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Experienced, recreational scuba divers in Australia continue to dive despite medical contra-indications

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Key words

Scuba, diving, medical examination, medical conditions and problems

Abstract

Objective: In Australia, a medical examination is required prior to undertaking a scuba diving course in order to screen for contra-indications to diving. No further medical screening is required, yet divers may develop diseases during their diving careers. This study aimed to survey experienced recreational scuba divers to determine the prevalence of diseases contra-indicated in diving.

Methods: A cross-sectional, postal survey of divers belonging to scuba diving clubs across Australia.

Results: 346 divers returned completed questionnaires. 254 (73.4%) were male and 258 (74.6%) were aged 31–60 years. The mean years of diving was 10.6 ± 9.18 years and the mean number of dives undertaken was 414 ± 740 dives. 162 (46.8%) divers were overweight, 45 (13.0%) divers required regular medication and 39 (11.3%) divers smoked. 36 (10.4%) divers reported a past or present history of asthma and the same number reported hypertension or coronary heart disease. 86 (24.9%) divers reported past or present psychological symptoms. 42 (12.1%) divers reported hearing difficulties and 81 (23.5%) divers reported past or present tinnitus. Two divers had a past history of epilepsy, two had a history of pneumothorax and one diver was diabetic.

Conclusions: Experienced, recreational scuba divers continue to dive despite medical contra-indications. This raises the questions: Did the divers fail to disclose these conditions at the initial examination or did these conditions develop subsequently? Is the risk associated with these conditions clinically significant or should screening examinations be undertaken at regular intervals? The high prevalence of hearing difficulties and tinnitus may be the result of aural barotrauma and requires further research.

Introduction

Scuba diving is a popular but high-risk sport.^{1,2} In Australia, medical practitioners screen diving candidates for medical conditions thought to increase the risks of diving.^{1,3} Today, standards for fitness to scuba dive are described in the Australian Standards⁴ and guidelines for medical examinations have been published.^{1,2,5}

Traditionally, candidates with medical conditions contra-indicated in diving (eg. asthma, diabetes, epilepsy) have been excluded from the sport via the medical examination. However, the screening medical examination may not detect such conditions⁶ and practitioner's determination of fitness to dive may be inconsistent.⁷ Also, anecdotal and some published evidence suggests that divers with contra-indicated conditions tend to remain covert and may falsify their medical history in order to dive.^{6,8}

In Australia, data on the prevalence of contra-indicated conditions among divers are scant. In particular, the fitness to dive of experienced recreational divers is not known. Importantly, this group may have been screened and certified as fit at the beginning of their diving careers but

may have developed contra-indications that have subsequently placed them at increased risk.

This study aimed to examine the health of experienced, recreational scuba divers in Australia and to determine the prevalence of medical conditions which preclude diving within this group. These data will assist in evaluating the effectiveness of the initial medical screening process, the need for repeated medical examinations and the safety of these conditions among experienced, recreational divers.

Methods

The study was a cross-sectional survey of active, experienced scuba divers belonging to scuba diving clubs across Australia. A list of clubs, published on the "Diving in Australia" internet website,⁹ was used to identify sources of potential subjects. E-mail or telephone contact with each club's contact person (president or secretary) was attempted. Forty eight clubs were contactable and all agreed to participate in the study.

In June 2000, each club's contact person was mailed a variable number of study questionnaires depending on the

TABLE 1
GENDER AND AGE OF THE SUBJECTS (n = 346, percentages in parentheses)

	Subject age group (years)						Totals
	18–20	21–30	31–40	41–50	51–60	61+	
Male	5 (1.5)	44 (12.7)	85 (24.6)	69 (19.9)	46 (13.3)	5 (1.5)	254 (73.4)
Female	5 (1.5)	28 (8.1)	35 (10.1)	16 (4.6)	7 (2.0)	1 (0.3)	92 (26.6)
Totals	10 (2.9)	72 (20.8)	120 (34.7)	85 (24.6)	53 (15.3)	6 (1.7)	346 (100)

number of active members. These were distributed at the next club meeting, completed immediately and returned by the contact person in a stamped, addressed envelope. Two months after the initial mailing, clubs that had not returned questionnaires were mailed a reminder letter. This was repeated in one further month's time, when necessary.

