EUROPEAN JOURNAL OF PSYCHOTRAUMATOLOGY
2022, VOL. 13, 2031590
https://doi.org/10.1080/20008198.2022.2031590

SHORT COMMUNICATION

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Comparing meditative scuba diving versus multisport activities to improve post-traumatic stress disorder symptoms: a pilot, randomized controlled clinical trial

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ABSTRACT

Background: Post-Traumatic Stress Disorder (PTSD) is a chronic and disabling disease that currently has no fully effective therapeutic solution. Complementary approaches, such as relaxation, sport, or meditation, could be therapeutic aids for symptom reduction. Scuba diving combines sport and mindfulness training and has been found to have a positive effect on chronic stress and PTSD.

Objectives: The first objective of this pilot study is to compare the effectiveness of diving associated with mindfulness exercises (the Bathysmed® protocol) with multisport activity in reducing PTSD symptoms. The secondary objective is to compare the impact of the Bathysmed® protocol on mindfulness functioning in the two groups of subjects suffering from PTSD.

Method: This proof-of-concept took the form of a controlled randomized clinical trial. The primary endpoint was the severity of PTSD symptoms, measured by the PCL-5 (PTSD Check List) scale. Half of the group were exposed to the Bathysmed® protocol (the experimental condition), and the other half to a non-specific multisport program.

Results: Bathysmed® protocol improved PCL-5 scores more than the multisport program but the result was not significant. The protocol was significantly better than the multisport activity in reducing intrusion symptoms of PTSD after one month. Globally, trait mindfulness scores improved up to one month after the course, but the result was not significant. Three months after the course, there was no difference between the two groups with regard to PCL-5 and Freiburg Mindfulness Inventory scores..

Conclusion: Our study demonstrates the value of the Bathysmed® protocol even though it suffers from a lack of power and could only obtain partial but encouraging results. Mindfulness must be practiced over the long term to achieve stable benefits. This probably explains why no differences persisted three months after the course. Further work is needed to confirm the initial results obtained with this pilot study.

Una comparación de ensayo clínico piloto, aleatorizado y controlado del buceo meditativo (el protocolo Bathysmed®) versus actividades multideportivas para mejorar los síntomas del trastorno de estrés postraumático (TEPT)

Antecedentes: El trastorno de estrés postraumático (TEPT) es una enfermedad crónica e incapacitante que actualmente no tiene solución terapéutica totalmente eficaz. Enfoques complementarios, como relajación, deporte o meditación podrían ser ayudas terapéuticas para la reducción de síntomas. El buceo combina deporte y entrenamiento mindfulness y se ha encontrado que tiene un efecto positivo sobre el estrés crónico y el trastorno de estrés postraumático.

Objetivos: El primer objetivo de este estudio piloto es comparar la efectividad del buceo asociado a ejercicios de mindfulness (el protocolo Bathysmed®) con la actividad multideportiva para reducir los síntomas del TEPT. El objetivo secundario es comparar el impacto del protocolo Bathysmed® sobre el funcionamiento de mindfulness en los dos grupos de sujetos que padecen TEPT.

Método: Esta prueba de concepto tomó la forma de un ensayo clínico aleatorizado controlado. El criterio de valoración principall fue la gravedad de los síntomas de TEPT, medida por la escala

ARTICLE HISTORY
Received 29 April 2021
Revised 6 January 2022
Accepted 6 January 2022

KEYWORDS
PTSD; scuba diving; mindfulness; terrorist attack

PALABRAS CLAVE
TEPT; Buceo; mindfulness; Ataque terrorista

关键词
PTSD; 水肺潜水; 正念; 恐怖袭击

HIGHLIGHTS

- Meditative scuba diving improved overall PTSD symptoms after one month more than multisport activity but not significantly.
- PTSD Intrusion symptoms were significantly improved after one month by the meditative diving.
- The positive effects of meditative diving faded after 3 months.

