4
	Other (i.e., Navy, National Guard/Reserves)	4	14.3



**Table 1 (cont.)**

	Not reported	1	3.6
		<i>M</i>	<i>SD</i>
Age		45.58	13.02
Years of service		8.74	6.46
Times of deployment		2.76	4.10

*Note.* Participants could report multiple health issues, or comorbidity, and thus adding the numbers of each mental/physical health issue does not add up to the corresponding subtotal.

Cronbach's alpha coefficients for internal consistency were: .87 and .83 for pre- and post-dive mindfulness, and .85 and .74 for pre- and post-dive contentment, respectively. Two ANOVAs were conducted to examine if there were any differences in mindfulness or contentment level across the three diving settings (i.e., quarry, open ocean, large-scale aquarium tank). No difference was detected at .05 level, and thus we assumed the data's comparability across the settings. Shapiro-Wilk's tests revealed that the distributions of post-dive mindfulness and contentment scores were significantly and negatively skewed ( $p = .04$  and  $.01$ , respectively). Thus, non-parametric tests were utilized in the following main analyses.

### Data Analyses

First, to test  $H_1$  and  $H_2$ , Wilcoxon's ranked-sign tests, or the non-parametric extension of dependent  $t$ -test, were applied to the entire sample. The results are shown in Table 2, under the rows of all sample. In terms of mindfulness, the post-dive mean (4.07) was significantly higher than the pre-dive mean (3.45),  $Z = -2.72$ ,  $p = .007$ ,  $r = -.36$ . Cohen (1992) recommended .14, .36, and .51 for cut-off points for small, medium, and large effects for  $r$ . Therefore, the effect of adaptive scuba diving on veterans' mindfulness was medium in size. With regard to contentment, the post-dive mean (4.46) was significantly higher than the pre-dive mean (3.60),  $Z = -4.08$ ,  $p < .001$ ,  $r = -.55$ . This qualified as a large-size effect. Second, to test  $H_3$ , Spearman's  $\rho$  correlation analysis, or the non-parametric extension of Pearson's  $r$  correlation, was applied to changes in mindfulness and changes in contentment. These change scores were computed by subtracting pre-dive scores from post-dive scores. The resultant coefficient  $\rho$  was .60 ( $p < .001$ ). Third, to test  $H_4$ , our sample was divided into the following sub-samples: (a) 16 veterans with mental health issues (i.e., depression, PTSD, and/or anxiety disorder) and 12 others without mental health issues, and (b) 11 veterans with physical impairment (i.e., SCI, TBI, and/or amputation) and 17 others without physical impairment. Then, Wilcoxon's ranked-sign tests were performed again, and the results are summarized in Table 2. Overall, the significant increase in contentment was consistent across veterans who did have mental/physical health issues and those who did not. However, mindfulness significantly increased only among veterans with either mental or physical health issues. Moreover, among those with mental or physical issues, the effects were large ( $r = -.46$  and  $-.54$ , respectively).

**Table 2**  
*Results of Wilcoxon's Signed-Rank Tests*

		Pre- dive <i>M</i>	Pre- dive <i>SD</i>	Post- dive <i>M</i>	Post- dive <i>SD</i>	Wilcoxon's <i>Z</i>	<i>p</i>	<i>r</i>
State-level mindfulness	All sample	3.45	1.04	4.07	0.74	-2.72	.007	-.36
	Mental impairment ( <i>n</i> = 16)	3.16	1.10	3.98	0.75	-2.60	.009	-.46
	No mental impairment ( <i>n</i> = 12)	3.88	0.79	4.20	0.75	-1.08	.281	---
	Physical impairment ( <i>n</i> = 11)	3.35	1.03	4.20	0.69	-2.52	.012	-.54
	No physical impairment ( <i>n</i> = 17)	3.55	1.05	3.99	0.78	-1.44	.150	---
State-level contentment	All sample	3.60	0.86	4.46	0.50	-4.08	.000	-.55
	Mental impairment ( <i>n</i> = 16)	3.23	0.89	4.39	0.51	-3.27	.001	-.58
	No mental impairment ( <i>n</i> = 12)	4.10	0.53	4.56	0.49	-2.46	.014	-.50
	Physical impairment ( <i>n</i> = 11)	3.53	0.93	4.52	0.43	-2.68	.007	-.57
	No physical impairment ( <i>n</i> = 17)	3.65	0.84	4.42	0.55	-3.13	.002	-.54

*Note.* Both mindfulness and contentment were measured by using a 5-point Likert scale.