The study questionnaire was anonymous and designed by the authors. The first section collected demographic data on the divers including diving experience. The second section consisted of a list of medical conditions, each with the potential to interfere with a diver's activity and potentially compromise safety. This list was derived from published sources of information relating to medical fitness to dive.^{1,3-5} The divers were asked to record when they had ever experienced each of the conditions. The possible responses were: "never", "in the past" and "now and I dive with it". Only one response was permitted for each condition.

Body Mass Index (BMI) was calculated by the investigators and based upon reported weight and height values. The following classifications were used: BMI <20 (underweight), 20–24.9 (normal), 25–29.9 (overweight), 30–34.9 (obese) and ≥ 35 (morbid obesity).

Most responses were analysed descriptively. Mean values are reported with standard deviations. Comparison of proportions utilised the Yate's corrected chi-square test with EpiCalc, version 1.02 (2000) software.

The study was authorised by the Institutional Review Board (Ethics Committee) of the University of Pittsburgh, PA, United States of America.

Results

Of the 48 clubs that initially agreed to participate, 29 clubs (60.4%) ultimately returned questionnaires. (New South Wales 10, Victoria 7, Western Australia 4, Northern Territory 3, South Australia 2, Tasmania 2, Queensland 1.) A total of 346 questionnaires were returned.

The divers' gender and age are described in Table 1. Almost three quarters were male and most (59.3%) were middle-

aged (31–50 years). As expected, most were experienced scuba divers. The mean "years of diving" was 10.6 ± 9.18 years (median 7.5) and the mean "number of dives done" was 414 ± 740.82 dives (median 200).

Table 2 describes factors associated with the divers' socioeconomic status. Most divers were university graduates or postgraduates (206 divers, 59.6%) and were in white collar or professional employment (208 divers, 60.1%).

Table 3 describes the divers' risk factors for illness. Almost one half were classified as overweight or greater (162 divers, 46.8%). Importantly, eight divers (2.3%) were morbidly obese. Most divers admitted to a small (=5 drinks per week) or moderate alcohol intake (6–10 drinks per week) with only 42 divers (12.1%) consuming more than 15 drinks per week. The number of smokers in the group was relatively small and approximately the same number reported illicit drug use (marijuana, amphetamines, LSD). Only 53 divers

TABLE 2
SOCIOECONOMIC STATUS OF SUBJECTS (%)

Highest level of education completed

Primary school	8	(2.3)
High school	131	(37.9)
University	157	(45.4)
Postgraduate	49	(14.2)
No response	1	(0.3)

Total 346 (100)

Employment status

Unemployed	24	(6.9)
Blue collar/trade	104	(30.1)
White collar/clerical	53	(15.3)
Professional	155	(44.8)
No response	10	(2.9)

Total 346 (100)

TABLE 3
RISK FACTORS FOR ILLNESS AMONG THE
DIVERS, n = 346 (%)

(* marijuana 28, amphetamines 3, LSD 2, not specified 4
OCP - oral contraceptive pill)

The body mass index (BMI):

Underweight (<20)	9	(2.6)
Normal (20–24.9)	157	(45.4)
Overweight (25–29.9)	118	(34.1)
Obese (30–34.9)	36	(10.4)
Morbid obesity (=35)	8	(2.3)
No response	18	(5.2)

Number of alcoholic drinks per week:

None	28	(8.1)
<1	52	(15.0)
1-5	120	(34.7)
6-10	62	(17.9)
11-15	40	(11.6)
15+	42	(12.1)
No response	2	(0.6)

Smoking status:

Non smoker	294	(85.0)
Smoker	39	(11.3)
No response	13	(3.8)

Illicit drug use:

Not used	303	(87.6)
Used*	37	(10.7)
No response	6	(1.7)

Daily medication use:

OCP only	8	(2.3)
OCP plus other medication	1	(0.3)
Other medication	44	(12.7)

reported taking daily medication.

Table 4 describes the medical conditions, experienced by some divers, generally regarded as relative or absolute contra-indications to diving. Respiratory and upper respiratory diseases predominated. Seasonal allergies were common with almost half of all divers having either a history or active disease. Importantly, 28 divers (8.1%) had a history of asthma or chronic obstructive airways disease and an additional 10 divers (2.9%) were current sufferers. As expected, pressure equalising problems were common, with 50 divers (14.5%) continuing to dive despite this difficulty. Tympanic membrane rupture was not uncommon. However, as with the two cases of round or oval window rupture, it is not known if these injuries were caused by barotrauma whilst scuba diving. Also of importance is the finding that two divers reported a history of pneumothorax.

