

Surf bathing grew rapidly in popularity, but just as rapidly its dangers became apparent. Of necessity, small groups of experienced and regular surfers formed themselves into life-saving bodies to assist those who could not swim, and those who were not familiar with the dangers associated with surf bathing. These life-saving bodies gradually grew in size, numbers and importance and on 18th October, 1907, the New South Wales Surf Bathing Association (later changed to the Surf Life Saving Association of Australia) was formed.

Since then, the Association has developed into an organisation known throughout the world for its voluntary and humanitarian work which has resulted by the end of 1973, in the saving of 200,000 lives. In 1973 alone, 4,000 rescues on Australian beaches were made.

Surfing accidents range from the orthopaedic injuries of body surfers to the physical trauma of surf boards (especially with some of the sharpened fins now being employed). Tides, undertows and rips aggravate the likelihood of drownings, and marine animal injuries are common to both types of surfers.

Australia is fortunate in possessing the longest coastline of any country. The increased aquatic recreational activities and the commercial exploitation of the continental shelf, we are in the position of having available the largest and most varied group of aquatic accidents. There is every reason to be modest regarding the Commercial and Governmental backing given to the voluntary sports organisations, and individual enthusiasts who have made the above data available. It is hoped and anticipated that some future Australian Government shall see fit to assist and subsidise compilation of this data, and its promulgation to other countries.

MEDICAL STANDARDS FOR DIVING by Carl Edmonds

The imposition of medical standards for any occupational activity is, to a large extent, both presumptive and arbitrary. Although divers and hyperbaric personnel share some hazards, others are peculiar to one or the other. Even within the diving occupation there may be considerably different medical requirements for the occasional shallow water, sport diver and the professional deep and experimental diver. Some of these variations in standards will be discussed using the model of a medical history and examination format similar to those being used by most navies employing divers.

Reports of diver selection criteria are mainly anecdotal.^{2, 6, 9} These infer that the diver should be a psychologically stable or even phlegmatic personality, able to endure much physical and emotional stress, free of all serious physical disease and also free of minor illnesses affecting the upper and lower respiratory tracts. A group of more objective reports^{3,4,7,8} more clearly define the psychological assessments, physical fitness levels and medical disease limitations which are relevant to diving candidates. In appreciating the importance of these criteria, it is necessary to consider three aspects of diver training. One is the high failure rate of diving courses^{3,4} and the characteristics necessary for success in these courses. The second is the hazardous nature of the marine environment and the sudden unexpected demands it is likely to make on the diver. The third is the occupational diseases to which the diver is subjected.

Medical Standards Format^{1,9}

A copy of a typical diver medical examination form is shown in Tables 1-3. This was developed for the Australian Standards Association for use with compressed air divers. The reasons for the requirements are outlined below with an explanation of any permitted relaxations and cautions.

- TABLE I - Medical history questionnaires (MH items 1-60) is completed by the candidate.
- TABLE II - Diving history questionnaire (DH items 1-24) is completed by the examining physician in consultation with the candidate.
- TABLE III - Medical examination (ME items 1-42) is completed by the examining physician.

Identification and personal data is obtained (MH items 1,2,3,4,48,53; ME items 1,2,3,36) for medico legal reasons.

Age

The age range for diver training is between 16 and 30-35 years. Exceptions are usually made for specific circumstances in both military and civilian training centres. The maximum recommended age is extended to allow physically and medically fit individuals to undergo training. Annual medical examinations are required for all divers. For those still diving beyond the age of 40 years, annual electrocardiographic examinations are required.

Occupation

The candidate's occupation may give some indication of his physical fitness, but may also be important in increasing the diving hazards, eg. aviators or air crew should be specifically advised of the flying restrictions imposed after diving. Sonar operators and musicians may not wish to be exposed to the otological complications of diving.

Medical treatment and Drugs

Physical treatments and medication (MH item 8) may have an adverse effect on diving and vice versa. Any drug which influences the conscious state may also affect the susceptibility to nitrogen narcosis and oxygen toxicity, whereas others may affect the assessment of decompression sickness signs. Alcohol and hallucinatory drugs are absolutely contraindicated because of the effects on the diver's psychological reaction to stress and the impaired judgment. Hallucinations and illusions will be enhanced in the insecure marine environment. Alcohol and Marijuana have the added disadvantage of blocking vasospastic reactions to cold, resulting in more rapid hypothermic complications.