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PCL-5 (Lista de chequeo para TEPT). La mitad del grupo estuvo expuesto al protocolo Bathysmed® (la condición experimental), y la otra mitad a un programa multideportivo no específico.
Resultados: El protocolo Bathysmed® mejoró las puntuaciones de PCL-5 más que el programa multideportivo, pero el resultado no fue significativo. El protocolo fue significativamente mejor que la actividad multideportiva para reducir los síntomas de intrusión del TEPT luego de un mes. Globalmente, los puntajes de mindfulness de rasgo mejoraron hasta un mes luego del curso, pero el resultado no fue significativo. Tres meses después del curso, no hubo diferencias entre los dos grupos con respecto a las puntuaciones de PCL-5 y FMI (Freiburg Mindfulness Inventory).
Conclusión: Nuestro estudio demuestra el valour del protocolo Bathysmed® a pesar de que sufre una falta de poder y solo pudo obtener resultados parciales pero alentadores. Mindfulness debe practicarse durante un largo plazo para alcanzar beneficios estables. Esto probablemente explica por qué no persistieron diferencias tres meses después del curso. Es necesario seguir trabajando para confirmar los resultados iniciales obtenidos con este estudio piloto.

冥想水肺潜水与多项目运动活动对于改善创伤后应激障碍 (PTSD) 症状的比较:一项试点随机对照临床试验

背景: 创伤后应激障碍 (PTSD) 是一种慢性致残性疾病, 目前尚无完全有效的治疗方案。补充方法, 例如放松, 运动或冥想, 可以作为减轻症状的治疗辅助手段。水肺潜水结合了运动和正念训练, 已被发现对慢性应激和创伤后应激障碍有积极作用。
目的: 本试点研究的第一个目标是比较与正念练习相关的潜水 (Bathysmed® 方案) 与多项目运动活动在减少 PTSD 症状方面的有效性。次要目标是比较 Bathysmed® 方案对两组PTSD 患者被试正念功能的影响。
方法: #x8FD9;一概念验证采用了对照随机临床试验的形式。主要终点是 PTSD 症状严重程度, 由 PCL-5 (PTSD 检查表) 量表测量。该组中一半人接受了 Bathysmed® 方案 (实验条件), 另一半人接受了非特定的多项目运动计划。
结果: Bathysmed® 方案对改善PCL-5 分数多于比多项目运动计划, 但结果并不显著。一个月后, 该方案在减少 PTSD 闯入症状方面显著优于多项目运动活动。全局范围上, 特质正念分数在课程结束后最多提升了一个月, 但结果并不显著。课程结束三个月后, 两组在 PCL-5 和 FMI (弗莱堡正念量表) 分数方面没有差异。
结论: 我们的研究证明了 Bathysmed® 方案的价值, 尽管它缺乏动力并且只能获得部分但令人鼓舞的结果。必须长期练习正念才能获得稳定收益。这可能解释了为什么课程结束三个月后没有差异持续存在。需要进一步工作来确认通过本试点研究获得的初步结果。

1. Introduction

Post-Traumatic Stress Disorder (PTSD) is a chronic and disabling disease that currently has no fully effective therapeutic solution (Solomon & Mikulincer, 2006). Complementary approaches, such as relaxation, sport, or meditation could be therapeutic aids for symptom reduction. Mindfulness meditation programs have shown therapeutic benefits for PTSD in general (Gibert et al., 2015; Janssen et al., 2018) and chronic forms in particular (Hilton et al., 2017). Practicing Mindfulness practice is based on attention to the present, and acceptance (accepting inner events such as emotions, thoughts or physical sensations without judging them as either good or bad (Hayes & Feldman, 2004)). Attention training has had a positive impact on veterans PTSD symptoms (Badura-Brack et al., 2015). Acceptance is associated with less anxio-depressive symptoms Intrusion symptoms could be reduced by shifting attention to the present moment, avoidance symptoms by increased openness to experience, alterations in cognition and mood by non-judgemental acceptance of trauma-related cognitions, alterations in arousal by reducing attentional bias towards trauma stimuli, and dissociative symptoms by increased connection and awareness of somatic sensations. (Boden et al., 2012; Boyd, Lanius, & McKinnon, 2018).

