

# Alcohol and UK recreational divers: consumption and attitudes

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## Abstract

(St Leger Dowse M, Cridge C, Shaw S and Smerdon G. Alcohol and UK recreational divers: consumption and attitudes. *Diving and Hyperbaric Medicine*. 2012;42(4):201-207.)

**Introduction:** Scuba diving demands information processing, recall, reasoning, decision making and the ability to take control of situations under different scenarios. Anecdotal evidence suggests that some divers consume alcohol to excess around the time of a dive. This study investigates alcohol consumption and attitudes to alcohol in United Kingdom (UK) recreational divers.

**Methods:** A questionnaire addressing diving demographics, general health, type and frequency of alcohol consumption, and attitudes to drinking alcohol around the time of diving was available for anonymous completion online between September 2010 and January 2011.

**Results:** Records from 818 divers were analysed. Older divers were more likely to exceed the weekly alcohol units recommended by the UK government compared to younger divers ( $P < 0.001$ ), but binge drinking was associated with younger divers ( $P = 0.014$ ). Diving when considering themselves unfit to drive a car was reported by 151 (18.5%) respondents and 187 (22.9%) had witnessed a diving incident which they felt was attributable to alcohol. Only 313 (38.3%) respondents reported a responsible attitude to alcohol by their dive clubs both under normal circumstances and whilst on a dive trip.

**Conclusion:** Some divers undertook diving activities when potentially over the legal limit to drive a car and demonstrated a possible lack of understanding of the effects of alcohol beyond dehydration. Divers considered club attitudes to drinking and diving to be less responsible when on a diving trip. Some divers took a more responsible attitude to alcohol consumption having witnessed a diving incident which was potentially related to alcohol.

## Key words

Alcohol, health, recreational divers, survey, world wide web

## Introduction

The effects of alcohol are a major health issue, and the burden of alcohol-related health problems to society as a whole has been widely studied.<sup>1-7</sup> Gender, weight, age, activity, comorbidities and ethnic origin govern the response of an individual to alcohol consumption in both the acute setting and over time. Not only is the excessive use of alcohol a risk factor in disease processes, it is a leading causative factor in accident and injury. The effects of alcohol on human responses in differing activities, environments and situations have been reported.<sup>8-15</sup> Alcohol impairs psychomotor ability, including cognition, reaction time, judgment and visual function, and recommendations and legislation by authorities and governments internationally regarding activities such as flying and driving reflect this.<sup>13-15</sup> In addition, the downstream effects of excessive alcohol consumption in the form of a hangover cause impaired cognitive and physical performance with subsequent problems including work absenteeism and reduced productivity.<sup>16-21</sup>

Recreational scuba diving is a sport requiring information processing, recall, reasoning, decision making, attention and the ability to take control of a given situation in any number of scenarios: on shore, in the boat, at the water surface or underwater. These are all situations in which behaviour and performance may be affected by the inappropriate use of alcohol within a given time frame prior to diving. Studies have shown an increased risk where alcohol has

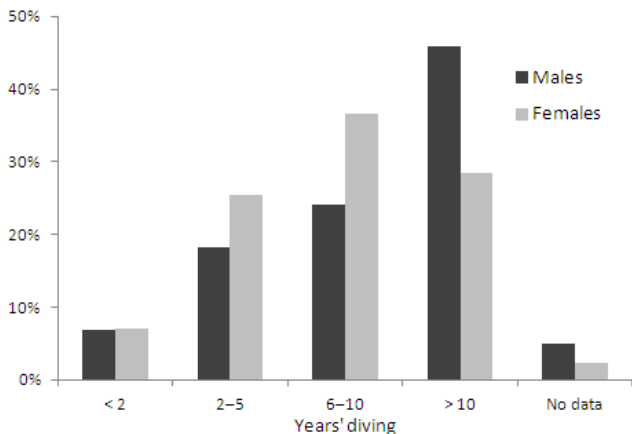
been consumed around the time of aquatic activity, and a relationship between reduced capability and alcohol intake has been demonstrated.<sup>22-26</sup> Dehydration and increased nitrogen narcosis resulting from alcohol intake have also been described.<sup>27-29</sup>

