

Diving and mental health: the potential benefits and risks from a survey of recreational scuba divers

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Abstract

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Introduction: Scuba diving is physically and cognitively demanding. Medical guidance regarding physical and mental health (MH) issues and related prescribed medication is often based on limited evidence. There is a paucity of data concerning diving with MH issues. This survey aimed to investigate the prevalence of MH issues and use of prescription medications among United Kingdom (UK) sport divers, and the rate of non-compliance with current guidance among divers suffering depression and anxiety. The positive effects of scuba diving on MH were also considered.

Methods: An anonymous online survey was publicised through diving exhibitions and social media. Measures included diver and diving demographics; GAD-7 Anxiety and PHQ-9 depression questionnaires; diagnosed current and/or past MH conditions; medication usage; comorbid medical conditions/treatments; disclosure of past/current MH issues; and perceived MH benefits of diving.

Results: Data from 729 respondents revealed MH issues at rates comparable with the general population. Current and/or past MH issues were reported by 111/729, with 60 having active diagnoses, and 45/60 taking prescribed psychotropic medications; 21/45 did not declare their medication on diver self-certification medical forms. The activity of diving was thought to be beneficial to MH by 119/729 respondents.

Conclusions: Divers experienced expected levels of MH issues, but did not comply with current medical guidelines on modifying or abstaining from diving activity or reporting their MH condition. Changes may be needed to diver training to encourage more accurate reporting and aid development of evidence-based protocols. Guidelines could be reconsidered in light of current diver behaviour, risks and potential MH benefits.

Introduction

Scuba diving requires both physical and mental discipline, organization, and the ability to interact with other divers in an environment where initiative and dependency are crucial for the safety of those involved. These risks, combined with the specific physiological demands placed on divers, have led to the development of a regulatory culture in which divers are required to disclose relevant medical conditions to a qualified specialist, and to refrain from diving when medical conditions may affect their own safety and the safety of others.¹⁻⁵

Medical recommendations for divers are usually based on sound understanding of basic physiological processes; for example, in relation to respiratory conditions which increase risks of pressure-related injuries to the lung.¹⁻⁵

For some conditions, including the common mental health (MH) issues of depression and anxiety, few data exist to support evidence-based recommendations. The United Kingdom Diving Medical Committee (UKDMC) describes the relation between MH and fitness to dive as complex. Existing guidelines may be unclear to the ordinary diver, or not evidence based. Large datasets on which to base recommendations (e.g., clinical trials among divers) are unlikely to be forthcoming. Nonetheless UKDMC strives to produce pragmatic advice for divers and guidance for medical professionals involved in fitness to dive certification.¹

In common with other medical conditions which may impact fitness to dive, UKDMC require diagnoses of MH conditions to be reported to an approved diving medicine referee for further assessment. For depression, the guidance

states that divers should only return to the water once depression has 'lifted', and that they should wait three months after initiating medication to allow side effects to resolve. Divers are only permitted to take newer selective serotonin reuptake inhibitor (SSRI) antidepressants, or some second line agents such as Mirtazepine (with additional depth restrictions). Divers should refrain from diving whilst using older antidepressant medications (ADM), or if taking multiple psychotropic medications concurrently. For anxiety, no specific recommendations are made by UKDMC, but the advice not to dive when taking multiple psychotropic medications still applies.¹

It is difficult to estimate the proportion of sport divers who would be judged unfit to dive based on UKDMC criteria, but the number may be substantial. MH issues are a principle burden of disease globally with 25% of adults in the UK diagnosed with MH issues in any one year.⁶⁻⁸ The disorders of anxiety and depression represent the majority of cases.⁹ Despite the effectiveness of psychotherapy, the mainstay of treatment for mood disorders remains ADM.¹⁰ A retrospective analysis of UK prescribing data reveals a steady increase in the use of ADM over the past 20 years.¹¹ For the 1.5 million patients observed between 1995 and 2011, growth in new prescriptions for SSRI antidepressants did not reduce usage of older tricyclic antidepressants (TCA). Across this 17-year period 23% of patients were prescribed ADM at least once. Extrapolating from these 2011 figures, and applying UKDMC guidance, as many as 6% of the general population might therefore be excluded from diving based solely on rates of TCA and other non-SSRI ADM usage.¹² Fully accounting for dual-prescriptions, changes in dose or the SSRI prescribed, and the relapsing/remitting nature of depression itself, would all serve to increase this estimate.

