

- 11 Edmonds C. *Dangerous Marine Creatures*. Sydney: Reed Publ, 1989. Best Publ, Arizona. In Press, 1995.
- 12 Pacey H. Australian catfish injuries with report of a typical case. *Med J. Aust* 1966; 2: 63-65.
- 13 Cleland JB and Southcott RV (ed) *Injuries to Man from Marine Invertebrates in the Australian Region*. National Health Med Res Counc (Canberra) Special Report, Series 1965. no 12.
- 14 Barnes JH. Observations on jellyfish stings in North Queensland. *Med J. Aust* 1960; 2: 993-9
- 15 Hartwick R, Callanan V and Williamson J. Disarming the box-jellyfish. Nematocyst inhibition in *Chironex fleckeri*. *Med J. Aust* 1980; 1: 15-20.
- 16 Williamson J. *Some Australian Marine Stings Envenomations and Poisonings*. Brisbane: Surf Life Saving Association of Australia, 1981.
- 17 Fenner P. *The Marine Stinger Guide*. Brisbane: Queensland Life Saver Association, . 1985
- 18 Wiener S. The production and assay of Stonefish antivenene. *Med J. Aust* 1959; 2: 715-719.
- 19 Sutherland SK. *Australian Animal Toxins*. Melbourne: Oxford Uni Press, 1983
- 20 Edmonds C, Freeman P, Thomas R, Tonkin J and Blackwood F. *Otological Aspects of Diving*. Sydney: Australasian Medical Publishing Co, 1973
- 21 Miles S. *Underwater Medicine*. London: Staples Press, 1962
- 22 Halstead BW. *Dangerous Marine Animals*. Centreville, Maryland: Cornell Maritime Press, 1959
- 23 Halstead B. *Poisonous and Venomous Marine Animals of the World*. (Vols. 1-3). Washington DC: US Government Printing Office, 1965
- 24 Bennett PB and Elliott DH. *The Physiology and Medicine of Diving and Compressed Air Work*. London: Bailliere Tindall, 1969
- 25 Edmonds C, Lowry C and Pennefather J. *Diving and Subaquatic Medicine 3rd Edition*. London: Butterworths, 1991
- 26 Parker J. *The Sports Diving Medical*. Melbourne: J L Publications, 1994
- 27 Lippmann J and Bugg S. *The DAN Emergency Handbook*. Melbourne: J L Publications, 1985

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NOVICE RECREATIONAL SCUBA DIVERS AND ASTHMA : TWO SMALL SURVEYS REPORTED

Rhys Cullen

Abstract

In two separate pilot studies, consecutive candidate open water divers were surveyed to estimate the incidence of asthma.

In the first of these, the diving medicals of 32 novices were examined. All had been passed as fit to dive. Two had current asthma, while two more had a history of asthma.

In the second survey, which was supported by a different Auckland dive club, fifty-two open water trainees completed a short questionnaire. Six of them answered yes to a question which asked if they had ever had, or now had, asthma or wheezing, or to use a puffer or inhaler. Eight were current smokers. One was both a smoker and asthmatic. All were medically certified as fit to dive.

The consistent finding of these surveys is that 12% of Auckland open water candidates have asthma or a history of asthma that they are willing to declare.

Two conclusions can be drawn from these results. Asthmatics are sufficiently common to make possible a prospective controlled cohort study of their outcomes as recreational divers, compared to both "normals" and smokers. Such a study is now underway in Auckland. Second, some scepticism needs to be attached to claims that asthma is an absolute contraindication to recreational diving, or that asthmatics are over-represented in diver deaths. The data just are not there to support definitive statements.

Introduction

There is, internationally, no consensus of medical opinion as to what criteria determine respiratory fitness for recreational diving.

