How old is old enough?

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Abstract
(Walker RM. How old is old enough? *SPUMS J* 2003; 33: 78-80)
Recreational diving training agencies are increasingly introducing young adults and children to self-contained underwater breathing apparatus (scuba) activities. This paper reviews the SPUMS position as at 2002 and its rationale on diving fitness and minimum age for diving.

Recreational diving training agencies are increasingly introducing young adults and children to self-contained underwater breathing apparatus (scuba) activities. In response to a number of enquiries from SPUMS members who requested advice in respect to fitness to dive and minimum age, a position statement, reprinted on the preceding page, was published in the *Medical Journal of Australia*.[1]

This paper provides the rationale for that position.

TABLE 1
PADI COURSES FOR 8- TO 15-YEAR-OLD CHILDREN

Supplied Air Snorkelling
Snorkel with a personal flotation device with a scuba tank and regulator attached
Need to be 10 years old and dive with a parent, guardian or PADI professional

PADI Bubblemaker
Pool diving with an instructor in confined water less than 2 metres sea water (msw)
Direct supervision of a PADI assistant instructor or above
Designed for 8- to 9-year-old children

PADI Seal Team
Learn the basis of safe diving and explore different aqua missions – wreck, navigation, buoyancy, underwater photography, environmental awareness
Designed for young divers 8 years and older

PADI Junior Open Water Diver
Certified to dive in open water under the direct supervision of a qualified adult diver
10–11 years – must dive with a certified parent, guardian or PADI professional
12–14 years – must dive with a certified adult
15 years – may upgrade to open water certification with a maximum depth of 12 msw

Current situation

SPUMS recommends that, before starting scuba diving activities, all candidates undertake a medical assessment by a doctor trained in diving medicine. SPUMS recommends a minimum age of 14 years for all entry-level scuba activities and that both the minor and their parent or guardian participate in the consultation to ensure the risks are fully understood. The Australian Standard AS 4005.1 – 2000 *Training and Certification of Recreational Divers - Minimum Entry level SCUBA Diving* also recommends a minimum age of 14 years. However, this standard specifically refers to those students who undertake the basic diving course and receive a qualification certifying them to dive in open water.

The British Sub-Aqua Club offers restricted certification courses to 12-year-old children and open water certificates at 14 years. The Scottish Sub-Aqua Club requires candidates to be 15 years or older. In the USA, the Recreational Scuba Training Council requires all participants to complete a questionnaire and anyone answering in the affirmative to any question is required to consult a medical practitioner. There is no requirement to consult a doctor if all questions are answered in the negative and there is no specified minimum age limitation.

Why is there concern?

Commercial organisations have developed and introduced scuba activities to children as young as eight years old. The courses conducted by the Professional Association of Diving Instructors (PADI) are listed in Table 1. Within Australia the AS 4005.1 does not apply to these courses and therefore no medical examination is required. The question has been asked that if a 14-year-old child requires a diving medical assessment, then why does an eight-year-old not need one?

How to assess a child's fitness to dive

When assessing medical fitness to dive in children under 14 the same basic rules that apply to adults will apply to

children. For example, active asthma, juvenile onset diabetes and epilepsy will disqualify an individual from scuba diving. However, specific consideration should also be given to the assessment of physical, physiological and psychological maturity when assessing children's fitness to dive.

Children are not little adults. They are smaller, less powerful and may have difficulty coping with heavy scuba equipment, particularly on land. It is essential that exposure suits are appropriately sized, as children have a higher body surface area to weight ratio than adults and are more susceptible to cold and hypothermia. It is vital that buoyancy control devices (BCDs) are not oversized, as excess buoyancy may result in a rapid ascent and predispose to pulmonary barotrauma and cerebral arterial gas embolism (CAGE). Equipment should not be bought for the child to grow into and it needs to be regularly updated as the child grows.

All divers must be physically capable of dealing with the environment. Whilst conditions in a confined space such as a swimming pool are highly controlled, open water exposures may rapidly change. It is not unusual for weather conditions to change during a dive. Whilst you may enter during slack water, the tide may change and you exit battling a significant current. The child needs to be able to swim unassisted back to the boat or to the shore and be able to handle choppy surface conditions.

The buddy pair system exists so that if one of the dive pair experiences trouble their partner will be able to assist. Is it reasonable to expect a 10-year-old to effect a rescue, particularly if the affected individual is their parent or guardian?

Scuba diving requires a specific set of skills and physical coordination that may be poorly developed in the young. Demonstration of these skills in a highly controlled environment such as a swimming pool may not readily transfer to the open water environment.

Historically, concern has been expressed about the unknown effect of bubbles generated during decompression on unfused bony epiphyses. Many individuals continue to grow in stature until their late teens or early twenties when their long bone epiphyses fuse. Theoretically, bubbles formed during decompression could damage the active epiphyses resulting in early closure and retardation of growth resulting in reduced height. Although there are no animal or human data to support this claim it does remain a theoretical possibility. Inert gas dynamics are such that tissue or venous bubbles will not form in depths of 2 msw so this is not a consideration for the Bubblemaker programme.