Medical regulations and medical authorities are sometimes perceived by divers as excessively risk averse, and a threat to continuing participation in the sport.^{1,2,13} It is known that divers do not always disclose medical conditions, especially those relating to respiratory, cardiac or diabetes issues, that might affect their dive status either during the season, or when completing the annual medical self-certification form.^{14,15} Thus, there is likely to be a small but important covert population of active divers with current MH problems, and prescribed ADM, which remains understudied.

Anecdotal evidence may suggest that divers with MH conditions are successfully diving outside the UKDMC guidelines, perhaps indicating an opportunity to consider the acceptable level of risk against the potential benefits of the activity of diving on MH.

For diving guidance to be pragmatic it must reflect both the risks and potential benefits of the activity. Diving involves physical activity and encourages social connectedness and cooperation, acknowledged to be beneficial for MH.^{16,17}

A growing literature indicates that green spaces (gardens, parks, fields, moors etc.), and more recently blue spaces (lakes, beaches, sea etc.) may have restorative effects, and provide benefits for mental health and wellbeing.¹⁸⁻²⁰ Specific effects of scuba diving on MH have not been studied but the restorative effects of exposure to nature have been found sensitive to differences in activity type, and divers frequently access blue spaces for extended periods of time and are active within them.²¹⁻²³ The role of positive emotional regulation is receiving increasing attention in the treatment of mood disorders, implying that greater scrutiny should be given to medical guidance that may disrupt a sociable, physically active, and positively-affective pursuit.²³

The aim of this study was to collect data which might help place an upper bound on the potential harms caused by relaxing the current MH diving guidance, and the opportunity costs of the current restrictions. Specifically, we investigated the prevalence of MH issues and the use of prescription medications among sport divers, and the rate of non-compliance with current guidance among divers' suffering depression and anxiety. The benefits of scuba diving on improving mental well-being were considered, and perceived barriers to diving were elicited. Our study did not attempt to establish any association between MH issues and risk of decompression illness (DCI), or psychological stress as an influence in diving accidents.

Methods

An anonymous, observational, on-line questionnaire was compiled using diver and diving-demographic questions used in previous field data studies along with the Patient Health Questionnaire for Depression (PHQ-9) and the Generalized Anxiety Disorder (GAD-7) questionnaire (GAD-7 for regular or uncontrollable worries regarding everyday life).^{14,15,24-27} Demographic questions included affiliations, year of first dive, year of most recent dive, total dives since learning, dives in the last 12 months, and maximum depth ever dived.^{14,15,24,25} Technical divers were defined by maximum depth ever dived > 40 metres and affiliation to one or more technical diving organisations. Other questions involved current and/or past diagnoses for both MH and other conditions, and medications and treatments used. Additional questions probed the perceived benefits of diving on MH; diver understanding of transparency/openness with other divers, and awareness of the UKDMC recommendations concerning MH issues. Subjectively divers were also asked if they had experienced panic before or during a dive, and if so, how frequently. Finally, free text comments were encouraged.

The survey was available online for seven months from March 2015 and publicised through diving exhibitions and social media. Divers were free to participate and were not actively recruited. At the close of the survey, data were scrutinised for duplicate entries and completeness.

Table 1

Contingency table of PHQ-9 and GAD-7 scores by 729 respondents

PHQ-9	GAD-7				Total
	0–4	5–9	10–14	15–21	
0–4	531	40	2	1	574
5–9	54	38	6	0	98
10–14	6	20	9	1	36
15–27	2	3	8	8	21
Total	593	101	25	10	729

Descriptive statistics and tables are used to summarise the distribution of responses. Chi squared (χ^2) was used to test for independence in 2 x 2 tabulations. Generalized linear models using a gaussian or negative-binomial link were used to estimate the effect of covariates on the PHQ-9 and GAD-7, and on the number of dives; these were fitted using the rstanarm R package using default, non-informative, priors. From these models we report mean differences in scores or proportions, along with 95% credible interval (CI) or Bayes factor (BF) as appropriate. All software and data required to reproduce the findings reported here are included in an online data supplement doi: 10.5281/zenodo.1421734. In the opinion of the National Health Service (NHS), Health Research Authority, NRES Committee South West, Cornwall and Plymouth, no ethical review is required for anonymous studies of this type.