Sport has also been found to be beneficial for health and emotional regulation; physical activity is of interest in the prevention and treatment of anxiety-related mental illness (Anderson & Shivakumar, 2013), and is reported to play a more-than-beneficial role in stress-related pathologies (Kandola et al., 2018). These benefits are especially apparent when sport is practiced regularly. In the specific case of PTSD, the data are promising (Fetzner & Asmundson, 2015; Hegberg, Hayes, & Hayes, 2019). Scuba diving combines sport and mindfulness training, as it focuses on the diver's breathing capacities. It has been found to have a positive effect on mindfulness abilities, chronic stress (Beneton et al., 2017) and PTSD (Morgan, Sinclair, Tan, Thomas, & Castle, 2019) although there is little literature on the subject. The two studies mentioned focus on the impact of simple recreational diving programs. No other practices were added to any of these programs.

In this context, a scuba diving training team has designed a mindfulness-associated diving program called the Bathysmed® protocol. This protocol combines the experience of diving and psycho-education on sophrology including breathing techniques.

The first objective of this pilot study is to compare the effectiveness of diving associated with mindfulness exercises (the Bathysmed® protocol) with multisport activity (sailing, canoeing, mountain hiking and snorkelling sessions) in reducing PTSD symptoms. The secondary objective is to compare the impact of the Bathysmed® protocol on mindfulness functioning in two groups of subjects suffering from PTSD, and identify any association between PTSD symptoms and changes in mindfulness.

2. Method

This proof-of-concept took the form of a controlled randomized clinical trial. The primary endpoint was the severity of PTSD symptoms, measured by the PCL-5 scale (PTSD Check List Scale) and its four sub-scales related to DSM5 (*Diagnostic and Statistical Manual* of Mental Disorders) (American Psychiatric Association, 2013) clusters of symptoms: intrusion; avoidance; change in mood and cognition; and arousal. Participants travelled together to Guadeloupe, a French Caribbean Island, from November 18 to 30, 2017. We chose this location to avoid the thermocline (colder water layer) which can be stressful for any diver. Half of the group were exposed to the Bathysmed® protocol (the experimental condition), and the other half to a non-specific multisport program that included two hours of physical activity per day (the control condition), during the ten-day stay. We measured the PTSD severity before and at the end of the program, and then one and three months afterwards. Trait mindfulness was measured in both groups at the same times. The DiveHope study was approved by the South East VI Ethics Committee on 10 October 2017 (Clinical Trial number: NCT03332290).

2.1. Participants

Thirty-four subjects (members of the association Life For Paris, an association of victims of the terrorist attacks of 13 November 2015 in Paris) participated. The primary inclusion criterion was that the individual suffered from PTSD at the time of recruitment, diagnosed with the Clinician-Administered PTSD Scale (CAPS) (Weathers et al., 2018) following his or her involvement in the Paris (France) terrorist attacks of 13 November 2015. CAPS is the gold standard for PTSD diagnosis, and has been revised to match the PTSD criteria given in the Diagnostic and Statistical Manual of Mental Disorder (DSM-5) (American Psychiatric Association, 2013). The diagnosis has been done by the study team physicians. The main exclusion criterion was a medical contraindication to the practice of scuba diving. Contraindications to scuba diving were checked by a hyperbaric medicine department with the appropriate authorizations. Scuba diving specialists were present during the diving sessions.

The participants did not pay anything to participate, received no monetary compensation and gave their informed consent in writing. The participants were flown from Paris to the Island of Guadeloupe. They were accommodated in a hotel. They travelled by bus each day to the diving club or to the sports facilities. The travel time was about 45 minutes.

2.2. Variables

The primary endpoint was assessed using the validated French version of the PTSD Check List Scale (PCL-5) (Ashbaugh et al., 2016), which is consistent with the DSM-5 definition of PTSD, at a threshold score of 33 (American Psychiatric Association, 2013). Trait mindfulness was measured by the validated French version of the 14-item Freiburg Mindfulness Inventory (FMI). A score over 38 indicates effective mindful functioning (Trousselard et al., 2010; Walach, Buchheld, Buttenmüller, Kleinknecht, & Schmidt, 2006). PCL-5 and FMI measurements were taken on arrival in Guadeloupe and before departure from Guadeloupe. All participants were measured at the same time. Post-course measurements (at one and three months) were carried out during sessions organized in Paris.