Cardiovascular

The existence of serious cardiovascular disease disqualifies the candidate from diving. A history of cardiovascular disease (MH items 9-13) and the physical examination (ME 24, 25, 39-42) should make the examiner aware of this. Tolerance to physical exertion and the absence of factors predisposing to myocardial failure or infarction, are required. If in doubt, a resting and exercising ECG should be performed, and should not show any evidence of abnormal arrhythmias or ST depression. Blood pressure should not exceed 140mmHg systolic and 90mmHg diastolic. Weight should be within 20% of the average for age of the height and build. Obesity (ME items 2 and 3) is contraindicated because of the increased propensity for decompression sickness it produces, even though it may have a beneficial effect in reducing the likelihood of hypothermia. For civilian sport diving it is permissible to allow diving with degrees of obesity that would not normally be accepted in professional or military diving. This is achieved by imposing an added 50% safety margin in calculating the depth/duration dive profile, also by making an absolute depth limit of 20 metres and not permitting any dive that requires decompression staging.

Respiratory

The existence of respiratory disease disqualifies diving candidates. Divers must not only be able to tolerate severe physical exertion, which requires good respiratory reserve, but must also be able to tolerate rapid changes in lung volumes and pressures with equal compliance throughout the lung segments. Any local restrictions, fibrosis, cysts, etc. may result in pulmonary barotrauma with a tearing of lung tissue and subsequent complications, including air embolus. A history of asthma is particularly ominous, as a recurrence will result in increased pulmonary airway resistance, and also the use of adrenergic drugs. Neither are acceptable in any diving operations, sport or professional. The history of respiratory disorders (MH items 14-19, 57) is complimented by the physical examination (ME items 4, 23), chest x-ray and simple respiratory function (ME items 8,11). High pitched expiratory rhonchi, which may only be elicited during hyperventilations, indicate airway obstruction and preclude diving. To comply with the Australian Standards for Divers, vital capacity should be more than 4 litres in males, 3 litres in females, and the forced expiratory volume in 1 second must not be less than 75% of vital capacity. A more rational standard would be to accept a value of $VC = (27.63 - 0.112 \times \text{age}) \times \text{height in cm for males}$, $(31.78 - 0.101 \times \text{age}) \times \text{height in cm for females}$, and allow 20% below this value as the minimum standard. The full plate chest radiograph must be normal.

Upper Respiratory Tract

Disorders of this system comprise the largest cause of occupational morbidity in divers. History of chronic or recurrent allergies or infections (MH items 20-22) and evidence of these, or acute disorders of the ears, nose or throat (ME items 13-19), will disqualify the diving candidate. Chronic sinusitis, allergic rhinitis, dental caries, pharyngitis and tonsillitis, etc. will all have a detrimental effect on diving. Sinus and nasal polyps may produce obstructions during ascents or descents, resulting in barotrauma. A deviated nasal septum may also result in abnormal nasal mucosa, influencing patency of sinus ostia and the eustachian tube. Whenever obstruction or restriction of the upper respiratory tract airways occurs, barotrauma is likely. If infection is present, it is likely to be spread by the movement of gases during the changes in depth and pressure. Sinus x-rays should be obtained in doubtful cases. A break in the skin or mucosal lining of gas filled spaces is a danger in diving, allowing access of gas into the body tissues, resulting in barotrauma or surgical emphysema.

Otological⁵

The diver must have normal external ear canals, normal middle ears, and normal inner ears. In addition, he must have normally functioning eustachian tubes and this requires a normal, healthy nose.

EXTERNAL EAR

Cerumen - The external ear should be free of cerumen. Occlusion of the external ear by cerumen may lead to vertigo or external ear barotrauma.

Exostoses - These should not be of such size as to occlude the external auditory meatus or to lead to occlusion by cerumen being washed into the narrowed area when swimming.

Otitis Externa - A diver is rendered unfit by the presence of acute or chronic otitis externa.

MIDDLE EAR

Tympanic Membrane - A healthy tympanic membrane, intact and mobile, is a prerequisite for diving. The following conditions should render the individual unfit for diving. Any evidence of otitis media, however mild, a perforation of the tympanic membrane, or a thin atrophic scar. Obviously it would be unwise to submit a tympanic membrane which had been weakened by a thin scar, to the pressure changes involved in diving. On the other hand, a healed perforation which left the tympanic membrane normal in strength and mobility would be quite acceptable. A retracted and immobile tympanic membrane is unacceptable.

Middle-Ear Cavity - This should be free of fluid and be aerated. This is shown by the appearances of the tympanic membrane and its mobility on auto-inflation.

Eustachian Tube - This must function normally, ie. auto-inflation must be accomplished without excessive force. It should be noted that the ability to autoinflate at any one point in time does not preclude the possibility of intermittent Eustachian tubal obstruction at another time. The function of the Eustachian tube is dependent upon normal nasal function, and this requires careful assessment.

INNER EAR

Cochlear Function - Ideally, divers should have normal cochlear function, but minor changes in auditory acuity may be acceptable.