A history of neurological conditions was reasonably common although prevalent illness was confined mainly to recurrent headaches (19 divers, 5.5%) and migraine (13 divers, 3.8%). No diver reported suffering from epilepsy at the time of the survey although two divers had a past history of this condition. Single divers reported a history of brain tumour, TIAs and brain aneurysm, and five divers reported a history of significant head trauma. Thirteen divers (4.8%) reported having suffered from decompression illness. Cardiac conditions were relatively uncommon and mainly confined to hypertension (12 divers, 3.5%). It is possible that some divers who reported a history of hypertension were, in fact, being treated for this condition. Importantly, three divers reported a history of angina. The nature of the cardiac arrhythmias reported is unknown. Many divers reported a history of psychiatric illness and, importantly, 14 divers (4.0%) continued to dive with either claustrophobia or anxiety. Only one diver suffered from diabetes at the time of the survey.

Table 5 describes medical conditions, experienced by some divers, not generally regarded as relative or absolute contra-indications to diving. However, these conditions may interfere with a diver's activity or may be aggravated by diving. Tinnitus was surprisingly common with almost one quarter of all divers having a history or presently suffering from this condition. Hearing loss was also reported more than expected with 42 divers (12.1%) reporting this condition.

As expected, many medical conditions listed on the questionnaire had not been experienced by any of the divers. These included myaesthesia gravis, stroke, multiple sclerosis, paraplegia, trigeminal neuralgia, congestive cardiac failure, mitral valve prolapse, cardiac valve stenosis, pulmonary blebs or cysts, emphysema, lung surgery, ulcerative colitis, kidney failure or transplant, osteonecrosis, limb amputation, haemophilia, leukaemia and sickle cell disease.

Discussion

The response rate of participating dive clubs was rather poor. However, the divers in this study are likely to represent experienced, recreational divers belonging to dive clubs in Australia. Each of the States and Territories was represented in approximate proportion to its population, with the exception of Queensland which was under-represented. This is of importance as much of the diving in Australia is undertaken in Queensland. The finding that most divers were male, middle-aged, and had logged a considerable number of dives over many years, is consistent with a United States (US) study of experienced, recreational divers.¹⁰ The high socioeconomic class of most divers is consistent with their ability to continue participation in this relatively expensive sport.

Although almost half of the divers were overweight, this

TABLE 4
REPORTED MEDICAL CONDITIONS THAT ARE RELATIVE AND ABSOLUTE CONTRA-INDICATIONS
TO DIVING (n=346, percentages in parentheses, DCI - decompression illness)