2.3. The Bathysmed® protocol and the multisport program

To measure the effects of scuba diving in combination with the practice of meditation, the 34 subjects were randomly assigned, before departure, to one of two groups: one group followed a multisport program, and the other followed the Bathysmed® protocol. Subjects did not know their group at the time of departure, and had accepted, in principle, to be assigned to either of the two groups.

2.4. The diving program

Diving may seem anxiogenic because of the environment, and the use of complex equipment. Therefore, a very progressive training program was implemented to reduce, or even eliminate this potential problem. In order to limit the risks as far as possible, and comply with the recommendations of the Divers Alert Network, the protocol did not include any long dives at depths greater than 20 metres. To further reinforce safety, and prevent barotrauma accidents, the first two dives took place in a swimming pool. This made it easy to evaluate the level of stress of subjects, and to form homogeneous groups for dives in the sea. Throughout the course, the depths reached increased very gradually, and the ratio of students to monitors varied from four to one (for very comfortable subjects), to two to one (for those who were less comfortable in the water), and one to one (for the most stressed individuals).

Since diving depth had little impact on the implementation of the protocol, all the objectives of the session could be achieved, even at a shallow depth of three metres.

All diving instructors held a professional diploma. They had also received specific training in stress management and sophrology. Sophrology is an exclusively verbal and non-tactile method, sophrology uses a set of techniques that act on both the body and the mind. It combines exercises that work on breathing, muscle relaxation and mental imagery (or visualization). In the Bathysmed® protocol, we focused on breath control and body awareness. Each exercise was prepared before the dives as no oral communication was possible underwater.

The choice of location (the Cousteau reserve in Guadeloupe) made it possible to optimize the sessions by using dive sites that limited stress (warm and clear waters with a profusion of marine life) and allowed contemplation of the extensive underwater fauna and flora. All dives were made in Guadeloupe.

2.5. The Bathysmed® protocol

The Bathysmed® protocol was created specifically for the DiveHope study, and it introduces the use of a new form of scuba diving. In the short term, the protocol requires concentration, openness to experience, self-acceptance and care. In the longer term, it supports the intention to maintain these practices. There are 10 dives, and each session is structured in the same way: diving theory; psychoeducation; a review of diving exercises with demonstration videos; mental preparation based mainly on sophrology techniques and, finally, the meditative dive. The 10 dives take place over 6 days (4 days with 2 dives, 2 days with 1 dive). The whole group dives each time. One day in the middle of the course is a no dive day.

2.6. Diving theory

In France, scuba diving is covered by the Sport Code. It is not possible to exceed a six-metre zone without the presence of a qualified instructor. The 10 dives theory includes the classic level 1 theory defined by the French Diving Federation. It is the equivalent of the PADI Open Water certification. Participants must have a good understanding of the hyperbaric environment, which helps to prevent accidents. They are therefore taught all of the basic theoretical knowledge they need to reach this objective. This knowledge is tested with a multiple-choice questionnaire that is validated individually by each trainee.

2.7. Psychoeducation

The Bathysmed® protocol includes an element of psychoeducation. The first objective is to reduce the level of anxiety related to diving, by providing explanations of the physiopathology of diving and stress, and the reasons driving the adoption of the Bathysmed® protocol. The second objective is to increase adherence to the program. This is in line with the need to reinforce the intention to practice, which is one of the pillars of meditative practices. Psychoeducation focuses in particular on breathing techniques and sophrology explanations.

2.8. Presentation of meditative diving exercises in the classroom

In most meditative practices, the session is conducted verbally by an instructor. The transfer of the session to the underwater environment requires that students have a full understanding of what will happen, prior to the dive. The protocol specifies a standardized teaching method based on a video demonstration that is as close as possible to the actual session. This is followed by a practice run of the meditative training that will be reproduced during the next dive.