As a consequence of the Eustachian tube not fully developing until approximately 12–13 years of age, children typically suffer more than do adults from middle ear infections. Therefore, children are at greater risk of suffering from middle- or inner-ear barotrauma. Some adults experience difficulty with the concept of ear equalization techniques and instructors and parents must be convinced the child comprehends the importance of this skill and is physically capable of performing it. Children also experience frequent upper respiratory tract infections with associated sinus and airway congestion and must not dive when so afflicted.

Parents need to be aware of the potential morbidity and mortality that can result as a consequence of pulmonary barotrauma. Boyle's Law explains why pressure and volume changes increase proportionately the closer you are to the surface, and episodes of CAGE have been reported during ascents from depths of only 2–3 msw.[2] A child breathing on scuba in a swimming pool only 2 m deep may not be at risk of decompression sickness but is certainly at risk of pulmonary barotrauma and CAGE if they do not exhale adequately when surfacing. In Australia, the incidence of asthma, with associated bronchoconstriction, air trapping, and reduced exercise tolerance, appears to be increasing although an unknown number of children will 'grow out' of their symptoms as they approach adulthood. Parents of children with asthma need to understand the possible consequences of exposing their child to a diving experience.

Children need to be sufficiently mature to understand the concepts of Boyle's Law, decompression theory and dive

TABLE 2
SCUBA DEATHS IN CHILDREN REPORTED IN PROJECT STICKYBEAK[5]

Case 1 – 1973
16 years old, newly trained, separated from buddy
Found dead fully equipped in 8–10 ft water but no buoyancy vest
Cause of death reported as aspiration of vomit

Case 2 – 1975
15 years old, no scuba training
Separated from buddy
Body found in 15 ft water with a near-full tank

Case 3 – 1990
13 years old, diving with father, both inexperienced
Father found unconscious and suffered permanent mental impairment
Child found dead, all equipment in place except for tank and regulator, which were separated from each other

Case 4 – 1992
15 years old, separated from buddy whilst crayfishing
Found dead, no mask, tank empty
Presumed became lost in rock passages and unable to find way to surface

TABLE 3
SCUBA FATALITIES IN CHILDREN (from refs 5, 6)

Case 1 – 1995
14 years old, died along with his father after diving to 40 msw to free an anchor

Case 2 – 1997
Untrained 12-year-old embolised and died after ascending while breathing from his father's tank

Case 3 –1997
14 years old, died after apparently running out of air while ascending from a dive to 30 msw with his father

Case 4 – 1997
15 years old, died from a CAGE following free ascent training during the first dive of a scuba class

Case 5 (New Zealand) – 1987
13 years old, died from a CAGE after panicking and making a rapid ascent from 12 m depth during an Open Water course

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planning. They need to be psychologically mature enough to handle underwater emergencies and not respond by bursting into tears. Children often have a well-developed sense of adventure and a poorly developed sense of mortality. They are often easily distractible and excited by new experiences. Children often lack well-developed reasoning skills and may be slow to comprehend situational emergencies.

Available data

PADI issued 122,298 Junior Open Water Diver certifications between 1988 and 1998 with only one reported fatality.[4] The Confédération Mondiale des Activités Subaquatiques programme that is similar to the PADI Bubblemaker course has recorded nearly 1,000,000 exposures without serious injury.[3] Walker reports 15 deaths in divers under the age of 16 between 1972 and 1993.[4] Four of these were using scuba, one using hookah and 10 were breath-hold divers. Table 2 shows the details of the scuba deaths. Warren reports four deaths in children under 16 years old from 1995 to 1997 (Table 3).[5] There was only one scuba fatality under 16 years old in New Zealand between 1980 and 2000 (Table 3).[6]

SPUMS' position[1]

SPUMS urges caution in assessing young children as fit to dive. Medical practitioners who make these assessments must do so fully cognisant of the nature of the activity, the type of equipment to be used and the environment in which it is to take place. They should also understand the nature of the certification to be awarded. It is considered that the presence of at least one legal guardian during this assessment is desirable to ensure that the risks are fully understood and to ensure the desire for the child to undertake the activity is not that of the parent alone.

An individual may meet the criteria laid down in a standard or understand and accept the risks of such an aquatic sport. However, it is not clear that a young child is sufficiently mature to make this informed choice.[7] Clearly, some 14-year-olds also lack the maturity and an experienced diving physician will advise them to delay their open water certification course until this maturity is demonstrated. Alternatively, some children younger than 14 years may completely safely undertake a highly structured and one-on-one supervised scuba experience in a swimming pool. It should also be understood that trialling scuba in a swimming pool has resulted in significant morbidity.

SPUMS continues to recommend a minimum age of 14 years for all entry-level scuba activities involving open water dives and caution in the assessment of younger children for all other scuba experiences.

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