Disease system	Past history of disease			Presently suffers from disease		
	Male	Female	Total	Male	Female	Total
Respiratory						
Seasonal allergies	54 (15.6)	18 (5.2)	72 (20.8)	54 (15.6)	25 (7.2)	79 (22.8)
Asthma	21 (6.1)	6 (1.7)	27 (7.8)	5 (1.5)	4 (1.2)	9 (2.6)
Chronic obstructive airways disease	-	1 (0.3)	1 (0.3)	1 (0.3)	-	1 (0.3)
Spontaneous pneumothorax	-	1 (0.3)	1 (0.3)	-	-	-
Traumatic pneumothorax	1 (0.3)	-	1 (0.3)	-	-	-
Eye, ear, nose and throat						
Equalising problems ears/sinuses	68 (19.7)	22 (6.4)	90 (26.0)	31 (9.0)	19 (5.5)	50 (14.5)
Chronic sinusitis	9 (2.6)	1 (0.3)	10 (2.9)	7 (2.0)	5 (1.5)	12 (3.5)
Diving within 12 months eye surgery	5 (1.5)	2 (0.6)	7 (2.0)	2 (0.6)	-	2 (0.6)
Chronic otitis media	10 (2.9)	2 (0.6)	12 (3.5)	1 (0.3)	-	1 (0.3)
Eardrum rupture	17 (4.9)	4 (1.2)	21 (6.1)	-	-	-
Inner ear surgery	5 (1.5)	-	5 (1.5)	-	-	-
Round or oval window rupture	2 (0.6)	-	2 (0.6)	-	-	-
Penetrating eye injury	1 (0.3)	-	1 (0.3)	-	-	-
Neurological						
Recurrent headaches	36 (10.4)	14 (4.1)	50 (14.5)	10 (2.9)	9 (2.6)	19 (5.5)
Migraine headaches	38 (11.0)	18 (5.2)	56 (16.2)	5 (1.5)	8 (2.3)	13 (3.8)
Brain/spinal cord disease or trauma	5 (1.5)	-	5 (1.5)	3 (0.9)	-	3 (0.9)
Spinal cord injury (temporary)	5 (1.5)	-	5 (1.5)	2 (0.6)	-	2 (0.6)
DCI (with nerve damage)	10 (3.9)	2 (0.6)	12 (3.5)	1 (0.3)	-	1 (0.3)
Brain tumour	-	1 (0.3)	1 (0.3)	-	1 (0.3)	1 (0.3)
Epilepsy	1 (0.3)	1 (0.3)	2 (0.6)	-	-	-
Head trauma (unconscious >24 hours)	4 (1.2)	1 (0.3)	5 (1.5)	-	-	-
Transient ischaemic attack	1 (0.3)	-	1 (0.3)	-	-	-
Brain aneurysm	1 (0.3)	-	1 (0.3)	-	-	-
Meniere's disease	2 (0.6)	-	2 (0.6)	-	-	-
Cardiac						
Hypertension	18 (5.2)	3 (0.9)	21 (6.1)	10 (2.9)	2 (0.6)	12 (3.5)
Cardiac arrhythmia	3 (0.9)	-	3 (0.9)	3 (0.9)	-	3 (0.9)
Patent foramen ovale	-	1 (0.3)	1 (0.3)	2 (0.6)	-	2 (0.6)
Coronary heart disease	1 (0.3)	-	1 (0.3)	2 (0.6)	-	2 (0.6)
Cardiac valve incompetence	-	-	-	1 (0.3)	-	1 (0.3)
Angina	3 (0.9)	-	3 (0.9)	-	-	-
Myocardial infarction	1 (0.3)	-	1 (0.3)	-	-	-
Psychiatric						
Claustrophobia	7 (2.0)	5 (1.5)	12 (3.5)	5 (1.5)	3 (0.9)	8 (2.3)
Anxiety	17 (4.9)	5 (1.5)	22 (6.4)	3 (0.9)	3 (0.9)	6 (1.7)
Depression	20 (5.8)	9 (2.6)	29 (8.4)	1 (0.3)	1 (0.3)	2 (0.6)
Drug or alcohol abuse	9 (2.6)	-	9 (2.6)	2 (0.6)	-	2 (0.6)
Panic disorder	6 (1.7)	1 (0.3)	7 (2.0)	-	-	-
Schizophrenia	3 (0.9)	-	3 (0.9)	-	-	-
Miscellaneous						
Joint surgery or trauma	17 (4.9)	3 (0.9)	20 (5.8)	8 (2.3)	3 (0.9)	11 (3.2)
Diabetes	-	-	-	1 (0.3)	-	1 (0.3)
Bleeding gastric or duodenal ulcer	5 (1.5)	-	5 (1.5)	1 (0.3)	-	1 (0.3)

TABLE 5
REPORTED MEDICAL CONDITIONS OTHER THAN RELATIVE AND ABSOLUTE
CONTRA-INDICATIONS TO DIVING
(n=346, percentages in parentheses, TMJ - temporomandibular joint)

