



WAYNE JASSON

# CHILDREN AND DIVING

## WHAT ARE THE REAL CONCERNS?

BY MATÍAS NOCHETTO, M.D.

WHEN RECREATIONAL DIVING EQUIPMENT became commercially available in the 1950s, scuba was established as an exciting activity for courageous adepts all over the world. As equipment and confidence in technique evolved, diving became available to more people, including children.

Children and diving, however, is not without controversy. Concerns range from kids not having sufficient body size and strength to aid a fellow diver to the risk of inhibited bone growth and other medical concerns.

Children are not small adults. They are still growing, with different organs and systems developing at various speeds. They are maturing and evolving both physically and psychologically. Children are predisposed to ear infections as a consequence of their Eustachian tubes' immature form and function, which may also increase their risk of middle-ear barotrauma.

Children burn lots of calories, and the resulting heat provides them with good tolerance to cold. Once the expendable calories are exhausted, however, without adequate thermal insulation children may be more prone to hypothermia, and their relatively high body-mass-to-surface-area ratio leads to accelerated heat loss.

Childhood asthma underscores how pulmonary function is still evolving in young people, and any risk of air trapping is a serious concern when breathing compressed gas.

Perhaps the most significant concern about children and diving involves psychology and cognitive ability. Children often lack the mental maturity to understand and manage invisible risks, and they can behave unpredictably in stressful circumstances. Adherence to plans can be a problem for those who are easily distracted.

Diving and dive training practices currently address the physical, physiological and psychological challenges inherent to children by adapting equipment, modifying techniques, limiting exposure and mandating strict supervision.

Data about diving injuries among children are very scarce. Limited statistics available through some training agencies do not provide any cause for alarm, and injuries reported through the DAN Emergency Hotline rarely involve children. Some dive instructors praise youngsters' surprisingly good water skills; others argue that a single dive-related fatality in a child would be too many.

We ask the experts.

### What risks concern you most when it comes to young divers?

**Simon Mitchell:** I am generally relaxed about diving by children provided there is strict adherence to the recommendations around training, supervision and scope of diving promulgated by the major training



organizations. I think the biggest potential problems relate to emotional and behavioral immaturity in children that may lead them to make poor decisions or be inattentive to plans. This concern can be mitigated by appropriate supervision.

**David Charash:** In general the risks of diving include barotrauma, decompression sickness, arterial gas embolism, panic, drowning and traumatic events. The risks of diving don't discriminate based on age or experience. So the real questions are:

- *How well can an individual diver handle a given problem?*
- *Can the diver understand the level of risk present and decide on the degree of risk he or she is willing to accept?*
- *Can a child mitigate the risk by adjusting his or her dive profile?*

**Thomas March:** By and large the pediatric population is quite healthy. We worry much more about mental errors that are unforgiving in scuba. The frontal lobe, which is associated with judgment, is generally not fully developed until the mid-20s. Panic, overconfidence and anxiety are serious concerns in the pediatric population. I also worry that many pediatric-age divers do not have the physical strength and/or skills to be a dive buddy responsible for the life of another diver.

**David Wakely:** Inexperienced adult divers are the greatest risk to children who dive. A child diver has a very different mindset from that of an experienced adult. Adults who think the child they are diving with is capable of all conditions and scenarios, who jump in the water beside the child but do not really watch them closely, are dangerous buddies for a child to have.

A child should always be paired with an adult who has the experience to deal with the child's short attention span and tendency to be distracted by shiny objects. The adult should constantly monitor the child's air and depth, swimming position and rate of ascent or descent.

### **Do you think that limiting the exposure makes diving safer for children?**

**Mitchell:** Limiting depth/time exposures makes diving safer for adults and children. It is one of a number of pragmatic ways of mitigating the possibility that children may be more prone to events such as running out of air and rapid ascent. It clearly does not affect the risk of some diving problems such as barotraumas.

**Charash:** Intuitively, placing a clear and defined limit on depth and time of exposure is likely to add an additional layer of safety in children, but we must not forget that there is risk at any depth and dive time.

**March:** Turning loose young divers with compressed air even in shallow depths may be a big mistake. In my opinion it's more important that the instructor has the skills to assess a young diver's ability to be mentored. Stratification based on skills and experience — as seen in martial arts training, for example — could be useful. Many young divers are eventually able to appreciate the risks, but readiness can vary dramatically and depends much less on age than maturity. I think efforts to credential specialized instructors might be worthwhile.