The Bathysmed® protocol is very progressive, and is divided into three dive stages. Each stage has different objectives. The aim during the first four dives is to maintain attention on the present moment, and develop the re-appropriation of bodily sensations and concentration. The fifth to eighth dives are contemplative. In these sessions, the subject is helped to visualize the future from another angle. Finally, the last two dives consolidate confidence in the individual's personal abilities, and focus on letting go.

2.9. The multisport program

The multi-sport group had activities at the same time as the other group had dives. These included various activities such as sailing, surfing, canoeing, mountain hiking and snorkelling. It was compulsory for the subjects to follow the activities.

2.10. Statistical analyses

All analyses were run using R software (V3.6.3). We did not calculate the minimum number of subjects as the literature is very sparse on this topic, and we were limited to 34 subjects for logistical reasons. In practice, we consider this study as a proof of concept. We compared the mean change in PCL-5 and FMI scores between the two groups with a Student's t test. We also looked for an association between change in FMI and PCL-5 scores. Finally, we analysed the size of the course effect for both groups with Cohen's d.

3. Results

Both groups were composed of 11 female and 6 male subjects. The mean age for the Diving Group (DG) was

36 years (standard deviation (SD) = 6.9) and 34 years (SD = 5.6) for the Multisport Control Group (MSG). All had been diagnosed with PTSD according to the CAPS. Prior to the course, the average PCL-5 score was 38.9 (SD = 14.7, range from 10 to 66), the average FMI score was 31.4 (SD = 5.9, range from 22 to 44) and no difference was observed between groups in terms of gender, age, FMI and PTSD severity (PCL-5 scores).

All subjects in the MSG group completed all sessions. As for the DG group, out of the 187 dives initially planned (10 Bathysmed® protocol dives per subject, plus an optional night dive), 186 dives were carried out without any serious adverse events. One dive was cancelled because of ear pain linked to a mild inflammation of the eardrum.

Although implementation of the Bathysmed® protocol improved PCL-5 scores (Figure 1) more than the multisport program, the result was not significant (Table 1). However, the protocol was significantly better than the multisport activity in reducing intrusion symptoms of PTSD after one month, and was slightly better ($p < .1$) in improving trait mindfulness immediately after the course ended (Table 1). Globally, FMI scores improved up to one month after the course, but the result was not significant. Three months after the course, there were no differences between the two groups with respect to PCL-5 and FMI scores (Table 1).

The analysis of Cohen's *d* found a large effect of the course on the DG group for up to one month. This was not the case for the MSG group (Table 1). The magnitude of the effect size measured with the PCL-5 and the FMI was higher for every single measure, for the DG group, for up to one month.

PCL-5 and FMI changes were significantly correlated immediately after the course, and also three months later, but not after one month, although the direction of the effect did not change (Table 2).

4. Discussion

Although our pilot, proof of concept study only included a small number of subjects, it shows the possible interest of using diving practice as a therapy for subjects suffering from PTSD. Our results shows that the meditative diving, Bathysmed® protocol seems to be more beneficial than the multisport program up to one month after the course. However, the superiority of the diving protocol was only significant for intrusion symptoms of PTSD.

Intrusion symptoms play a special role in the physiopathology of PTSD. The intensity of re-experiencing past trauma in the present time is an indicator of patient outcomes (Brewin, 2015). The Bathysmed® protocol emphasizes the present moment. Divers are trained to be 'more present' during exercises, which could explain the rejection of traumatic memories. It has been proposed that shifting attention to the present moment reduces the attentional bias towards trauma stimuli (Boyd et al., 2018). Mindfulness-based therapies may increase activity in prefrontal regions and reduce activity in limbic regions. This could explain an effect on intrusion symptoms (Tang, Hölzel, & Posner, 2015). *Shifting attention to present moment could reduce attentional bias to trauma stimuli* (Boyd et al., 2018). Our result is all the more important since there is little evidence in the literature of the positive impact of other mindfulness exercises on intrusive symptoms (Boyd et al., 2018).