Recreational scuba diving facilitates socialising as a group, thus encouraging the consumption of alcohol. Dive training by the accredited bodies advises that divers do not drink an excess of alcohol the night before a dive, though no formal recommendations with regard to units of alcohol imbibed exist. Anecdotal data suggest that some divers clearly dive the morning after consumption of what may be considered excessive amounts of alcohol the night before, and sometimes dive with a hangover. Studies with the primary aim of observing United Kingdom (UK) diver alcohol habits have not been published. Scrutiny of the last 10 years of British Sub-Aqua Club (BSAC) incident reports shows only passing reference to alcohol consumption, where appropriate within a specific report, but no focus on the prevalence of alcohol consumption around the activity of diving or its effects.

The aim of this study was to gain an insight into the general alcohol habits of divers and to utilise the outcomes to initiate an educational programme for the promotion of safer diving. Although divers were asked if they had ever witnessed a diving incident which, in their opinion, could be attributed to alcohol, no attempt was made to gather data directly

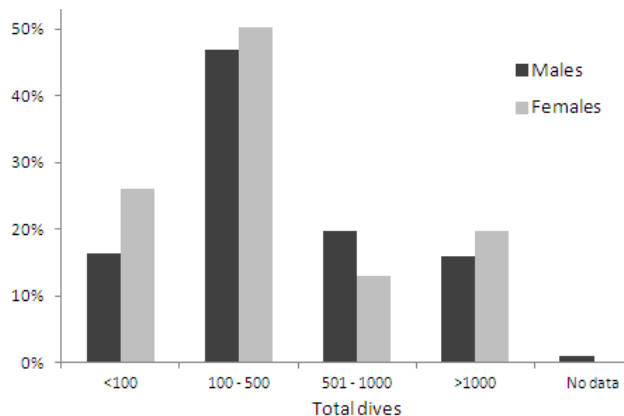
**Figure 1**

Years of diving experience: males and females



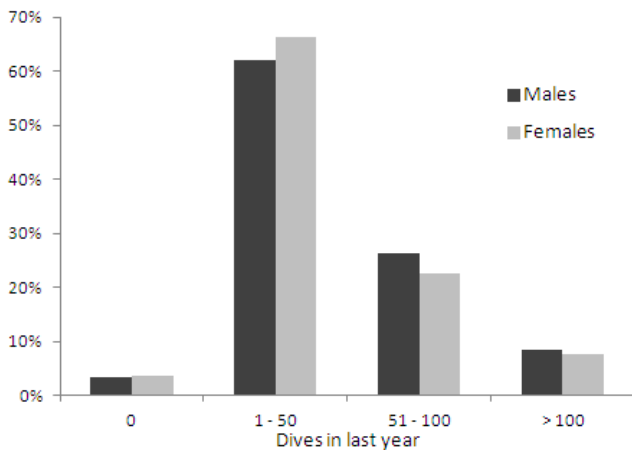
**Figure 2**

Total dives since learning: males and females



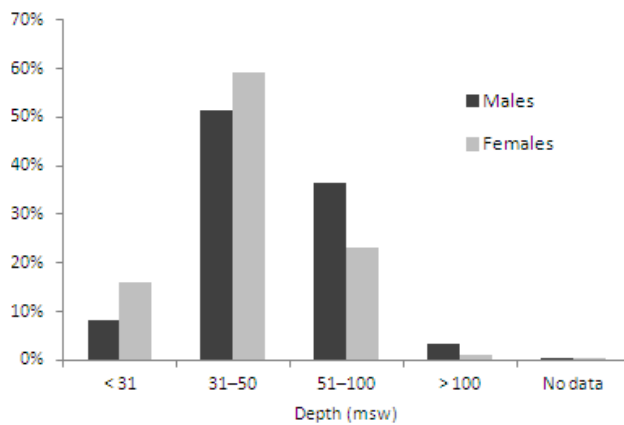
**Figure 3**

Total dives in last year: males and females



**Figure 4**

Maximum depth ever dived: males and females



linking alcohol intake with risk of an incident or rates of decompression illness (DCI).