Results

Analysis was performed on 729 records, of whom 29% were women. The median age was 48 (range 16 to 85, IQR 19). Men in our sample were typically older than women (mean difference = -4.6; 95% CI = -6.6 to -2.5). Diving demographics were representative of the UK sport diving population; the median years of diving experience was 14 (IQR = 15), and the median number of life-time dives was 465 (IQR 840). The median number of dives completed in the last 12 months was 40 (IQR = 50). Maximum depth ever dived ranged from 5 to 200 metres' sea water (msw) (median = 47, IQR = 21). As a group, the maximum depth ever dived by the technical divers (232) was a median of 63 msw (IQR = 32). Even accounting for age, women had less life-time diving experience than men but had not been less active in the past 12 months. The estimated difference in the lifetime number of dives since learning for women vs. men was -195 (95% CI = -351 to -31), and for dives in the previous 12 months this difference was immaterial (a single dive less, 95% CI = -12 to 9 dives).

GENERAL HEALTH

Of the 729 respondents, alcohol was regularly consumed on a weekly basis by 66% and 7% were current cigarette smokers. Of the 98% (716) respondents who reported their weight, 32% had a normal body mass index (BMI 18.5–24.9); 42%

were overweight (BMI 25.0–29.9) and 25% were obese (> 30.0). Five women were underweight (BMI < 18.5).

Medications prescribed for non-MH health conditions were reported by 35% of divers with cardiac (9%), asthma (3%), and diabetes (2%) issues reported.

DEPRESSION (PHQ-9) AND ANXIETY (GAD-7)

All 729 respondents completed both PHQ-9 and GAD-7 questionnaires (Table 1). Depression and anxiety scores were comparable with national population norms, and selected items from both scales were compared with data from the UK Biobank.^{28,29} Comparison of individual items from the PHQ-9 and GAD-7 also indicated our respondents endorsed items at similar rates to the large sample held at www.ukbiobank.ac.uk.^{28,29}

Moderate to severe depression scores (PHQ-9 from 10 to 27) were reported by 8% (57/729) of respondents, with 77% (44/57) of this group undiagnosed. Moderate to severe anxiety scores (GAD-7 from 10 to 21) were reported by 5% (35/729), with 60% (21/35) of this group undiagnosed. Further analysis showed moderate and/or severe scores for both depression and anxiety (≥ 10) were reported by a small group (26/729), of whom 11/26 were diagnosed.

CURRENT OR PAST DIAGNOSED MENTAL HEALTH ISSUES

Of the 729 respondents, current or past MH issues were reported by 15% (111/729) of divers, with 8% (60/729) reporting a current MH issue. Women were more likely to report a current MH issue than men (28/183 vs. 32/486, $\chi^2[1] = 9.1$, $P = 0.003$). Separate to the PHQ-9 and GAD-7 questionnaire, physician diagnosed depression (7%) and anxiety (3%) were the most frequently self-reported issues, with other conditions including: bipolar disorder (0.5%), and single cases of schizophrenia, social/generalized anxiety disorder, post-traumatic stress disorder, eating disorder, personality disorder, and dysthymia. Due to the anonymity of the study further clarity of the mental health reports was not possible.

Regular use of physician-prescribed psychotropic medication was reported by 45 divers (Table 2). Significantly more women (25/28 $P < 0.016$) were prescribed medication than men (20/32). SSRIs were prescribed for 68% of these respondents, with five respondents prescribed more than one medication. Perceived daily side effects from medication were reported by two respondents, and three more were unsure; the remaining 40 reported no side effects from their drug regime.