The effect size confirms these preliminary results. Overall, the Bathysmed® protocol tended to improve FMI scores more than the multisport program. The analysis of the effect size found a larger effect of the Bathysmed® protocol on PCL-5 and FMI scores and sub-scale scores for up to one month. However, we cannot draw any firm conclusions, because effect sizes are calculated separately for each of the two groups. None of the results that were identified up

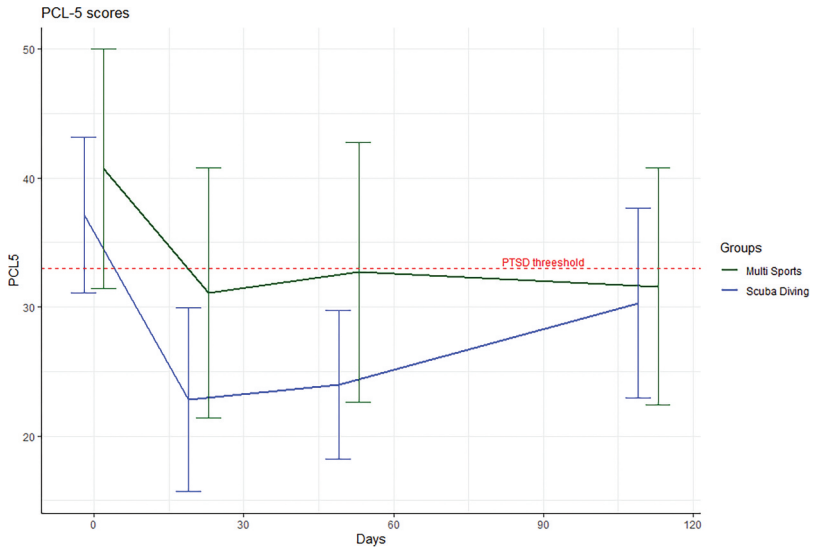

Figure 1. PCL5 scores before, immediately after, one month after, and three months after the course.

Table 1. Comparison of change in FMI (mindfulness) and PCL-5 (PTSD) scores over time.

	After	SD	*d*	p	1 M	SD	*d*	p	3 M	SD	*d*	p
PCL-5 DG	−14.3	14.3	1.1	0.29	−13.2	10.1	1.15	0.14	−6.8	15.2	0.52	0.63
PCL-5 MSG	−9.6	10.8	0.54		−8.0	9.3	0.44		−9.1	12.3	0.53	
PCL-5 DG-I	−4.1	4.2	1.5	< 0.1	−5.1	2.6	1.85	< 0.01	−2.9	3.2	0.94	0.59
PCL-5 MSG-I	−1.9	2.8	0.34		−2.2	3.1	0.38		−2.3	3.4	0.43	
PCL-5 DG-Av	−1.2	2.0	0.72	0.3	−0.6	1.8	0.29	0.34	0.35	1.8	0.16	0.27
PCL-5 MSG-Av	−0.4	2.3	0.15		0	1.7	0.00		−0.44	2.2	0.17	
PCL-5 DG-MC	−3.5	5.8	0.55	0.8	−3.5	5.2	0.58	0.85	−1.2	7.7	0.19	0.32
PCL-5 MSG-MC	−4.0	4.5	0.58		−3.1	4.8	0.44		−3.6	5.7	0.53	
PCL-5 DG-Ar	−5.5	6.1	1.1	0.27	−4.1	3.2	1.15	0.25	−3.1	4.8	0.77	0.88
PCL-5 MSG-Ar	−3.3	4.8	0.57		−2.7	3.5	0.45		−2.8	4.2	0.49	
FMI DG	7.3	6.5	1.19	< 0.1	4.1	4.4	0.74	0.12	2.12	6.3	0.34	0.75
FMI MSG	3.0	6.5	0.41		1.9	3.4	0.27		2.9	7.4	0.42	
FMI DG-P	3.1	3.0	1.05	0.17	1.8	2.1	0.63	0.18	1.1	3.3	0.32	0.92
FMI MSG-P	1.6	2.9	0.46		0.8	2.1	0.21		0.9	3.8	0.25	
FMI DG-A	4.2	4.2	1.14	< 0.1	2.3	2.6	0.74	0.21	1.1	3.5	0.32	0.52
FMI MSG-A	1.4	4.4	0.3		1.1	2.7	0.26		1.9	4.2	0.48	

DG: Diving Group, MSG: Multisport group. I: Intrusion, Av: Avoidance, MC: Mood and Cognition, Ar: Arousal, P: presence, A: Acceptance, SD: standard deviation, *d*: Cohen's *d*.

