The use of drugs by UK recreational divers: prescribed and over-the-counter medications

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Key words
Recreational divers, drugs, risk factors, medications, fitness to dive, health survey, epidemiology

Abstract
(St Leger Dowse M, Cridge C, Smerdon G. The use of drugs by UK recreational divers: prescribed and over-the-counter medications. *Diving and Hyperbaric Medicine*. 2011;41(1):16-21.)
Introduction: Various prescribed and over-the-counter medications may theoretically be incompatible with the diving environment. Anecdotally, it is known divers regularly take medications around the time of their diving activities for different health conditions, possibly ignoring the recommendations not to do so. As part of a diversion in a study of illicit drug use in sport divers, secondary data regarding the use of prescribed and over-the-counter medications were gathered.
Aims: The aim of presenting these data is to attempt to evaluate and promote debate surrounding the fitness of some divers to participate in the sport and the potential problems medication may cause whilst diving.
Methods: Anonymous questionnaires addressing diving demographics, general health, alcohol, smoking, illicit drugs, prescribed and over-the-counter medications were circulated via United Kingdom dive clubs, schools, dive shows and conferences. Divers were asked if they were currently taking medication prescribed by a physician, if they had ever taken any over-the-counter drugs within six hours before a dive, and to give details. Questions were fixed-option and free-format.
Results: A response rate of 26% provided 531 records (68% male, 32% female) for analysis. Over-the-counter medication was used by 303 (57%) of the respondents 6 hours or less before diving. Analgesics were the most commonly reported (180/303), with the use of decongestants (132/303) the next most regularly reported. Prescribed medications were used by 23% of respondents, with 10% reporting the use of cardiovascular drugs. The majority of the cardiovascular medication was for primary disease prevention; however, drugs only used in the treatment of symptomatic cardiovascular disease were reported, indicating individuals were diving with medical conditions recommended not compatible with diving. Other medication reported would also suggest liaison with a diving physician should have been undertaken prior to diving.
Conclusion: Although these data were diversionary, secondary and therefore open to criticism, the range of prescribed medications reported in this study was broad and suggested a need for further investigation regarding medication use and fitness to dive.

Introduction

The safe use of physician-prescribed and over-the-counter medications has been a topic of debate within the diving community and often remains a difficult area when considering fitness to dive. Studies, theoretical possibilities and anecdotal evidence have been used to assess the effect of diving and drugs, but the information available is inadequate for conclusions to be drawn definitively regarding the huge variety of medication used by recreational divers.[1–14]

Many divers take medications prescribed by their physician or other health professionals. Studies have shown, and it is anecdotally known, that divers regularly take medications around the time of their diving activities for minor complaints such as sea-sickness, headache, nasal congestion, and coughs and colds.[11–14] This is despite being advised during dive training not to do so because of the risk of diving-related problems occurring, and medical standards defined in the self-declaration medical questionnaire.[15,16]

The potential compatibility or risks of a medication whilst diving is a common query posed to diving medicine physicians. Prescribed medications are diverse and the implications in relation to diving and their use may not be realised by a non-diving prescriber. Divers may ignore the recommendations of their physician or consultant through lack of understanding of latent issues with regards to diving.[17] Admissions of use of a certain type of medication can be an indicator of an existing medical condition that previously had not been declared by the diver. A report in 2002 showed that a number of divers clearly disregarded any recommendations they may have been given and were regularly diving using analgesics containing opioids, anti-convulsants, anxiolytic, hypnotic drugs and a range of other potentially risk-enhancing medications.[17]

In the United Kingdom (UK), recreational divers complete self-declaration medical questionnaires. UK divers only have to contact a diving medicine physician or undergo a diving medical examination if a condition is indicated on the self-declaration form.[18] However, in the UK an individual has a single medical record in the primary-care domain, which is transferred when a patient moves to a different general practice. Secondary care services are obliged to provide information to the general practitioner regarding hospital appointments or admissions. This means that the past medical history of an individual is relatively complete