The British Sub-Aqua Club recommends that asthmatics should not dive within 48 hours of wheezing. This is supported by a BMJ article¹ which attracted some contrary correspondence.^{2,3} The article is of limited merit. Its methodology consisted of collating completed questionnaires received from 104 divers with asthma. The questionnaire was included in the magazine *Diver*. This highly selected group of asthmatic divers provides anecdotal evidence that some divers who report themselves as having asthma also report a large number of trouble free dives. To conclude from this study, as the

authors do, that the British Sub-Aqua Club's recommendation is safe may only be as valid as concluding from a sample of living Russian roulette players that that activity is without risk.

A review article in the *New England Journal of Medicine*⁴ states "In principle, diving is absolutely contraindicated in persons subject to spontaneous pneumothorax, as well as in those with air-trapping pulmonary lesions or bronchial asthma". This view was immediately challenged in correspondence^{5, 6} on the (good) grounds that it was not supported by clinical data.

The recommendations in Australasia are conservative compared to those in the UK and USA. A discussion document of the Thoracic Society of Australia and New Zealand recommends that diving candidates with a history of asthma should be advised not to dive.⁷ Edmonds, Lowry and Pennefather in their book⁸ disqualify any candidate with a history of asthma or bronchodilator use in the previous five years. They support this on theoretical grounds with accompanying clinical anecdotes.

The attitude of Gorman et al in the course notes,⁹ used at the Royal Adelaide Hospital and the Royal New Zealand Navy Hospital, to teach diving and hyperbaric medicine to medical officers and diver medical technicians, is that fitness for recreational diving is a matter of risk assessment, and the role of the medical examiner is to know these risks and ensure the candidate diver fully understands them.

The theoretical risk posed to asthmatics is unquestioned by all these authors.

Asthma is an air trapping disease triggered by a number of factors that are part of the diving environment such as salt water, exercise, and cold or dry air. Air that cannot escape from a part of the lung is subject to Boyle's law on ascent, and that part of the lung expands to four times its initial volume in coming from 30 msw depth to the surface, and doubles its volume in the journey from 10 msw depth to the surface. The theoretical risk is that the trapped air may burst a piece of lung with consequent arterial gas embolus, pneumothorax or mediastinal emphysema.

A useful contribution to the debate would be a prospective, controlled, cohort study of asthmatic divers. However, before undertaking such a study it is necessary to demonstrate that asthmatic divers are sufficiently common to make the assembly of a cohort practical. This paper purports to be such a demonstration.

Methods

Over the winter of 1993, an Auckland dive school

obtained consent from 32 consecutive open water trainees, from five classes, for copies of their diving medicals to be provided to the researcher. These medicals are in two parts. In the medical history section divers tick if they have a history of various conditions. The examining doctor also records comments on his or her examination.

Over the winter of 1994, a different Auckland dive school had fifty two consecutive open water trainees complete a short questionnaire. It asked two questions:

A Have you ever had or do you now have any of the following ? :

1 asthma or wheezing

2 use a puffer or any form of inhaler

B Do you smoke cigarettes ? If yes, how many per day ? for how many years ?

The questions were designed in consultation with a chest physician.

Respondents were also asked their age and sex.

Results

Four of the thirty two trainees who provided access to their diving medicals had volunteered a history of asthma. The examining doctor had confirmed that two of them had current asthma. All four were certified as fit to dive.

Six of the fifty two trainees who completed the questionnaire answered yes to the question which asked if they had ever had, or now had, asthma or wheezing, or to use a puffer or inhaler. Eight were current smokers. One was both a smoker and asthmatic. All were medically certified as fit to dive.

Of the eighty four participants, 53 (63%) were male, and 31 were female. Ages were available for seventy-five of the respondents (Table 1).

TABLE 1

AGES OF 75 RECREATIONAL OPEN WATER SCUBA TRAINEES

Ages	Numbers
≤ 15	2
16-20	12
21-25	17
26-30	14
31-35	13
36-40	9
41-45	5
≥ 46	3

Discussion

Small surveys suffer from two weaknesses. They may not be representative of a larger population, and they estimate parameters with wider confidence intervals than larger studies.

