

Guidelines

South Pacific Underwater Medicine Society (SPUMS) position statement regarding paediatric and adolescent diving

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Abstract

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This paediatric diving position statement was developed from a targeted workshop at the 51st Annual Scientific Meeting of the South Pacific Underwater Medicine Society (SPUMS) on 8 June 2023. It highlights the factors that SPUMS regards as important when undertaking health risk assessments for diving by children and adolescents (defined as aged 10 to 15 years). Health risk assessments for diving should be performed by doctors who are trained in diving medicine and who are familiar with the specific risks which result from breathing compressed gas in the aquatic environment. Undertaking a diver health risk assessment of children and adolescents requires a detailed history (including medical, mental health, psychological maturity), a comprehensive diver medical physical examination and evaluation of all relevant investigations to exclude unacceptable risks. In addition, assessment of the individual's motivation to dive and reported in-water capability should occur, whilst engaging with their parent /guardian and instructor, where appropriate, to ensure that safety for the child is optimised. The guideline applies to all compressed air diving including scuba and surface supply diving provided in open and contained bodies of water.

Introduction

This paediatric and adolescent diving position statement was formulated through expert consensus from a targeted workshop at the 51st Annual Scientific Meeting (ASM) of the South Pacific Underwater Medicine Society (SPUMS) on 8 June 2023. Ten statements were developed and accepted in principle by workshop participants. Final editing and referencing were by the SPUMS Paediatric Diving Working Group. During this process, the age range was reclassified as paediatric and adolescent, and an additional statement was added (11 statements in total) that enhanced certain salient points to consider when assessing and consenting these prospective divers.

The society published its first guidelines for paediatric divers in 1990, setting a minimum age of 16 years before medical

health risk assessments would be undertaken on prospective open water divers. This was revised in 1992 to a minimum age of 14 years, taking into consideration the level of psychological maturity, physical capability, and confidence for the candidate in managing the underwater environment.¹ It was also consistent with the now retired Australian Standards: Training and certification of recreational divers. Part 1: Minimum entry-level SCUBA diving. 4005.1(2000).²

The June 2003 edition of SPUMS Journal (Volume 33, Issue 2) was dedicated to children in diving. Many experts in the field weighed in and continued the discussion in that and subsequent journal issues that year.^{1–7} The two decades since the 2003 publication have seen substantial increases in diving course options for children by training organisations. Children as young as 10 years have been completing diving courses allowing open water diving with well-established

training organisations around the world, albeit with defined restrictions and limits. Some of these commenced prior to 2000, with even younger participants.⁷ It is noted also, that children aged 8–10 years can access introductory experiences using scuba equipment, directly supervised by instructors and confined to a pool environment.⁸

Evidence-based medical practice should be focused on the health and wellbeing of the prospective candidate and not the commercial interests of industry. It is widely acknowledged that a child's chronological age doesn't necessarily correspond to their physical, psychological, emotional, or intellectual level of development.^{3,9}

The latest version of the SPUMS Recreational Dive Medical was published in 2020, with updated cardiovascular health guidelines.^{10,11} At that time, SPUMS did not update the guidelines on medical health risk assessment of prospective child and adolescent divers.

Other medical societies, such as the Dutch Society for Diving and Hyperbaric Medicine and German Society for Diving and Hyperbaric Medicine recently revised their recommendations for this unique subset of the population.^{12–14} There is a paucity of quality evidence regarding current best practice for assessment of children and adolescents seeking to undertake compressed gas diving, and the advice provided to them and their parents or guardians. Most information consists of case reports, retrospective event analysis, prospective cohort studies, and expert opinion. The South Pacific Underwater Medicine Society acknowledged that its existing guidelines required updating to support health risk assessment of children and adolescent prospective divers.

Definitions

In developing this current position statement, SPUMS has adopted the following definitions:

Paediatric (adjective) – refers to describing children from birth to 17 years of age.

Child or Children (nouns) – refers to individuals or groups including infancy through to puberty (puberty is achieved when the child reaches reproductive maturity: this includes a range of ages and is different according to the sex of the individual).

Adolescent (noun or adjective) – defined by the World Health Organisation as 10–19 years of age.¹⁵

It is also recognised that there may be individuals from the above descriptor groups for whom this SPUMS position statement is not relevant. The terms will be used in the text to refer to a narrower range of age groups defined in Statement 1.

Whilst acknowledging limited data in this field, it appears that diving amongst children and adolescents is relatively safe. This is likely due to experienced medical assessment, consent alongside their legal guardian, and engagement with a supportive and skilled instructor through a training organisation with appropriate, established procedures. Vandenhoven's retrospective study demonstrated that children had a high rate of medical issues incompatible with diving when medically assessed prior to diving.⁷ One in eight children were excluded from diving on medical grounds.⁷ Available evidence also suggests that even after medical clearance, children still have a high rate of ear, nose and throat (ENT) issues, specifically middle ear barotrauma.^{4,7,9,12,16} Training organisations which vet their paediatric and adolescent divers by establishing pool skills and optimising ear equalisation techniques before proceeding to open water environments, appear to have a high degree of success with safe diving practices in their young trainees.⁷