Table 1
Diving demographics of respondents

	Males (n = 360)		Females (n = 171)	
	Number	(%)	Number	(%)
Diving experience (yr)				
<2	26	(7.2)	33	(19.3)
2–5	63	(17.5)	53	(31.0)
6–10	72	(20.0)	38	(22.2)
>10	195	(54.2)	44	(25.7)
No data	4	(1.1)	3	(1.8)
Dives in last year				
0	4	(1.1)	13	(7.6)
1–50	211	(58.6)	115	(67.3)
51–100	103	(28.6)	37	(21.6)
>100	42	(11.7)	6	(3.5)
Dives since learning				
<100	62	(17.2)	65	(38.0)
100–500	126	(35.0)	64	(37.4)
501–1000	80	(22.2)	25	(14.7)
>1000	82	(22.8)	13	(7.6)
No data	10	(2.8)	4	(2.3)
Maximum depth dived (msw)				
<31	38	(10.6)	50	(29.2)
31–50	151	(41.9)	79	(46.2)
51–100	156	(43.3)	38	(22.2)
>100	15	(4.2)	1	(0.6)
No data	0		3	(1.8)

at a single source and an invaluable source of information should permission be gained to access it. This much reduces the possibility of concealment, mistruth or oversight by the diver undergoing dive medical examination, if a diving physician is fastidious in requesting appropriate background medical history.

In order to covertly gather data regarding the prevalence of illicit drug use in divers, we conducted a study entitled *Health of divers*. This was performed against a background of a diversionary set of questions regarding general health, and prescribed and over-the-counter medication use. The aim of these secondary data presented here is to promote awareness of a diver's fitness or possible unfitness to dive.

Methods

A detailed methodology for this study is presented in the accompanying paper on illicit drug use by UK divers.[19] The questionnaire *Health of divers* was compiled using diver and diving demographic questions designed and used in previous field studies, which included the number of years' diving experience, number of dives since learning to dive, number of dives in the last twelve months, and maximum depth ever dived.[20] General health fixed-option (yes/no) questions based on the UK Sport Diving Medical Committee (UKSDMC) self-certification form were included.[18] Information regarding smoking and alcohol consumption was also requested. Respondents were asked to list current prescribed medication, and if appropriate any over-the-counter medication they had ever taken within 6 hours of diving. The format and order of questions was designed to suggest to the diver that the sole purpose of the study was to gather data regarding their general health, e.g., asthma, diabetes and other health problems. All age groups were used in the analyses. Where appropriate, data are reported as range (median). Confirmation in writing was received from the Chair of the Cornwall and Plymouth Research Ethics Committee that ethics approval was not required for this study. Statistical analysis was performed using SPSS version 17.

Results

Completed questionnaires were received from 531 respondents with a response rate of 26% from hard copy questionnaires. There was a small response (2%) from the internet from questionnaires that were printed out, completed on hard copy and mailed back; the facility to electronically return completed questionnaires was not available for this study. All 531 records (68% male, 32% female), were suitable for analysis, with an age range of 13–70 years (median 43). There were proportionally more females (40.9%) than males (16.1%) in the 20 to 34 age groups, and more males (48.9%) than females (31.6%) in the older age groups.

Diver and diving demographics are shown in Table 1 and follow similar trends to that of other DDRC data.[20] Forty-five per cent of respondents had more than ten years' diving experience. More females (50.2%) than males (24.7%) had less than five years diving experience. The most years of diving experience reported was 46 years. A total of 30,441 dives in the last 12 months (23,343 male, 7,098 female) were reported by 514 divers, with average annual dives 66 for males and 45 for females. Altogether, 517 divers reported a total of 388,209 dives (322,773 male, 65,436 female) since learning to dive.

OVER-THE-COUNTER DRUG USE, SMOKING AND ALCOHOL

A wide range of over-the-counter medication use was reported by 303 (57%) of the respondents within 6 hours of diving (Table 2). Analgesics were the most commonly reported, with the use of decongestants the next most regularly reported. Some divers reported using more than one category or type of medication. Antibiotics reported were purchased 'off prescription' whilst overseas.