**Methods**

A web-based questionnaire was compiled entitled *Diving and Alcohol*,\* and was available for anonymous completion online between September 2010 and January 2011 through the Diving Diseases Research Centre (DDRC) website. It was publicized by the UK recreational diving organizations and diving magazines. The questionnaire included diver and diving demographic questions used in previous DDRC field data studies.<sup>30,31</sup> These included age, gender, diving organization affiliation, number of years' diving experience, number of dives since learning to dive, number of dives in the last year and maximum depth ever dived. Health-related questions included whether the diver was taking prescribed medication, if they had completed a self-declaration medical form, had taken advice from a medical referee or had undergone a diving medical examination.<sup>32</sup> Alcohol

questions focused on the diver's understanding of the UK government recommendations for alcohol intake: how frequently divers drank (every day, four or more times a week, two to three times a week, two to four times a month, monthly or less, and never), and amount in units for each gender (males three to four units per day, females two to three units per day).<sup>4</sup> A unit was defined as approximately equal to 250 ml of ordinary-strength beer, lager or cider (alcohol by volume (ABV) 3-4%), or a small 25 ml measure of spirits (ABV 40%) or 175 ml of red wine (ABV 12%). Binge drinking is defined by the National Health Service and National Office of Statistics as drinking more than double the daily recommended units of alcohol in one session.<sup>4,33</sup> Questions concerning the types of alcohol consumed, alcohol health-related problems, shortest time alcohol was used prior to diving, whether the diver had dived when they considered themselves unfit to drive a car, the attitude of their dive club under normal conditions towards alcohol and the attitude when away on a diving trip were also included. Questions were fixed option yes/no where applicable. Divers

\* **Footnote:** Copies of the questionnaire are available from the corresponding author, e-mail: <marguerite@mstld.co.uk>.

were also asked to add additional information with free text if they considered they had witnessed a diving incident that in their opinion could have been attributed to alcohol. The questionnaire was initially piloted for understanding and validity of responses and compared with national data, and with diver and diving demographics.<sup>4,30,31</sup> The Chair of the Cornwall and Plymouth Research Ethics Committee confirmed that ethics approval was not required for this study.

All age groups were used in the analyses. Data, where appropriate, have been reported as median (range) or percentages and 95% confidence intervals (95% CI). Chi-square tests were used to examine the relationships between the following: gender and frequency of alcohol intake; age and number of alcohol units in a week; age and diving when over the legal limit to drive a car; and age and binge drinking. A significance level of 0.05 was applied throughout. Statistical analysis was performed using SPSS version 17.

**Results**

Self-reported records were received from 818 respondents (79% male, 21% female; median age 43 years, range 17–74). There were proportionally more females (121/169, 71.6%) than males (334/649, 51.5%) in the 16 to 44 age groups, and thus fewer females (48/169, 28.4%) than males (315/649, 48.5%) aged 45 and over. Diver and diving demographics are shown in Figures 1–4. A total of 46,092 dives (males 37,268, females 8,824) were reported in the last year (median 40, range 0–999). Altogether, the respondents reported a total of 541,228 dives (males 444,933, females 96,295) since learning to dive (median 320, range 6–14,000). The depths of dives reported by all respondents ranged from 10 to 210 metres’ sea water (msw).

**ALCOHOL – UNDERSTANDING UK GOVERNMENT RECOMMENDATIONS**

Divers were asked whether they understood the UK

government recommendations for daily intake of alcohol units for males and females. Overall, there was a reasonable understanding by both males and females of their own and each other’s recommended maximum daily intake. A total of 695 (84.9%, 95% CI 82.5 to 87.4%) respondents either returned the correct answer for the recommended daily alcohol intake or erred on the side of caution and underestimated the recommendations. The remaining 123 (15.1%, 95% CI 12.6 to 17.5%) either did not know or overestimated the government recommendations.