Table 2. Pearson's correlations between PCL5 and FMI scores. BF:

	Both groups		Diving group		Multi sports group	
	Pearson's *r*	*p*	Pearson's *r*	*p*	Pearson's *r*	*p*
BF-AF	−0.59	<0.01	−0.54	0.03	−0.62	<0.01
BF-1 M	−0.22	0.22	−0.11	0.66	−0.23	0.4
BF-3 M	−0.63	<0.01	−0.63	<0.01	−0.65	<0.01

BF: Before, AF After, 1 M: 1 month after, 3 M: 3 month after.

to one month after the program ended had persisted three months later.

There is little literature available on the persistence of the benefits of a mindfulness program. None of Beneton et al (Beneton et al., 2017) and Morgan et al (Morgan et al., 2019) studies did publish follow ups to our knowledge. However, in accordance with the recommendations of mindfulness programs, some statements suggest the need to a regular practice to maintain benefits. They mainly comes from findings from both Event Related Potentials (ERPs) and neuroimaging studies. They suggests an effect of time on brain activity changes (Rubia, 2009;). Some have made the assumption that long-term mindfulness practice may lead to automation of mechanisms/strategies (initially cognitive). Those mechanisms/strategies no longer require cognitive control effort (Brefczynski-Lewis, Lutz, Schaefer, Levinson, & Davidson, 2007).

As expected, and consistent with the literature (Gibert et al., 2015; Janssen et al., 2018), we found a constant association between changes in PCL-5 and FMI scores in both groups. However, the result at one month was not significant.

We could not expect a more general, homogeneous result for PCL-5 and FMI scores for two reasons. First, as mentioned earlier, our pilot study suffers from a lack of power. A larger number of subjects is needed to obtain more significant results. Second, to be effective, mindfulness must be practiced in the long term (Solhaug et al., 2019). Stable benefits only appear after several months of meditative practice. This probably explains why no differences persisted three months after the course. Nevertheless, our study shows the possible value of the Bathysmed® protocol. The protocol is a whole and must include psychoeducation to be effective. Diving alones might have been less effective but this still needs to be investigated. Amongst the limitations, we did not collect data on acceptability but all subjects in the diving group passed their first level diving diploma. The feasibility is more difficult. It happened far from home, diving is expensive. The cost makes it difficult to repeat the experience so often under the same conditions. Finally the limited number of subject and the diversity of their usual treatment did not allow us to take them into account.

Further work is needed to confirm the initial results obtained with this pilot study. The protocol is currently used in another pilot study in France including French military veterans (NCT03995992).

In this study, French military veterans suffering from PTSD were separated into two groups. One group follows a multisport program in the French Alps and the other group follows the Bathysmed® protocol in the Mediterranean (Toulon). In a more prospective way, the Bathysmed® team is working on a virtual reality device to be tested. Divers could exercise in the pool and be virtually in the sea. If it shows the same benefits, the feasibility of this new protocol would be greater.

Author contribution

LG, MT, FB and VM conceived and designed the analysis. LG and MT recruited the subjects. LG, MT, FB, FL, MC, AM and VM collected the data. LG and MT performed the data analysis. LG and MT wrote the first manuscript. JAM and FCR reviewed the scientific part of the manuscript. All authors contributed to and have approved the final submitted version.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by a grant from the FAVT (Fondation d'Aide aux Victimes du Terrorisme, Foundation for Victims of Terrorism) of 145,000 euros; Fondation pour l'Aide aux Victimes du Terrorisme (FAVT) [145000 euros].

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Data availability

The data supporting the findings of this study are located on a military server and cannot be accessed publicly but are available upon request from the corresponding author, Dr Lionel Gibert after following the IRBA (French Army Institute for biomedical research) procedure (military data procedure).

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