## Discussion

The purpose of this study was to examine the effects of adaptive scuba diving on psychological well-being outcomes—state-level mindfulness and contentment—among U.S. veterans. To this end, a one-group pretest-posttest evaluation was conducted with 28 veterans who participated in adaptive scuba diving. Below, each of the four hypotheses is discussed.

The first hypothesis ( $H_1$ ) stated that participating in adaptive scuba diving increases state-level mindfulness among veterans. With the entire sample, the post-dive mind-

fulness level was significantly higher than the pre-dive level. Thus,  $H_1$  was supported. This finding is consistent with past scuba diving studies (e.g., Benton et al., 2017; Dimmock, 2009; Morgan et al., 2019). In a non-veteran diver sample, Benton et al. also documented an increase in mindfulness, particularly non-judgmental acceptance aspect. Dimmock's qualitative study indicated that scuba diving and the underwater environment allowed divers to "unwind and think of nothing else except diving" (p. 288), which then resulted in enhanced mindfulness. It may be that the risks involved in scuba diving (Patkiewicz, 2015) made veteran divers surrender their urge to control their movement and environment and instead facilitated them to accept internal and external events. As the activity requires a high level of concentration, scuba diving may have functioned similarly to a focal object in meditative practices (e.g., candlelight, mantra).

The second hypothesis ( $H_2$ ) posited that participating in adaptive scuba diving increases state-level contentment among veterans. With the whole sample, the post-dive contentment level was significantly higher than its pre-dive counterpart. Hence,  $H_2$  was supported. This result is congruent with past studies that detected outdoor recreation's positive influences on contentment among veterans (Anderson et al., 2018; Greenleaf & Roessger, 2017). The current study suggests scuba diving is another activity that has a similar effect. This may have to do with the fact that scuba diving requires a certain level of skills and thus completing it boosts one's sense of accomplishment. Moreover, the increase in contentment might be related to holistic benefits of scuba diving including physiological and social elements (Dimmock, 2009; Morgan et al., 2019), although this study did not measure these outcomes.

The third hypothesis ( $H_3$ ) was that changes in state-level mindfulness through adaptive scuba diving are positively correlated with those in state-level contentment among veterans. The Spearman's correlation coefficient  $\rho$  was .60 and significant. Therefore,  $H_3$  was supported. This result is in line with Taylor's (2015) findings of the positive correlation between trait-level mindfulness and state-level contentment and meditation's positive effects on state-level contentment. Although limited in its causal implications, the current result lends credence to the argument that a higher level of mindfulness leads to an increase in contentment as mindful individuals are aware and appreciative of their everyday life experiences (Cordaro et al., 2016).

Lastly, the fourth hypothesis ( $H_4$ ) predicated that the positive effects of adaptive scuba diving on state-level mindfulness and contentment are heightened among veterans with disabilities compared with their able-bodied counterparts. The analyses based on the sub-samples discerned that although contentment level increased similarly regardless of the presence or absence of mental/physical health issues, significant improvements in mindfulness were only present among veteran divers with mental or physical health issues. Thus,  $H_4$  was partially supported. This finding suggests that scuba diving may be a particularly effective intervention tool for veterans with disabilities, if a target outcome is mindfulness. It may be that veterans with disabilities have more evident ongoing issues (e.g., flashbacks due to PTSD, chronic pain related to SCI) for which scuba diving facilitates acceptance (Benton et al., 2017). Another possibility is that those with disabilities experience difficulties in taking their mind off of their symptoms, and thus scuba diving's effect on enhanced focus is particularly salient among these individuals (Dimmock, 2009).