**HEALTH AND ALCOHOL**

A total of four males (0.5%) admitted that since learning to dive they had suffered alcohol health-related problems, with weight gain, and/or abdominal pain, and diarrhoea reported by three of the four respondents. The fourth respondent admitted to a “*semi-breakdown*”, attending out-patient services for treatment for alcohol abuse, abstaining for 10 years but having three relapses in the previous six months, during which time he had been diving. He had completed a diving medical self-assessment form but had not sought advice from a diving medical referee or had a physical examination. A total of six (0.73%) further respondents reported hospital attendance for alcohol-related accidents with broken bones, concussion, and a car crash being reported.

**TYPE, FREQUENCY AND UNITS OF ALCOHOL**

*Type*

More males (47.6%, 95% CI 43.7 to 51.4%) than females (27.6%, 95% CI 20.9 to 34.3%) reported drinking beer, lager, or cider, whilst more females (47%, 95% CI 39.6 to 54.6%) than males (33%, 95% CI 29.3 to 36.6%) reported drinking wine (Table 1).

*Frequency*

Alcohol consumption habits differed between genders (Table 1). When considering the frequency of drinking

**Table 1**

Alcohol habits and frequency for male and female divers

Type of alcohol in week*	Males	Females	Total
<i>n</i> (%)	1,032 (78.5)	283 (21.5)	1,315
Strong beer, lager or cider	491 (47.6)	78 (27.6)	569 (43.3)
Wine	341 (33.0)	133 (47.0)	474 (36.0)
Spirits	175 (17.0)	63 (22.3)	238 (18.1)
Fortified wine	15 (1.4)	3 (1.0)	18 (1.4)
Alco pops	10 (1.0)	6 (2.1)	16 (1.2)
<b>Frequency of intake (%)</b>			
<i>n</i> (%)	649 (79.3)	169 (20.7)	818
Every day	76 (11.7)	10 (5.9)	86 (10.5)
4 or more times a week	125 (19.2)	36 (21.3)	161 (19.7)
2–3 times a week	236 (36.4)	51 (30.2)	287 (35.1)
2–4 times a month	129 (19.9)	53 (31.3)	182 (22.2)
Monthly or less	55 (8.5)	15 (8.9)	70 (8.6)
Never	28 (4.3)	4 (2.4)	32 (3.9)

**Table 2**

Numbers (%) of divers by age who did or did not consume more alcohol than the weekly government recommendations

Age group	16–24 years	25–44 years	45 and older	Total
<i>n</i> (%)	53 (6.5)	402 (49.1)	363 (44.4)	818
Yes	10 (18.9)	87 (21.6)	126 (34.7)	223 (27.3)
No	43 (81.1)	315 (78.4)	237 (65.3)	595 (72.7)

**Table 3**

Numbers (%) of divers by age who did or did not binge drink

Age group	16–24	25–44	45 and over	Total
<i>n</i> (%)	53 (6.5)	402 (49.1)	363 (44.4)	818
Yes	16 (30.2)	65 (16.2)	52 (14.3)	133 (16.3)
No	37 (69.8)	337 (83.8)	311 (85.7)	685 (83.7)

**Table 4**

Numbers (%) of divers who self-reported diving whilst considering themselves unfit to drive a car

	Over weekly limits	No alcohol/within weekly limits	Total
<i>n</i> (%)	221 (27.5)	583 (72.5)	804
Yes	64 (29.0)	87 (14.9)	151 (18.8)
No	157 (71.0)	496 (85.1)	653 (81.2)

alcohol fewer females (5.9%, 95% CI 2.3 to 9.3%) than males (11.7%, 95% CI 9.3 to 14.2%) consumed alcohol every day ( $P = 0.009$ ), and more females (31.4%, 95% CI 24.5 to 38.3%) only consumed alcohol two to four times a month than males (19.9%, 95% CI 16.9 to 23.1%). More males (4.3%) than females (2.4%) were teetotal.