The Australian Standards Association has stipulated minimum ISO standards of hearing for divers and compressed-air workers as follows:

Hz	500	1000	2000	4000	6000	8000	Hz
db	40	35	35	45	50	50	
loss							

These standards now seem inadequate and inappropriate in many cases, at least without considerable qualification.

It should be borne in mind that loss of cochlear function may be associated with loss of vestibular function. If the vestibular proportions of the inner ears respond to stimuli unequally, then vertigo might result, more especially when visual fixation is poor, as frequently occurs in diving. This could constitute an appreciable hazard

for the individual diver. The whole question of vertigo occurring amongst divers is attracting considerable attention, and much investigation is under way. Until more is known about the part which an abnormal inner ear may play in inducing vertigo it seems reasonable and safe to expect that the hearing of the diver should be near normal.

Threshold hearing for divers should be 15 decibels at the frequencies of 500, 1000, 2000 and 4000 cps, using audiometers calibrated to ISO standard. This is the level classified as "Standard I" in most armed forces and it would seem to be appropriate to expect this standard to be reached by individuals who wish to participate in professional diving. Nevertheless, it is an insufficient range for divers, as it does not tend to 6000 and 8000 cps, which should be tested in both initial and annual examinations.

It is appreciated that this may be thought to be too harsh a standard, but it must be pointed out that this is a "safe" standard. Some individuals may have normal ears, which do not withstand stresses as well as other individuals, but once it has been shown that there is depression of inner ear function, an extra element of risk comes into diving. This will increase as the inner ear function deviates from normal.

Noise as a Hazard for Hearing - Attention has been drawn to the noise levels experienced by divers in helmets and compression chambers, and temporary threshold shift in the hearing of divers have been demonstrated. The possibility of noise-induced deafness resulting from exposure to loud noise should be borne in mind, and all divers should have an annual audiogram as part of a hearing conservation programme. The permissible duration of exposure to loud noise of different intensities is well documented, and should be adhered to when exposing divers to such noise levels.

Vestibular Function - It has been shown that vertigo can be induced by cold water entering one ear but not the other ear, owing to the latter's external auditory meatus being occluded by cerumen. Similarly, vertigo can be expected to occur when diving if one labyrinth is not functioning, and the other ear is stimulated by the caloric effect of cold water in the normal ear.

The significance or importance of less marked changes in vestibular function is not fully understood as far as diving is concerned, but there is ample evidence to suggest that abnormal vestibular function will play a part in disorientation. It may prove to be wise in the future to exclude from diving those individuals whose vestibular function is not perfectly normal and equal on each side. In the meantime, it is safe to say that a diver should have normal inner ear function in both cochlear and vestibular portions.

Visual

Good vision (MH item 24) is needed both underwater, to avoid dangerous situations, and after surfacing, when the diver may have to identify landmarks, floats, boats etc. The problems resulting from an incorrect visual bearing are obvious. The use of corrected lens in the face mask is of value in reducing this danger, but the technique of buddy diving (diving while attached by a line to a visually fit diver) is even more important. Distant vision should not be less than 6/12 both eyes, or 6/24 for the worse eye (ME items 5,6). Hypermetropia should not exceed 5.0 dioptries, but colour vision, unless grossly abnormal or required for ships watch keeping duties, is not of great importance.

Neurological

Any neurological abnormality (MH items 25-27,42,45,47 and ME items 20-22, 28-31,33,42) will add danger to the diver, as well as complicating the various neurological disorders due to diving, such as cerebral or spinal decompression sickness, air embolus from pulmonary barotrauma, oxygen toxicity, etc. Migraine is often exacerbated by diving. Sleepwalking is of importance when the diver intends to live on board the diving boats. Epilepsy and epileptogenic drugs are contraindicated in diving.

Freedom from psychiatric disorders (MH items 26,29,54 and ME items 34 and 35) is also of importance. There should be no increased susceptibility to neuroticism, anxiety states, depression, claustrophobia or agoraphobia, psychoses, or any organic cerebral syndrome.

General

The presence of severe gastrointestinal, renal (MH items 30-38 and 7, 26, 27), endocrine and systemic diseases has the same harmful sequelae as neurological disorders - making the diver a potential invalid in an environment that does not lend itself to first aid or medical support.

Hernia (MH item 39) may cause problems with the variation in gas volumes during changes of depth, as well as reflecting poorly on the diver's physical capabilities.

Musculo skeletal (MH items 43, 44, 45 and ME items 28-31) problems of any severity will limit the diver's physical capabilities, and complicate decompression sickness assessment. For divers (ME item 9) who were employed professionally, or who underwent many decompressions, or any recompression treatments, or who are exposed to experimental diving, annual long bone x-rays for dysbaric osteonecrosis are indicated.