Of the group prescribed MH medication (45/729), 51% continued diving immediately after diagnosis; 18% resumed diving after one month; and 27% resumed diving after two

Table 2

MH drug type, number and percentage reported by 45 respondents, five used more than drug

Drug type	Total reports from 45 respondents
Selective serotonin reuptake inhibitors	
Citalopram	15
Fluoxetine	8
Sertraline	6
Paroxetine	4
Escitalopram	1
Total	34 (68%)
Tricyclic antidepressants	
Amitriptyline	1
Total	1 (2%)
Other	
Bupropion/Wellbutrin	5
Venlafaxine	4
Mirtazapine	2
Lamotrigine	2
Clonazepam	1
Trazodone	1
Total	15 (30%)

months. Diving whilst on medication was not associated with perceived side effects by the majority 89%. One respondent thought he suffered from dry eyes whilst diving on the medication; the remaining four were unsure.

Non-pharmacological MH treatments were reported by 47% (28/60) of those reporting current MH issues and included cognitive behavioural therapy and other talking therapies including: counselling; psychodynamic therapy; stress anxiety and mood management courses; hypnotherapy; and eye movement desensitization and reprocessing.

DIVING WITH MH ISSUES

There was no difference in the lifetime number of dives between respondents with current MH issues (60) and those without MH issues (669) (difference = -94 dives, 95% CI = -324 to 198, BF10 = 0.09). However, respondents with current MH issues (60) reported substantially fewer dives in the previous 12 months compared with 669 respondents

with no MH issues (33 vs. 59 dives, difference = -27 dives, 95% CI = -36 to -16, BF10 = 567).

Asked if the MH issue affected their perceived ability to dive safely, 93% (56/60) participants said it did not, three were unsure, and one thought the ability to dive safely was affected but did not specify in what way. The activity of diving was considered to subjectively improve MH issues by 90% (54/60) of respondents.

DISCLOSURE, TRANSPARENCY/OPENNESS AND UNDERSTANDING OF MH ISSUES

Of the 60 respondents currently diagnosed with MH issues 55% did not declare their MH health status on the annual medical self-certification forms. Of the 45% (27/60) who had declared their MH issue through self-certification using internationally-recognised diving industry medical screening standards, none had ever been refused fitness to dive. Many respondents failed to disclose MH issues to their diving companions or buddy, with 48% (29/60) unsure if others were aware of their MH issue.

Overall 31% (227/729) stated that their general practitioner was, to their knowledge, unaware of their diving activity. Only 21% of all respondents (152/729) were aware of the UKDMC recommendations and guidance on MH issues. Free text responses suggested there is a degree of stigma attached to admittance of MH issues and a fear of exclusion due to their MH, for example: *“Because of this stigma we have dived where other people in the group, or dive operator/instructor does not know our medical history. We felt this was necessary in fear of being told we can’t dive when we know we are ok”*, and *“There is such stigma attached to mental health issues, not all mental health issues should stop people from being able to access the beauty of the underwater world”*.

More than half of respondents (482/729), both with and without a declaration of MH, had experienced feelings of anxiousness before or during a dive, at some time during their diving career. Self-defined panic was reported by 19% of all divers before or during a dive. Women were more likely than men to report experiencing panic before or during a dive (32% vs. 14%). Respondents with current MH issues were more likely to report panic before or during a dive (37%; 22/60) than those without MH (17%; 117/669).

TECHNICAL DIVERS

There was no statistical difference in the proportion of technical divers vs. non-technical divers with a current MH diagnosis (20/232, vs 40/497; $\chi^2[1] = 0.014, P = 0.907$) or a PHQ-9 or GAD-7 score > 10 ($\chi^2[1] = < 0.001, P = 1$). Mean differences between technical and non-technical divers on the PHQ-9 and GAD-7 were 0.11 (95% CI = -0.57 to 0.81), and -0.35 (95% CI = -0.88 to 0.20) respectively. Amongst divers with a current mental health issue, technical divers

were no more or less likely than non-technical divers to have informed their buddy ($\chi^2[1] = < 0.001, P = 1$), or to have self-declared any other medical condition ($\chi^2[1] = 1.894, P = 0.169$).