#### Units

The maximum daily number of alcohol units ranged from 0 to 33 (median 4). The number of units consumed weekly was investigated in relation to the government-recommended weekly amount of units (11–21 per week males, 8–14 per week females) with age as a factor (Table 2). There was a significant effect of age showing that older divers aged 45 years and over (34.7%, 95% CI 29.8 to 39.6%) were more likely to exceed the recommended weekly amount of units than divers of 16–24 years (18.9%, 95% CI 8.3 to 29.4%) and 25–44 years (21.7%, 95% CI 17.6 to 25.7%) age groups ( $P < 0.001$ , Table 2). When daily alcohol consumption was examined with age as a factor, binge drinking was associated with a small but significant number of divers in the 16–24 years age group ( $P = 0.014$ , Table 3).

#### ALCOHOL AND DIVING

A total of 151 (18.5%, 95% CI 15.8 to 21.1%) respondents admitted to diving when considering themselves unfit to drive a car. Further analysis showed that age was a significant factor, with younger divers more likely to dive when over the limit, and older divers more likely to exercise caution ( $P = 0.009$ ). Table 4 shows divers who exceeded the recommended weekly alcohol limits were also significantly more likely to dive whilst unfit to drive a car ( $P < 0.001$ ).

A total of 282 (34.5%, 95% CI 31.2 to 37.7%) respondents admitted consuming alcohol between six hours and less than 30 minutes before a dive. A significant number (73.5%, 95% CI 66.5 to 80.5%) of the group who had undertaken diving activities when unfit to drive a car also admitted drinking alcohol six hours or less before a dive ( $P < 0.001$ ). Sixteen divers (1.95%) reported consuming alcohol less than 30 minutes before a dive. Only 313/715 (39.4%, 95% CI 36.0 to 42.8%) respondents were in agreement that their dive clubs demonstrated a responsible attitude to alcohol under normal circumstances and also whilst away on a dive holiday/weekend. In general, the respondents considered their club to have a less responsible attitude to alcohol when away for diving weekends or holidays.

A diving incident that might be alcohol related, in their opinion, was reported to have been witnessed by 187 (22.8%, 95% CI 20.0 to 25.7%) of respondents. Some respondents recorded observations or described first-hand experiences with regard to alcohol and diving, together with their opinions (Table 5).

#### Discussion

Alcohol consumption in the UK is of increasing concern to the government and health authorities.<sup>4,33</sup> It is a global problem affecting both genders, all age groups, and all social classes and can be attributed to 4% of deaths worldwide.<sup>1,4,5</sup> Depending on consumption levels and variables such as age, body weight, health, alcohol tolerance and social environment, alcohol affects the ability to organize, orientate and concentrate; whilst judgment, decision making, mood and visual acuity are impaired to varying degrees.<sup>7</sup> Alcohol

**Table 5**

Free-text examples: alcohol and perceived diving incidents

**ID1.** *I have witnessed two diving incidents due to excessive alcohol consumption, both involving the person still being drunk the morning after drinking far too much alcohol.*

**ID2.** *My buddy suffered DCI; we had conducted a 40+ msw dive requiring 12-minute deco and a 3-minute safety stop. It was a square profile and we had identical dives over the previous week, the only difference in our activity was the night before the dive in question, I had one pint of beer and went to bed; he stayed out for at least four more beers before retiring.*

**ID3.** *Part of the attraction of diving is its inherent 'social' aspect. It is well understood that alcohol dehydrates you and that dehydration is a contributory factor in DCI. I have frequently 'over-indulged' as have my colleagues and dived, yet we remain 'responsible' as we take our dive marshalling and supervision roles seriously. We know our buddies and their capabilities well and assess the risks on a case-by-case basis. I am not condoning drinking and diving in any way; I just accept the risk and dive, drink and assess accordingly.*