Smoking and alcohol use are shown in Table 3. Amongst those who did smoke cigarettes, 40 per day was the greatest number reported. The alcohol habits of divers showed the

Table 2
Over-the-counter drugs taken within 6 hours of diving activities, *n* = 303

Category	Frequency	Comments
Analgesics	180/303	Paracetamol, ibuprofen, aspirin, codeine
Decongestants	132/303	Oral pseudoephedrine Topical – unspecified
Antihistamines	41/303	Sedative – cinnarizine, chlorphenamine, Non-sedative – loratadine, cetirizine diphenhydramine
Antiemetic	27/303	Unspecified
Cold/flu remedies	10/303	Cough mixture, cold/flu remedies
Gastrointestinal	3/303	Loperamide
ENT	2/303	Unspecified
Miscellaneous	3/303	Antimalarials, antibiotics

same trend as previous studies, with 414 (78%) regularly consuming alcohol and 26% of that group admitting to drinking alcohol 'frequently' 12 hours or less before diving. Thirty respondents (28 males, 2 females, 5.6% of the total respondents) reported consuming 30 or more units per week.

PRESCRIBED MEDICATION USE

The use of prescribed medications was reported by 121 (22.8%) of the respondents (Table 4). Some respondents reported more than one type of medication, with 70 (57.8%) of respondents in this group also reporting the use of over-the-counter medications within 6 hours of the time of a dive.

Discussion

The primary objective of the *Health of divers* project was to gather data regarding illicit drug use in recreational divers, and these data are reported in the accompanying paper.[19] The questions with regard to the use of prescribed and over-the-counter medications were diversionary and as such were part of a 'piggy-back' method used to gather data from an otherwise covert population. As a result, some areas of information pertaining to prescribed and over-the-counter medications were not available for analysis. For example, some divers who listed prescribed medications for cardiovascular conditions did not provide detailed data with respect to that condition; whilst conversely some divers who provided data concerning specific conditions did not list their medications in detail, if relevant. Additionally, data relating to frequency of medication use were not gathered.

Table 3
Regularly smoking and/or consuming alcohol

	Males (*n* = 360)		**Females** (*n* = 171)	
Smoking use	Number	(%)	Number	(%)
Yes	40	(11.1)	13	(7.6)
No	320	(88.9)	158	(92.4)
Alcohol use				
Yes	284	(78.9)	130	(76.0)
No	76	(21.1)	41	(24.0)

Methodologies in collecting data from covert populations such as illicit drug users are well documented, with 'piggy-backing', as used in this study, acknowledged as a credible method.[21] The authors acknowledge the problems and any possible bias associated with anonymous methodology due to an inability to follow up. However, there are clear advantages to this method inasmuch as those respondents who feel they have something to hide may be more willing to participate in the project.

This study confirmed that some divers may be using a wide range of medications, both over-the-counter and prescribed, around the time of their diving activities. It is possible that the limited advice given during dive training to exercise caution with regard to diving and drug interactions is not being heeded. It is not known if divers are seeking advice regarding the safety and suitability of diving with various medical conditions or whilst on medication, or if the divers are concealing this when completing their self-declaration medical certificates.[17] The use of some prescribed medications reported in a few cases also suggests underlying medical conditions that may not be compatible with diving, for example symptomatic ischaemic heart disease and asthma.[22,23]

Anecdotally, there appears to be confused understanding in the grass roots of diving as to the suitability of some prescribed medication use and scuba diving. Some studies have attempted to evaluate the use of prescribed medication in divers.[11–14] The issue of prescribed medication is a common theme in 'fitness to dive' enquiries to medical referees, but is a sensitive area to address, with divers perceiving the threat of being declared unfit to dive.[23–27]

Even allowing for methodological issues, these data have provided a useful insight into some of the medications used by divers. With nearly 25% of the total respondents having used over-the-counter decongestants, and some additional cough, cold and flu remedies reported, many divers appear to be ignoring recommended standards.[15–17] Problems could manifest themselves as a rebound effect causing reverse ear barotrauma, pulmonary barotrauma due to mucous plugging, or the theoretical risk of lowering the seizure threshold through decongestant use. All may endanger a diver or their buddy or impair their performance underwater.