Discussion

Our study group of UK sport divers were similar to the general population in terms of the number reporting MH issues, but with a lower prevalence of antidepressant prescriptions. The type of medication prescribed was broadly similar to the general population, the majority being prescribed an SSRI.¹⁰⁻¹² However, we found that substantial numbers of sport divers were either unaware of the current UKDMC guidance or failed to comply with guidance in relation to MH. Many divers failed to exclude themselves for a sufficient period when initiating or changing ADM, when taking a non-SSRI medication, or when taking more than one psychotropic medication. Five divers were currently prescribed more than one MH medication thus contravening guidelines.¹ A small number of divers had not informed their general practitioner that they were active scuba divers. Overall, the respondents were broadly representative of the UK sport-diving population and demonstrated similar diving demographics to those in other studies and reports.^{13,14,24,25}

When completing the GAD-7 and PHQ-9 our respondents revealed rates and severity of depression and anxiety comparable to, or marginally lower than, large national surveys.^{6,26-29} Women were at elevated risk for both depression and anxiety compared with men, and were more likely to be prescribed an ADM.^{6,30} Of note was the number of divers who scored ≥ 10 on both the PHQ-9 and GAD-7, but who were not currently diagnosed by a physician for depression or anxiety. This indicated a substantial burden of symptoms which were not under medical management.

The data showed that the divers with MH issues were no less experienced than others without a diagnosis but had logged fewer dives over the previous 12-month period. Our data cannot explain why this is the case, but it may be that MH conditions affect the motivation to dive, or that divers recognise the need for caution when they are unwell and modify their behaviour accordingly. However, these data are drawn from a relatively small subset of respondents and inferences should be treated with caution. Few divers believed that their MH issues affected their ability to dive safely, or that any medications produced unwanted side-effects whilst diving.

We found that a relatively large number of divers had reported feelings of panic before or during a dive, and that women were much more likely than men to report these feelings. Due to the methodology of the study we were not able to explain in any detail how the respondents defined their panic. Anxiety and panic as risk factors for diving accidents have been reported, although for fatalities it often remains unknown whether panic was a contributing

factor.³¹⁻³⁵ Nonetheless, these divers might benefit from a more open culture, in which vulnerability and subclinical MH issues can be disclosed without fear of prejudice.

As in a recent study of military veterans, divers in our study reported diving to have a positive impact on their mood and MH, and the majority of those reporting a MH issue thought the activity of diving improved their condition.³⁶ This belief is of interest given the attention in recent years regarding the benefits of green and blue spaces on mental health.¹⁸⁻²² These findings are also consistent with observations from non-diving groups where exercise has been found to be beneficial to mental well-being.^{16,17,37}

Responses to our survey indicate low levels of accountability and understanding in relation to mental health and fitness to dive. Divers did not routinely comply with UKDMC recommendations, and disclosure and openness of MH issues with other divers was not always observed. These findings are consistent with other studies on drug use, alcohol use, and cardiac health among divers, which show similar patterns of non-disclosure and relatively little knowledge of guidelines.^{13,14,24,25}

Few respondents in the MH group were aware of the formal guidance from the UKDMC. Only 21% were aware of the recommendations, indicating both the need for continuing diver-education, and greater emphasis on fit-to-dive guidelines in dive training regimes. Divers are variously required to complete a medical statement form according to the guidelines of specific diving bodies but there is little uniformity of questions nor a central body for data collection.^{1,2} Data suggest there may be the case for more rigorous health screening of the technical diver subgroup, due to the more extreme physiological conditions to which they are exposed.^{13,15}

Free text responses in this study clearly showed a stigma attached to MH issues as well as a fear of being prevented from diving through transparency/openness; this may in part account for the general overall lack of openness.

LIMITATIONS

Anonymous online surveys suffer from potential response bias. Divers who have left the sport may not be included in this study, and divers who feel they have something to report may be more likely to respond. Issues may be exaggerated or under-reported, and reluctance to admit MH issues may preclude participation. Mental health issues themselves may influence participation rates.

Conclusions

For diving health guidance to be pragmatic it must reflect both the risks and potential benefits of the activity. Divers resemble the UK population in their level of MH morbidity, but are not always compliant with current medical guidance

relating to antidepressant medication and mood disturbance. Failure to disclose in some respondents may reflect a stigma associated with MH issues, whilst some divers may be poorly informed. Divers may be deliberate in their non-disclosure, seeking to avoid exclusion from the sport. The vast majority of respondents reported that diving improved their mental health and wellbeing. With no consistent evidence and only field data relating to specific risks for ADM medication and mood disturbance when diving, perhaps future guidance to divers should consider the level of risk in light of the potential benefits of continuing to dive recreationally.

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