Motion sickness (MH item 49) is a dangerous disorder to have if any diving from boats or in rough water is contemplated. Vomiting underwater is a problem especially if the diver vomits into his diving equipment or air supply. The psychological manifestations of motion sickness also may result in injudicious decisions, eg. to return without completing adequate decompression stops.

Smoking of cigarettes (MH items 50-51) is contraindicated, but not only because of its effects on general health, but also because of its specific effect on respiratory and cardiac fitness.

Pregnancy (MH item 59) is a contraindication to diving. This is based more on the woman's systemic physiological reactions to the pregnancy (vomiting with morning sickness, reduced tolerance to exertion, reduction in respiratory function measurements, etc.) than the specific obstetric complications. (She may be exposed to difficulty with diving harness and equipment fitting, abdominal pressure gradients with depth changes, effect of high oxygen tensions and "silent" bubbles on the foetus, hypoxia subsequent to salt water aspiration, etc.) These may eventually be shown to be of serious import.

Diving History

A knowledge of previous hypobaric, hyperbaric and aquatic accidents (MH item 60 and DH items 1-24) may be invaluable as an assessment of future problems.

Diver selection⁴

In the above discussion, we have dealt mainly with what medical standards are required for diving. A much more complex situation exists when we attempt to define what standards are optimal or ideal. These standards will vary for each type of diving activity, but in the one large navy series available on diver selection, the diver was found to be a psychologically, stable, medically and physically fit individual, who is not overtly worried by diving hazards and has both a capability and a desire to function in a hyperbaric aquatic environment. In comparison to the unsuccessful candidate, he is usually more mature, motivated by an affinity for water sports, very capable at swimming and breathholding. He is not motivated by adventure or comradeship. He is a thick set individual with a low Cotton's Index of build, a non-smoker, and based on psychometric assessment, he is an intelligent, non-neurotic, self-sufficient and practical person.

Results of Medical Examination

In the one large survey of sport divers, it was found that 33.3% were classified as medically unfit on the first examination. This fell to 20.1% after subsequent treatment and examinations. The failure rate increased with age, and reached 45.5% over the age of 35 years. Of those who were permitted to dive, 10% received some operational diving limitation imposed by the examining medical practitioner.

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BUBBLES

SPUMS CONFERENCE '75

Over a few glasses of Heisswine, it was ascertained that the conference next year is likely to be in Indonesia. The sub-committee has done some very intensive work in planning the ideal site, which unfortunately does not include Bali. Perhaps Bali will be included as a conference site, with the other areas designated as diving sites. This would please both divers and the non-diving spouses.

2ND AUSTRALIAN UNDERWATER FILM FESTIVAL

The Second Australian Underwater Film Festival is to be held in Sydney on November 8th and 9th, 1974.

The location for the opening night film presentation is the main Concert Hall of the Sydney Opera House. Films will be presented on a giant screen by the most modern 16mm projection equipment in the world. Leading Australian underwater film producers will be in attendance to narrate and/or introduce their latest film. The programme will commence at 8pm and will last three hours. Ticket price will be in the vicinity of \$5 each and will be available from the Opera House eight weeks in advance.

On Saturday November 9th, the afternoon will be reserved for special films, slides and lectures presented by specialists directly associated with professional diving and photography. Location is yet to be announced but it will be either the Union Theatre (seating capacity 624) or the Menzies Hotel Banquet Room. Admission in the vicinity of \$2 per person.

Saturday evening will feature two special lectures, a film and a display of the latest in diving and photographic equipment. Location is the Menzies Hotel Banquet Room and admission will be free. This will be a wonderful opportunity to meet experts and professionals from all aspects of the diving industry.

The Australian Underwater Film Festival is directed by John H Harding and enquiries can be made to PO Box M456, Sydney Mail Exchange, 2012. Tickets will be available from the Opera House from September 8th. Additional information will appear in Skindiving in Australia magazine and in The Sydney Morning Herald amusements section.

ISLE OF PINES NAUTI CLUB

A group of SPUMS members visited the Isle of Pines, and had the most mind boggling series of dives, run by the very French Nauti Club. The area is thoroughly recommended, both because of the facilities for diving and the excellent French cuisine. The diving was also particularly economical, costing approximately \$50 for 7 dives, all found. When one considers this includes all equipment, and professional guides, it makes our Australian prices seem some what inflated. There is no guarantee that these prices will remain as they are now, but in the opinion of the SPUMS members who remained there one week, the prices could have been doubled without us complaining. Other aquatic pursuits are well represented, although it is probably not exciting enough socially for non divers to spend more than a few days there. The apres-dive was considerably benefited by some group psycho therapy sessions instigated by popular demand.