Table 4
Prescribed medications reported by respondents (*n* = 121) (numbers reported)

Category (in descending frequency of responses)	**Medication** (in descending frequency within category)	**Actual medication used**
Cardiovascular *(53)*	Angiotensic converting enzyme inhibitors /Angiotensin-II receptor antagonists *(15)*	Ramipril, irbesartan, perindopril, valsartan, lisinopril, losartan, enalapril
	Lipid lowering agents *(12)*	Simvastatin, atorvastatin, rosuvastatin, ezetimibe, fenofibrate
	Antiplatelet drugs *(10)*	Aspirin *(9)* and clopidogrel *(1)*
	Diuretics *(6)*	Bendroflumethiazide
	Calcium-channel blockers *(3)*	Felodipine, amlodipine
	Beta-adrenoceptor blockers *(3)*	Atenolol
	Alpha-adrenoceptor blockers *(1)*	Doxazosin
	Anti-anginal *(1)*	Nicorandil
Endocrine *(23)*	Diabetes agents*(9)*	Metformin *(7)*, Insulin (*2)*
	Thyroid replacement *(9)*	Levothyroxine
	Female hormones *(9)*	Norethisterone, hormone replacement therapy
Analgesics *(18)*	Non-steroidal anti-inflammatories *(10)*	Diclofenac, naproxen
	Opioids *(6)*	Tramadol, codeine phosphate, morphine
	Gabapentin *(1)*	for neuropathic pain
	Paracetamol *(1)*	
Respiratory *(16)**	Short-acting B2 agonists *(4)*	Salbutamol, terbutaline
	Inhaled steroids *(4)*	Budesonide, beclomethasone
	Inhaled combined steroid and long-acting B2 agonists *(3)*	Symbicort (budesonide and formeterol)
	Nasal sprays *(4)*	Fluticasone, mometasone, triamcinolone, Beclometasone
Gastrointestinal *(9)*	Proton pump inhibitors *(8)*	Lansoprazole, omeprazole
	Histamine-2 receptor antagonists *(1)*	Ranitidine
Drugs for infection *(7)*	Antibiotics *(4)*	Amoxicillin, amoxicillin/clavulanate, Metronidazole
	Antiviral *(2)*	Aciclovir
	Antifungal *(1)*	Fluconazole
Psychotropic *(6)*	Selective Serotonin Reuptake Inhibitors *(5)*	Citalopram, fluoxetine, paroxetine
	Benzodiazepine *(1)*	Diazepam
Neurological *(5)*	5 HT_1 agonist *(4)*	Rizatriptan, sumatriptan
	$Dopamine_2$ antagonist	Cabergoline
Musculoskeletal *(5)*	Arthropathy	Allopurinol, hydroxychloroquine, glucosamine
	Osteoporosis	Alendronate
Miscellaneous *(5)*	Antihistamines	Fexofenadine, loratadine
	Cancer	Anastrozole
	Skin (dermatitis herpetiformis)	Dapsone
	Opthalmology	Unspecified drops for glaucoma

**Listed according to Management of Chronic Asthma British Thoracic Society Guidelines*

There was a wide variety of medications recorded by the 23% of respondents who reported taking prescribed drugs. The issues arising from the compatibility within the diving environment of the medication being taken and the condition itself that requires the medication in the first place are of concern.[13,17] For example, an individual requiring medication such as Nicorandil, used in the management of symptomatic ischaemic heart disease, is at risk of in-water incapacitation and is also placing his fellow divers at risk in the event of a required rescue. The potential side effects of some medication could also cause problems during diving. This could range from cardiovascular performance impairment in an individual on beta-blocker medication, to increased risk of convulsion on medication such as selective serotonin reuptake inhibitors. It is recognised that some risks or side effects decrease with time on medication, but these time-factor data were not available to the investigators.