**ID4.** *Many people in our diving club still drink heavily during a diving weekend. One experienced diver is well known for sinking a couple of pints at lunchtime in between dives. There can be a lot of pressure on people in a club/group situation to drink whilst away on a diving trip, whether [in the] UK or abroad.*

**ID5.** *I have seen one guy pulled from the water and he died. He had drunk a lot the night before a deep dive course.*

**ID6.** *We are very responsible with regards alcohol following a fatality after which the inquest found a quantity of alcohol in the blood.*

**ID7.** *I notice that those who drink within 24 hours of a dive suffer excessive narcosis at depth and are more likely to panic and abort even in perfect conditions.*

**ID8.** *Over 20 years I have witnessed and dealt with several DCI incidents that were undoubtedly due to alcohol consumption leading to dehydration. Some of these DCI events were quite serious. Despite warnings, some divers were determined to drink multiple units of alcohol on Friday night and dive on Saturday morning. Ignorance of the consequences of alcohol consumption with diving is common, but some divers are wilfully in denial.*

The self-reported data in this study demonstrate that some divers admitted to knowingly drinking alcohol to excess around the time of their diving activities, and sometimes dived when they felt they were over the limit to drive a car. Statutory blood alcohol content (BAC) is used as a measure of intoxication for medical and legal purposes. The threshold limits for driving a motor vehicle vary between countries; in the UK the maximum legal BAC is 80 mg of alcohol per 100 ml of blood. The relationship between alcohol consumed and the BAC of any specific individual is dependent on many factors, including the number of units consumed over a given number of hours, the body mass index of the person and the immediate history of food intake. Carbonated drinks speed up alcohol absorption, whilst food in the stomach will slow down the process. Gender also plays a role, with women, particularly younger women, in general having a lower tolerance threshold than men, due to lower alcohol dehydrogenase levels. Some medications may prevent alcohol dehydrogenase from metabolizing alcohol, thus exacerbating its effects. All these factors affect the speed that the liver can process the alcohol consumed; the alcohol that cannot be metabolized remains in the bloodstream and is measured as BAC.

National data comparing the attitudes of drinking and driving within legal limits shows drivers have their own individually set limits, often based within the concept of the legal limit to drive.<sup>4</sup> Divers have no recommended drink-diving limit and therefore there is no such 'psychological' guidance. This may, in part, be owing to the issues surrounding drinking and diving in the UK having been inadequately addressed to date, together with the lack of formal literature with regard to the effect of alcohol and/or hangover on accidents and fatalities within the recreational diving industry. Universally, accident and incident reports within the diver training bodies have not specifically focused on alcohol consumption around the time of a dive.

Divers generally do not regard diving after drinking the night before, or diving with a hangover, as the legal equivalent of 'drink driving'. Free text gathered by the survey (Table 5) illustrates that attitudes to alcohol consumption in conjunction with diving activities become more responsible when a diver has actually witnessed an incident that they perceive to have been attributable to alcohol. Some divers additionally observed an increased susceptibility to nitrogen narcosis under the influence of alcohol, whilst others felt they observed an attitude of drink-dive denial amongst some divers.

Historically the dive training organizations have focused on the dangers associated with dehydration which occurs due to the diuretic effects of alcohol and which may increase the risk of DCI.<sup>28</sup> In general, there has not been a policy of expanding lectures to impart a broader knowledge and understanding of the metabolic effects of alcohol or alcohol hangover. Personal communications show this policy may be

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hangover is also known to affect cognitive function.<sup>18-20</sup> These factors suggest alcohol consumption to be a contra-indication to safe diving, possibly increasing the risk of a diving incident.

owing to the dilemma facing the diver training organizations; namely that a strategy of policing the enjoyment of alcohol could result in damage to membership of a sport with a heavy social reliance, particularly in the UK where there is an emphasis on club membership.