Fatalities are infrequent in children and adolescents compared to adult recreational divers, although participant rates are far lower.⁹ The Australasian Diving Safety Foundation data from 1966 to 2020 revealed five out of 531 scuba deaths (1%) were in children and adolescents (aged 8–15 years).¹⁷ One series from DAN North America reported that children (defined as aged 12–17 years) made up 1.9% of all deaths reported between 2012–2015.¹⁸ These data did not permit incidence to be calculated. Although infrequent, any child or adolescent diver death is unacceptable.^{19–23} The cause of most paediatric deaths was arterial gas embolism from pulmonary barotrauma.¹⁸ Anxiety and/or panic was a common precedent to rapid ascent in children and adolescent divers, which in turn resulted in pulmonary barotrauma.^{9,22} Pulmonary barotrauma and subsequent arterial gas embolism can occur in water depths as shallow as one metre.²⁴ Asthma may also result in pulmonary barotrauma.^{12,25} Decompression sickness was a less commonly confirmed diagnosis in one paediatric population.⁹ Depth restrictions and less provocative diving may have reduced incidence of decompression sickness in this series. Fortunately, recompressing children with hyperbaric oxygen for decompression sickness under the current adult guidelines appears safe.²²

Disclaimer

The advice contained in this SPUMS Position Statement is applicable to medical health risk assessment of children and adolescents aged 10–15 years who are seeking to undertake compressed air diving including scuba diving and surface supplied compressed air (e.g., 'hookah' diving).

The statements do not constitute a 'Standard'. The statements are based on analysis of available published evidence and expert opinion. They are expected to provide guidance to medical practitioners when undertaking health risk assessments on children and adolescent prospective divers.

The document should be used on a case-by-case basis utilising information on individual circumstances and as broad guidance for doctors. The society recommends engagement with the child or adolescent, their parent(s) / legal guardians, and the dive instructor when assessing 'fitness to dive' of the applicant. From the age of 15 years, adult guidelines apply.

Statement 1

The definition of a paediatric/adolescent diver for SPUMS diving medical assessment is from attaining the age of 10 years to less than 15 years of age.*⁴

* The society recognises that there is considerable individual variability of physical and emotional maturity in this age range, which needs to be taken into account by the assessing doctor. See Statement 11 for additional recommendations. The society also recognises that there are other definitions and published age ranges for this population.^{12,18,22}

Statement 2

It is the society's position that all prospective children and adolescent divers should be medically assessed for health risks that may be incompatible with diving before commencing scuba diving training. It is recommended that doctors who perform diving medical assessments on children and adolescents have undertaken additional professional development in diving medicine and are up to date with specific risks for this population. Where there is doubt or the child has complex health issues, additional specialist (or specialist centre) advice should be sought.

For children (and those who are legally minors), such a medical assessment would also include consent from the parent(s) / legal guardian to confirm appropriate education regarding risk has been covered, understood and accepted by both parties.^{1,4,23} The doctor should determine the reason why the child wishes to dive and their motivation and should be mindful of any excessive coercion from care givers.^{4,6,12,16,23,25}

Statement 3

Dive medical assessments should be performed:

- prior to initial training for any compressed air diving, including scuba and surface supply diving, provided in open and contained bodies of water (from 10 years of age), and
- following any significant health event.

Statement 4

In addition to adult contraindications which preclude diving, children or adolescents should not dive if they have any of the following medical conditions:

- Epilepsy (any type including absence seizures);¹⁰
- Combined anxiety disorder and panic disorder;^{7,9,12,22,23}
- Attention deficit hyperactivity disorder;^{12,16,26,27}
- Asthma (including well controlled and exercise induced), cystic fibrosis, and other chronic respiratory tract illness;^{6,7,10,12,16,22,23,27,28}
- Congenital heart disease despite correction;^{10,12,27}
- Insulin dependent diabetes mellitus;¹⁰
- Migraine with aura;¹⁰
- Tympanostomy tubes present in either or both ears;
- Hereditary or acquired bleeding disorders;
- Any medical condition that could cause sudden incapacity.¹⁰

This list is not exhaustive and detailed specialist advice should be sought regarding any specific medical conditions which are identified in children and adolescents who seek to dive.

Statement 5

There is evidence of increased potential risk from diving in children / adolescents compared with adults, particularly relating to:

- cognitive and emotional maturity, attention and focus, and antecedent risk for panic underwater;^{5,7,9,12,22,28}
- attention deficit and hyperactivity disorder and associated potential risks;²⁶
- risk of ear nose and throat and respiratory tract infections;^{7,16,28–30}
- immaturity of the paediatric airway;^{6,7,12,22,27,28,31}
- risk of persistent (patent) foramen ovale (PFO);^{6,7,9,12,16,27,28}
- risk of hypothermia;^{5,6,12,16,25,27,28}
- limited physical capabilities.^{3–5,9,12,25,32}

Statement 6

The assessing diving doctor needs to pay careful attention to the child or adolescent's:

- past medical history;
- psychological maturity and executive function*;^{3–5,7,9,12,16,22,25,32}
- physical maturity;^{3–5,9,12,25,32}
- ear nose and throat assessment;^{5–7,9,12,16,23,25,27,28,32}
- asthma risk;^{9,12,23,27}
- risk of PFO;^{6,9,12,16,27}
- hypothermia risk;^{5–7,9,12,16,23,25,27,28}
- reported in-water and swimming capability**;^{6,7,8,33}
- motivation for diving including whether the child perceives they are under pressure to dive.^{4,6,12,16,23,25}

Physical examination should include a comprehensive medical assessment as performed for an adult diving medical examination, including pulmonary function testing and audiogram.¹⁰

* Where this is unable to be assessed accurately at interview, the assessing physician should seek further information from reliable third-party sources (e.g., other clinicians, allied health personnel, teachers).

**If a child is unable to swim, then they should not dive.

Statement 7

The society considers that for a diving doctor to form an opinion about medical risk for children and adolescents intending to scuba dive, the discussion with the candidate, legal guardian/s, and diving instructor must include:

- the child's / adolescent's swimming ability / in-water capability;⁷
- assessment of their level of maturity and understanding of the risks involved with diving;²²
- assessment of their physical capabilities;^{3-5,9,12,25,32}
- additional acceptance of risk by the legal guardian/s;⁷
- consideration of Gillick competency (determining whether a child / adolescent diver is functionally competent to provide informed consent).³⁴

Statement 8

Recommendations for child / adolescent diver safety during subaquatic activities should include:

- emphasis of the need for physical and psychological fitness during their training;^{1,4,5,23}
- emphasis of the need for accessory diving skills, including snorkelling and buoyancy control;^{4,23}
- counselling regarding the risk of pulmonary barotrauma and resultant arterial gas embolism and the avoidance of panic;
- ensuring that the child / adolescent and their parents / guardians are complicit in this understanding and sign the acceptance of risk on the SPUMS Statement of Health for Recreational Diving;^{1,4,5,10,23}
- determining that the child / adolescent is complicit in the decision to dive and not being coerced;^{4,6,12,16,23,25}
- where possible, include the dive instructor in the decision making;^{1,7,27}
- when diving, ensure:
 - » that a minimum of two adult certified, competent divers accompany the child or adolescent when diving; one of whom knows them well (e.g., parent or sibling);⁹
 - » the focus of the adults is as supervisors to the child or adolescent only;³⁻⁵
 - » the child or adolescent should be within arms-length distance from the adult and in direct view at all times;⁹

» that the child or adolescent diver is not expected to rescue their adult supervisor(s).^{3-5,9,12,25,32}

- encouragement for training agencies to develop specialised training modules (including on-line) to teach young divers and lead them on open water dives;⁹
- in addition to limitations in Statement 6, child or adolescent divers should not dive in hazardous marine environments as defined in AS/NZS 2815.6 (2013) Section 1.1.4 (a)–(g), listed in [Appendix 1](#).³⁵

These recommendations are best managed by training agencies who have a special interest in child and adolescent divers and can provide individualised support for the specific needs and unique behavioural aspects of this population.

Statement 9

Regarding garments and equipment for the child / adolescent diver, these should:

- be appropriately sized and fit;^{7,16}
- be appropriate thickness of wetsuit for thermal protection in the planned water temperatures*;³³
- be of a weight that the child can carry when walking;
- preferably have integrated weights in the buoyancy compensator device**.¹²

* Hypothermia is a greater risk in children due to higher surface area to volume ratio.

** This avoids the need for a weight belt which could more easily slip off a child, leading to a rapid ascent with subsequent pulmonary barotrauma / arterial gas embolism.

Statement 10

The society recognises that there is limited evidence of harm to children and adolescents who have undergone medical risk assessment by a doctor who has training in diving medicine, and who undertake compressed air diving in a controlled, supervised environment within current training systems.^{7,9,18,20-22,27} However, available studies also provide limited evidence of safety and do not permit accurate assessment of risk or incidence of harm in the child / adolescent population of divers. The negative impact of fatalities and episodes of significant injury in children is of such magnitude that a conservative approach is warranted when providing health risk advice.

Statement 11

The society supports, in-principle, the position of other medical societies and experts to stratify children or adolescents by age, when considering the diving activity,

* **Footnote:** Appendix 1 can be found on the DHM Journal website: <https://www.dhmjournal.com/index.php/journals?id=346>

environment, water temperature and limitations on depth of diving, and number of supporting certified diving adults (minimum of 2), when the child / adolescent is diving.^{4-7,12,16,28,33,36}

Recommendations

This guideline was based on expert opinion from SPUMS clinician members present at the 51st SPUMS Annual Scientific Meeting, Cairns, Australia, June 2023. Their expert opinion is based on lived experience and currently available literature, which is limited to expert consensus, case studies, prospective cohort studies, and retrospective analyses.

Conclusions

Children and adolescents are an important group within the diving population who have development-specific considerations. Close attention needs to be placed on the medical history and assessment of the ear, nose and throat, and respiratory systems, in-water capabilities, and neurodevelopmental evaluation due to antecedent risks in the subaquatic environment.

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