Disease state	Past history of disease			Presently suffers from disease		
	Male	Female	Total	Male	Female	Total
Tinnitus	31 (9.0)	11 (3.2)	42 (12.1)	33 (9.5)	6 (1.7)	39 (11.3)
Hearing loss	8 (2.3)	5 (1.5)	13 (3.8)	26 (7.5)	3 (0.9)	29 (8.4)
Chronic back pain	12 (3.5)	2 (0.6)	14 (4.1)	10 (2.9)	4 (1.2)	14 (4.1)
Arthritis	2 (0.6)	-	2 (0.6)	10 (2.9)	2 (0.6)	12 (3.5)
Excessive ear wax	48 (13.9)	5 (1.5)	53 (15.3)	8 (2.3)	2 (0.6)	10 (2.9)
Severe gastric reflux	17 (4.9)	2 (0.6)	19 (5.5)	8 (2.3)	2 (0.6)	10 (2.9)
Herniated spinal disc	9 (2.6)	-	9 (2.6)	6 (1.7)	1 (0.3)	7 (2.0)
Anaemia	1 (0.3)	4 (1.2)	5 (1.5)	3 (0.9)	2 (0.6)	5 (1.5)
Scoliosis	2 (0.6)	2 (0.6)	4 (1.2)	2 (0.6)	1 (0.3)	3 (0.9)
Bronchitis	47 (13.6)	24 (6.9)	71 (20.5)	3 (0.9)	-	3 (0.9)
Functional bowel disease	1 (0.3)	-	1 (0.3)	2 (0.6)	-	2 (0.6)
TMJ dysfunction	-	-	-	2 (0.6)	-	2 (0.6)
Crohn's disease	1 (0.3)	-	1 (0.3)	1 (0.3)	-	1 (0.3)
Pneumonia	9 (2.6)	8 (2.3)	17 (4.9)	-	-	-
Bowel obstruction	6 (1.7)	-	6 (1.7)	-	-	-
Hepatitis	3 (0.9)	-	3 (0.9)	-	-	-
Inguinal hernia	2 (0.6)	-	2 (0.6)	-	-	-
Aseptic bone necrosis	1 (0.3)	-	1 (0.3)	-	-	-
Polycythaemia	1 (0.3)	-	1 (0.3)	-	-	-

proportion did not differ significantly ($p > 0.05$) from that of the general Australian population (45%)¹¹ and is consistent with a report on other experienced divers.¹⁰ This finding has important implications. It may reflect a level of physical fitness that is suboptimal for a sport that can require considerable exertion, particularly in the event of an emergency. Also, obesity can further restrict the mobility of divers already encumbered with scuba gear. These factors may be particularly relevant to the eight morbidly obese divers. Finally, it has been demonstrated that obesity is a risk factor for decompression sickness.¹

Alcohol can impact directly upon diving safety in two ways. Clearly, diving whilst under the influence of alcohol is likely to increase the risk several fold. Also, moderate or heavy alcohol intake can lead to dehydration and, in turn, an increased risk of decompression sickness.^{1,3} The alcohol consumption of the divers in this study is not remarkable but the findings give no indication of the proximity of consumption to diving.

As expected, the proportion of smokers was relatively small and significantly less ($p < 0.01$) than that of the Australian population (24%).¹¹ This finding is encouraging as many tobacco-related respiratory diseases, including asthma and chronic obstructive airways disease, have long been considered contra-indications to diving.¹ A small proportion of divers did report illicit drug use although, like alcohol,

the proximity of drug use to diving is not known. Although only 45 divers (13.0%) required daily medication for chronic disease, many others are likely to require medication for episodic illness, for example, asthma, allergies and migraine.

Traditionally, there have been good theoretical reasons why many medical conditions have been contra-indicated in diving. Firstly, the sub-aquatic environment is inherently dangerous and any condition that might reduce the physical or mental capacity of the diver may increase these dangers significantly. Such conditions include migraine, epilepsy, seasonal allergy, asthma, cardiac disease, obesity, diabetes, hernias and some psychiatric states.^{1-3,12,13} Secondly, some conditions are associated with an increased risk of barotrauma associated with changes in ambient pressure. Such conditions include seasonal allergies, asthma and obstructive airway diseases, pneumothorax, equalisation difficulties, chronic sinusitis, middle and inner ear disease or surgery, and ocular surgery.^{1,3,13} Thirdly, some conditions are associated with an increased risk of decompression illness; these include obesity, diabetes, and central nervous system and connective tissue scarring.^{1,3,5} This study demonstrates that many conditions within these three categories are quite prevalent among experienced divers.