## Implications for Therapeutic Recreation Practices and Research

Our findings indicate that adaptive scuba diving can be an effective treatment method for veterans with mental and physical health issues. Therapeutic recreation (TR) practitioners should consider this activity especially when their therapeutic goal is psychological. Given that mindfulness practices have been increasingly used within the veteran population (Boyd et al., 2018), TR practitioners should advocate for and document scuba diving's unique roles. For example, if TR practitioners identify that their veteran clients are interested in scuba diving and the activity may serve their therapeutic purposes, they should contact adaptive scuba diving organizations to explore upcoming programs and diving trips. Once TR practitioners' evaluation corroborates the therapeutic effects of adaptive scuba diving among their clientele, they should obtain information regarding more diving opportunities and share it with their other clients. When rapport is established between TR practitioners and a scuba organization, TR experts may be able to assist in the assessment, planning, and evaluation processes that seem to remain lacking in adaptive scuba diving programs. This includes introducing valid measures of health outcomes and clearly documenting therapeutic goals and corresponding interventions. Comprehensive evaluation could help TR practitioners and the scuba organization pinpoint especially therapeutic aspects of this activity, depending on outcomes of interest (e.g., aesthetic underwater environment for mental health issues). This knowledge may allow TR practitioners and researchers to identify viable experimental control treatments (e.g., watching underwater scenes with 3D goggles).

Another important implication for TR practice is the possible synergistic effect between mindfulness and scuba diving. TR practitioners should consider adding mindfulness techniques to adaptive scuba diving procedures. For instance, mindful breathing (Colgan et al., 2016) can be implemented immediately before and after scuba diving sessions. This would involve breathing deeply and slowly while directing attention to breathing sensations and accepting on-going emotions and thoughts. Body scanning (Colgan et al., 2016) may be also effective within the scuba diving context. This could be done by attending to bodily sensations in each part of body (e.g., foot to thigh to trunk) and redirecting their attention to these sensations if one is distracted. These mindful techniques improve divers' underwater experiences. For instance, mindful breathing could lead to deeper, steady breathing through a regulator, while body scanning might help divers redirect their attention to cold-water sensations when their focus is lost.

We recommend that future researchers use different control activities (e.g., snorkeling, above-ground exercise, watching underwater environment on a screen) to discern what aspects of scuba diving experience have positive psychological effects. Future studies should also expand their measurements to physiological (e.g., heart rate, hormone level) and social (e.g., camaraderie, trust) variables. Longitudinal studies can clarify how long it takes for the psychological and other effects of scuba diving to wear off. Moreover, longitudinal studies that involve multiple diving sessions will help examine if changes in state-level variables due to scuba diving carry over into changes in trait-level variables. It would be also interesting to examine how veterans from different military backgrounds might respond differently to scuba diving interventions. For instance, those with the marine background may feel more at ease under water due to their training, or anxious because of their traumatic experiences.

## Limitations

Despite these contributions, the current study was limited in several important aspects. First, as noted earlier, the one-group pretest-posttest design (Riddick & Russell, 2015) did not include any control group. Thus, the causality among the studied variables should be examined through more rigorous experimental designs. Second, although the current sample size of 28 was substantially larger than that of the preceding study by Morgan et al. (2019), studies with larger samples and future systematic reviews are necessary to determine the generalizability of the current findings. Third, this study measured mindfulness and contentment only immediately before and after a diving session, and thus it remains unknown how sustainable the observed changes are. Fourth, also noteworthy is that although only six out of 10 contentment scale items by Taylor (2015) were used in this study, which could have limited the content validity of the measure. Fifth, generalization of the findings beyond the current research contexts (e.g., U.S. military) should be done with caution.

## Conclusion

The purpose of this study was to examine the effects of adaptive scuba diving on psychological well-being outcomes—state-level mindfulness and contentment—among U.S. veterans. The results supported the hypotheses that participating in adaptive scuba diving increases state-level mindfulness and contentment among veterans, changes in mindfulness and contentment through scuba diving are positively correlated with each other, and the positive effect of adaptive scuba diving on mindfulness is heightened among veterans with disabilities compared with their able-bodied counterparts. These results serve as evidence for diving-based TR that targets veterans' psychological well-being. The findings also indicate the potential synergistic effect between scuba diving, mindfulness, and contentment.

Veterans face myriad mental health issues (e.g., Seal et al., 2009). As traditional psychiatric treatments have limitations (Hoge et al., 2004), it is crucial that we research and practice alternative methods, including TR (van Puymbroeck & Lundberg, 2011). Although our study and several others have suggested the promising potential of TR for this population, many activities remain understudied. We hope that the current study contributes to the growing awareness of mental health issues among veterans in the TR field.

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