When addressing the fitness of an individual to undertake diving, understanding is needed of how the condition or medication required may impact on the diver or be influenced by the diving environment. Many non-diving medical practitioners will be unaware of possible risks associated with diving whilst taking specific prescribed medications and, therefore, are not able to pass on this information to the diver. In a suggested framework for fitness to dive, thought should be given as to:

- how the health condition of the diver will be affected by the activity of diving
- how the health condition will affect diving performance
- whether there is an increased risk of diving-related illness
- what is the liability to the safety of others in the dive party?[23,25]

For instance, there was report of neuropathic analgesic use. This may affect a diver's alertness, judgement, and decision-making abilities, resulting in impairment of in-water performance. Both the indication for the neuropathic analgesia and the drug itself call into question the diver's fitness to dive due to a risk of incapacitation, which could cause symptoms that might also be confused with DCI.

Some of the prescribed medication reported may suggest primary prevention of cardiovascular disease or, indeed, treatment of existing disease; this information detail was not available from this study. Much of the cardiovascular medication documented may fall into the category of primary prevention, perhaps reflecting preventative health strategies by general practitioners in the UK. Other medications are for secondary prevention in the treatment of existing cardiovascular disease (Table 4). Some divers may be diving with conditions that not only put themselves at risk, but potentially increase the risk of incident to others. This is an area that warrants further investigation, as has been undertaken, for instance, with regards to diabetes and diving. Health declines with advancing years and many divers continue diving irrespective of the fact that their health differs as they become older. Growing into a health problem may 'condition' a diver to the health complaint and any risk factor associated with diving may be either ignored or simply not appreciated. In the UK, the use of the Recreational Scuba Training Council Medical Statement, and the UK Sport Diving Medical Committee self-declaration medical form, whilst broadly successful, clearly enables some divers to avoid medical guidance, thus increasing the potential for risk whilst diving.[26–30] UK reports in 2009 noted that there was a disproportionate trend towards fatalities in the older age groups amongst divers and cardiovascular disease features annually in diving fatality statistics in the UK.[31]

In recognising that medications are used widely within the sport, the question needs to be asked by both physicians and divers as to whether there is a lack of education in this area, or whether the recreational dive industry is adequately informed but divers are simply choosing to ignore the advice given. With the lack of available data regarding the influence of medications on diving incidents, the opportunity exists for a closer liaison between the dive training agencies and the medical fraternity.

Conclusion

These data support anecdotal and published reports that divers use over-the-counter and physician-prescribed medications around the timing of their diving activities. The wide range of physician-prescribed medications reported by divers also confirmed a need for further investigation into use of medication such as cardiovascular drugs and compatibility with recreational scuba diving.

References

1 Groner-Strauss W, Strauss MB. Divers face special peril in use/abuse of drugs. *The Physician and Sports Medicine.* 1976;4:31-6.
2 Tofano ME, De Boer B. Effects of hyperbaria upon morphine antidiuresis and analgesia in rats. *Aviat Space Environ Med.* 1976;47:26-28.
3 Adair AC. Drugs and diving. *SPUMS Journal.* 1979;9:59-66.
4 Walsh JM. Should divers use drugs? *SPUMS Journal.* 1979;9:16-7.
5 Fowler B, Hamilton K, Porlier G. Effects of ethanol and amphetamine on inert gas narcosis in humans. *Undersea Biomed Res.* 1986;13:345-54.
6 Williams TH, Wilkinson AR, Davis FM, Frampton CMA. Effects of transcutaneous scopolamine and depth on diver performance. *Undersea Biomed Res.* 1988;15:89-98.
7 Brown M, Jones J, Krohmer J. Pseudoephedrine for the prevention of barotitis media: a controlled clinical trial in underwater divers. *Ann Emerg Med.* 1992;21(7):849-52.
8 Sipinen SA, Kulvik M, Leiniö M, Viljanen A, Lindholm H. Neuropsychologic and cardiovascular effects of clemastine