Few other studies have examined the prevalence of chronic disease among scuba divers. A recent Australian study by

Cresp et al⁶ examined the health status of recently qualified divers. As expected, their subjects had a similar gender ratio (72% male), were younger (median age 24 years), leaner (24.0% overweight or greater) and inexperienced (76% had done fewer than 20 dives). Compared with the present study, Cresp et al found a greater prevalence of asthma and obstructive airways disease (10.3%) and hypertension (4.2%) but a similar prevalence of epilepsy (1.0%), diabetes (0.2%), ischaemic heart disease (0.2%) and smoking (11.6%). The authors noted that a number of divers commented on how easy it was to avoid the detection of medical conditions during the diving medical examination. Hansen et al reported higher prevalence of hypertension (9.7%) and active asthma (4.2%) in their large study of experienced divers in the US.¹⁰

In this study, the prevalence of medical contra-indications to diving is of concern. It is possible that some divers failed to disclose their conditions during the medical screening examination.⁶ If confirmed, this possibility would challenge the worth of the traditional screening process as an instrument for the determination of fitness to dive. A second possibility is that some divers develop contra-indicated conditions as they age yet continue to dive through ignorance or neglect. In Australia, there is no requirement in sport diving for repeat medical assessment for fitness to dive. This raises the question of whether medical assessment should be undertaken at regular intervals throughout a diver's career, as part of a re-certification process.¹⁴

The above discussion is based on the premise that the theoretical risks of diving with medical contra-indications are clinically significant. This may not be the case. Indeed, some studies have challenged traditional theory by suggesting that the risk associated with some conditions, including asthma and diabetes, may not be as great as originally thought.^{8,13,15,16} Furthermore, the available evidence shows that diving fatalities as a direct result of medical conditions are rare. An analysis of the deaths of 286 fatalities in the United Kingdom and the US between 1990 and 1994 showed that health factors, as possible contributory causes, accounted for 2% and 5.1% of deaths, respectively.¹⁶ Australian figures appear to be higher. Of the 46 scuba diving deaths in Australia between 1993 and 1997 inclusive, eight cases (17.4%) were thought to have a possible medical contributing factor. Presumed cardiac events were considered the most common contributing medical conditions. These diving deaths included two cases of planned suicide.¹⁷⁻²¹

In recent years, the risks associated with many medical conditions have been re-evaluated.⁵ This has led to policy shift among professional bodies, notably the South Pacific Underwater Medicine Society (SPUMS), regarding candidate fitness to dive^{5,22,23} and a shift away from the prescription-based approach to diving fitness towards a more discretionary one.^{3,5,7} This would involve the medical practitioner in a risk assessment rather than a regulatory

role.⁵ SPUMS has proposed a draft policy statement for consideration by Standards Australia which states "A medical practitioner's statement of the compatibility of a candidate's health and recreational diving must include both an acknowledgment of "health risk" and an acceptance of liability by the candidate." Should a candidate then choose to ignore the advice given, the advising physician should not be subsequently liable.⁵ In any event, a shift toward this discretionary approach might encourage the disclosure of existing conditions and promote a more informed discussion about the risks involved.

In this study, few divers reported other conditions that might interfere with their diving activity or may be aggravated by diving. However, the reported prevalence of tinnitus and hearing difficulties is greater than expected and greater than the prevalence reported by Hansen et al¹⁰ of 8.1% and 5.1%, respectively. It is conceivable that the repeated, even subclinical, aural barotrauma often experienced over a long diving career might have an aetiological role in these conditions. The findings suggest that further research into the possible association between scuba diving and chronic middle and inner ear disease is required.

This study has several limitations. The sample size was small relative to the estimated number of experienced, recreational scuba divers in Australia. Also, recruitment of subjects from dive clubs only, the under-representation of Queensland clubs (and total Queensland divers) and the club response rate may have introduced selection bias. Although the questionnaire was anonymous, the results are subject to prevarication and recall bias. Finally, as a screening study examining many medical conditions, precise definitions of each condition could not be provided to the divers. This may have limited the accuracy of some responses.

This study indicates that further research is required in order to evaluate more clearly the risks associated with some traditionally contra-indicated medical conditions. This undertaking may allow previously denied candidates the opportunity to participate in the sport with reasonable safety. If such research does confirm clinically significant theoretical risks then repeated re-assessment of fitness to dive should be considered. It is recommended that the evolution of the traditional screening examination continues and that a greater emphasis be placed upon risk assessment and candidate education. Such an evolution may require a revision of training procedures for medical practitioners planning to undertake diving medical examinations.

Conclusion

Many experienced recreational scuba divers continue to dive with medical conditions. This raises the question of non-disclosure at the initial medical screening examination or subsequent disease development. The findings may indicate either that the risks of some conditions are not of clinical

significance, or that repeated screening assessments are indicated. Research to assess more clearly the risks of traditionally contra-indicated conditions is required and an evolution of medical screening towards a risk assessment process is recommended.

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