The aviation industry and the legislation of governments worldwide have sought to address the issues surrounding the effects of alcohol and BAC.<sup>1,4,14,33</sup> The European Community is currently reviewing the whole issue of alcohol and driving, as is the UK government.<sup>34</sup> Road-traffic and aviation accidents have been the subject of much scrutiny to date.<sup>14,34</sup> In line with today's litigious society it is possibly time for the diving industry to give greater educational emphasis to the effects of alcohol and post alcohol effects (hangover) in relation to diving on cognitive, visual and vestibular function.<sup>14</sup> Headache, gastrointestinal upset, and fatigue have been observed as post-consumption effects, and some studies have shown decreased cognitive ability even though the subject may be unaware of their impairment.<sup>15,21</sup>

Of added interest in this study were the background health data of the participants, which showed that of the 172 respondents currently taking prescribed medications, 16 (9.3% of this subset) had not completed a diving medical self-assessment form, and 80 (46.5%) had not sought advice from a diving medical referee. This poses the question regarding the hidden effects of alcohol and some prescribed medications. The six divers who admitted they had attended hospital for alcohol-related accidents, though small in number, illustrate that some divers drink to excess with consequent results that may endanger others. Additionally, the 151 (18.5%) divers who said that they had gone diving when they were unfit to drive a car should be of serious concern. Further interrogation of these data showed that over two-thirds of this sub-group (98) had aborted a dive at some time due to one of the following: headache, vomiting, still drunk, not thinking straight and general fatigue. All these symptoms could be attributed to alcohol hangover.

This was a self-reporting study; respondents were not selected or recruited. The study did not seek to establish any relationship between diving accidents, or DCI and alcohol consumption. The authors acknowledge these data may suffer from selection bias in as much as divers who consume alcohol may be more likely to respond or divers who consume alcohol may not respond due to embarrassment; or conversely divers who do not consume alcohol may not respond to the study. Anonymous on-line survey data may suffer from fictitious submissions, though multiple submission programming was implemented in this study in order to prevent this occurrence. On-line data collection benefits from being efficient with respect to time and cost for the researcher and participant alike. The facility to expand question stems according to response, reduce illogical responses, eliminate difficulty interpreting handwriting and an improved ability to address sensitive

issues are all benefits of on-line data collection. Although many respondents in this study were experienced divers, the diver and diving demographics were similar to previous diving studies.<sup>30,31</sup> The divers in this study were active and dived more regularly than might be expected from some sport diving groups in other countries. However, the well-entrenched culture of UK club diving follows the trend of regular, year-round weekly diving through socializing and weekly club meetings. This results in the average number of dives per year per UK diver perhaps being greater than would be expected when compared with a dive shop/school environment and organizations that may also cater for a slightly different socio-economic cohort.

The study alcohol data reflected the national data in the following criteria: beer, lager and cider were most popular with men, and wine the most popular with women; more men than women drank alcohol every day; more men than women exceeded the recommended daily limit on the days they did consume alcohol; men were more likely than women to exceed the weekly recommended limit for alcohol intake; and there is a relationship between age and exceeding the weekly recommended limit.<sup>4</sup> These data provide a useful insight into the everyday drinking habits of UK sport divers, and indicate that the current guidance of advising not to consume alcohol in excess in close proximity to diving activities may no longer be adequate. It could be argued that the term 'excess' is ambiguous and which needs to be defined.

## Conclusions

This study demonstrates that, in this cohort, a number of respondents were diving when they would have considered themselves over the legal limit to drive a car. The timing of dives after consumption of alcohol demonstrates a greater need for a more comprehensive understanding of the effects of alcohol beyond dehydration. Divers considered that the attitude to drinking and diving was not as responsible when away on a diving weekend or holiday; also some divers had been influenced to take a more responsible attitude to alcohol consumption having witnessed what they considered to be an alcohol-related diving incident. Perhaps there is now an opportunity for diver training organisations to implement a more wide-ranging approach to the subject of alcohol and diving within their respective training programmes and consider a consensus of guidelines on the subject.

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- Conflict of interest:** nil
- Submitted:** 07 February 2012  
**Accepted:** 09 September 2012
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