fumarate under pressure. *Undersea Hyperb Med.* 1995;22:401-6.
9 Taylor DM, O'Toole KS, Auble TE, Ryan CM, Sherman DR. The psychometric and cardiac effects of pseudoephedrine in the hyperbaric environment. *Pharmacotherapy.* 2000;20:1045-50.
10 Taylor DM, O'Toole KS, Auble TE, Ryan CM, Sherman DR. The psychometric and cardiac effects of dimenhydrinate in the hyperbaric environment. *Pharmacotherapy.* 2000;20:1051-4.
11 Nemiroff MJ. Drugs and divers – case report and comments. *SPUMS Journal.* 1977;7:17-18.
12 Taylor S, Taylor D, O'Toole K, Ryan C. Medications taken daily and prior to diving by experienced scuba divers. *SPUMS Journal.* 2002;32:129-35.
13 Taylor DM, O'Toole KS, Ryan CM. Experienced, recreational scuba divers in Australia continue to dive despite medical contraindications. *Wilderness Environ Med.* 2002;13:187-93.
14 Fraisse T, Nicolas B, de Wazieres B. [Evaluation of self medication by scuba divers.] *Therapie*. 2005;60:409-12. French
15 *Recreational Scuba Training Council Medical Statement* [Internet]. Jacksonville FL: WRSTC; 2007. Available from: <http://www.wrstc.com/downloads/10%20-%20Medical%20Guidelines.pdf>.
16 Health and Safety Commission [internet]. *The medical examination and assessment of divers (MA1)*. Health and Safety Commission; 2008. Available from: <http://www.hse.gov.uk/diving/ma1.pdf>.
17 Shelly S, St Leger Dowse M, Bryson P. *Survey of scuba diving for disabled divers and divers with other conditions that may affect their diving (injuries, surgery & disease).* Plymouth, UK: The Diving Diseases Research Centre; 2002.
18 *UK Sport Diver Medical Form* [Internet]. UKSDMC; 2008. Available from: <http://www.uksdmc.co.uk/downloads/medicalform.pdf>.
19 St Leger Dowse M, Shaw S, Cridge C, Smerdon G. The use of drugs by UK recreational divers: illicit drugs. *Diving and Hyperbaric Medicine*. 2011;41:9-15.
20 St Leger Dowse M, Bryson P, Gunby A, Fife W. Comparative data from 2250 male and female sport divers: diving patterns and decompression sickness. *Aviat Space Environ Med*. 2002;73:743-9.
21 Decort T, Mortelmans D, Tieberghien J, De Moor S. *Drug use: an overview of general population surveys in Europe*. Luxembourg: European Monitoring Centre for Drugs and Drug Addiction; 2009; Available from: <http://www.emcdda.europa.eu/publications/insights/driving>.
22 *British guideline on the management of asthma* [Internet]. London: British Thoracic Society; 2008, revised 2009. Available from: <http://www.brit-thoracic.org.uk/clinical-information/asthma/asthma-guidelines.aspx>.
23 Gorman D. From police to health adviser: the evolution of modern occupational health surveillance. *SPUMS Journal.* 2003;33:134-9.
24 Elliott D, Edge C. Restricted diving for the unfit. *SPUMS Journal.* 2001;31:41-4.
25 Gorman D. Health surveillance in the 21st century. *SPUMS Journal.* 2001;31:39-41.
26 Meehan C, Bennett MH. Medical assessment of fitness to dive – comparing a questionnaire and a medical interview-based approach. *Diving and Hyperbaric Medicine*. 2010;40:119-24.
27 Ong LM, Bennett M H, Thomas PS. Referral patterns and outcomes of dive medical examinations in a tertiary hyperbaric facility. *Diving and Hyperbaric Medicine*. 2010;40:125-30.
28 Glen S, White S, Douglas J. Medical supervision of sport diving in Scotland: reassessing the need for routine medical examinations. *Br J Sports Med.* 2000;34:375-8.
29 Smith P, Glen S, Douglas J. Reassessing the need for sport diving medicals. *Br J Sports Med*. 2001;35:282.
30 Glen S. Three year follow up of a self certification system for the assessment of fitness to dive in Scotland. *Br J Sports Med*. 2004;38:754-7.
31 Cumming B. *British Sub Aqua Club National Diving Committee Diving Incidents Report 2009*. Ellesmere Port: British Sub-Aqua Club; 2010. Available from: <http://www.bsac.com/page.asp?section=1038>.

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