One can have some confidence that around twelve percent of present Auckland open water trainees are asthmatic or have a history of asthma. The same figure has been obtained by two dissimilar methodologies. In the first, the information provided to, and by, a medical practitioner who in most cases presumably knows the candidate was relied on. In the other, information volunteered by the trainee was collected.

The aim of this study was to determine whether there are enough asthmatic open water trainees to make the gathering of a cohort for prospective study a feasible proposition. For this purpose a sample of eighty four is not small. It is, however, difficult to ascribe a rigorous confidence interval to the estimate as the "consecutive sampling" methodology is quite distinct from the simple random sample, and other standard techniques for which theory on the distribution of sample variance is established.

The results have been submitted for publication because they provide denominator information which has been missing from the debate about asthmatics and fitness for scuba diving. They may also encourage other researchers to seek out and study asthmatics who dive. These small surveys provide no information on the diving behaviour of asthmatics who complete open water training.

An immediate consequence of any future study confirming that around twelve percent of novice recreational divers have asthma or a history of asthma, while about half that proportion have current asthma, would be that asthma is not a contraindication to diving. There may be an increased relative risk (and there may not be) but in absolute terms the risk is small. It is easy to speculate that in a diving population of 150,000, if even one third of these are active, and 5% of those have asthma, there may be 10,000 to 50,000 dives a year made in New Zealand by asthmatics.

Finally, if 6% of divers are current asthmatics and if their diving behaviour can not be distinguished from non-asthmatic divers, then asthmatics are not over-represented in diving fatalities. The ANZ series of 100 dead divers¹⁰ identified nine as having pre-existing asthma. Treating this as a series of Bernoulli trials with the probability of success at any one trial being 0.06, there is a probability of about 15% of nine or more successes, i.e. $p=0.15$, which is not significant. A Bernoulli trial in this instance is exactly analogous to tossing a coin with the probability of a "head" (being asthmatic) equal to 0.06. The experiment consists

of 100 such tosses, where each toss corresponds to a diver death. Asthmatics are over represented in diver deaths if the probability of the observed number of asthmatics in a series of diver deaths is less than 0.05, given that asthmatics form 6% of the live diver population. The observed number was nine and the conclusion is that asthmatics are not over represented in the ANZ series if the proportion of asthmatics in the live diver population is 6%

References

- 1 Farrell PJS and Glanvill P. Diving Practices of scuba divers with asthma. *Br Med J* 1990; 300: 166
- 2 Martindale JJ. Scuba divers with asthma. *Br Med J* 1990; 300: 609
- 3 Wall SJ and Gunnyeon WJ. Scuba divers with asthma. *Br Med J* 1990; 300: 609
- 4 Melamed Y, Shupak A and Bitterman H. Medical problems associated with underwater divers. *NEJM* 1992; 326: 30-34
- 5 Martin L. The medical problems of underwater diving. *NEJM* 1992; 326: 1497
- 6 Smith TF. The medical problems of underwater diving. *NEJM* 1992; 326: 1497-8
- 7 Jenkins C, Anderson SD, Wang R and Veal A. Compressed air diving and respiratory disease. A discussion document of the Thoracic Society of Australia and New Zealand. *Med J Aust* 1993; 158: 275-279
- 8 Edmonds C, Lowry C and Pennefather J. *Diving and Subaquatic Medicine*. 3rd edition Butterworth-Heinemann, 1992; 461-7
- 9 Gorman D. (Ed) *Diving and Hyperbaric Medicine* (second edition)
- 10 Edmonds C and Walker D. Scuba diving fatalities in Australia and New Zealand. 1. The human factor. *SPUMS J* 1989; 19 (3); 94-104

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THE REGULATION OF RECREATIONAL SCUBA DIVING IN QUEENSLAND

Rob Davis

Introduction

Few activities can match scuba as an "out of this world" experience, and few countries can match Australia