**Wakely:** A graduated response to learning and freedom to dive is essential for child safety. I like to use the analogy of skiing — it's a potentially dangerous sport, but there are few adults who argue that children shouldn't be skiing. It's widely accepted that children should start on gentle slopes, wear a helmet and gradually move up to more advanced terrain according to their abilities.

### **Is decompression stress a concern with regard to long bone development in children?**

**Mitchell:** There is no evidence for it. The epiphyseal plates of the long bones do not close until late adolescence, and there has been extensive diving by teenagers for decades. Despite this, I am unaware of a single case of apparent growth inhibition in a limb as a result of decompression sickness in a teenager.

**Charash:** There are no studies that show clear evidence that diving (decompression stress) can affect long bone development in young divers. What is not so clear is the effect of microbubbles that may enter the circulation and possibly affect the blood vessels in the growth plates (epiphyseal plates). I suggest limiting children's exposure to nitrogen by restricting depth and dive time and increasing surface interval time.

**March:** We know that tissue perfusion in the growth plates is significantly different from that in most other body compartments. This is clear because we find pediatric patients much more susceptible to bloodstream infections in these areas. The standard gas-compartment models are likely inadequate as routine dive tables, and experimental confirmation is neither ethical nor practical. The general consensus of a margin of safety seems prudent.

**Wakely:** There is no evidence that the hyperbaric environment has any ill effect on growing bones. The Undersea and Hyperbaric Medical Society (UHMS) lists 14 medical conditions that are known to benefit from hyperbaric oxygen therapy (HBOT). For two of these conditions, osteomyelitis (long-term bone infection) and osteoradionecrosis (bone damaged by radiation therapy),



the HBOT addresses the underlying problem (infection and dead bone), encourages new blood vessels to form in the bone and allows the bone to heal itself. HBOT has no known negative effect on healthy bone of any age.

**Do you think 10-year-olds have the mental maturity to understand and manage the invisible risks involved in scuba diving?**

## MEET THE EXPERTS

**David Charash, D.O., CWS, FACEP, UHM,** is medical director of wound care and hyperbaric medicine at Danbury Hospital in Connecticut. He is a certified diving medical examiner as well as a DAN Referral Physician and DAN Instructor. Dr. Charash lectures locally and nationally on dive safety and dive medicine.

**Thomas March, M.D.,** a practicing pediatrician for 30 years, has a special interest in developmentally and behaviorally challenged pediatric patients. A diver for more than 35 years, he has special training and interest in administrative medicine and fitness-to-dive evaluations.

**Simon Mitchell, MB, ChB, Ph.D., FUHM, FANZCA,** is a physician who is widely published in his specialist fields of anesthesiology and dive medicine. Head of the department of anesthesiology at the University of Auckland, he is an avid technical diver, a Fellow of the Explorers Club and the 2015 DAN/Rolux Diver of the Year.

**Margo Peyton, MSDT,** is a scuba educator, member of the Women Divers Hall of Fame and the founder and director of Kids Sea Camp, through which more than 5,900 young people have learned to dive. Each year roughly 1,200-1,600 students dive with Kids Sea Camp, which has a perfect safety record.

**David Wakely, FRCEM, FRCS, MBBS, BSc, Dip IMC, EDTC-II,** is a consultant in emergency medicine as well as wound care and hyperbaric medicine at the King Edward VII Memorial Hospital in Bermuda. He also is a dive medicine consultant for the Bermuda police and government and a dive instructor who works extensively with children.

**Mitchell:** The question requires context. Within the framework of a dive training program and guidelines of practice designed specifically for this age group, my answer would be “yes, in most cases.” Put another way, if the supervision and depth/time recommendations for diving are adhered to, then most properly motivated 10-year-olds should be fine. But if the question is whether a 10-year-old should be considered an independent open-water diver (as we understand that concept in adults), then my answer would be no.

**Charash:** To answer this question it is important to understand normal childhood growth and development. As there is significant variation in maturity and development, it is not possible to predict who will have the capacity to understand and also manage risk. Specific to the question, it would be a challenge to expect a 10-year-old to understand “invisible risk.”

**March:** Many 10-year-olds may be capable, but many more may not be. Unfortunately there are often incentives for instructors, parents and even dive operations to train unready students. Adults who have the skills to assess the readiness of pediatric-age divers can facilitate positive and acceptably safe in-water experiences for kids of any skill level.

Prioritizing positive experiences for pediatric-age students allows for better advancement of all skill levels and avoids the all-or-none dichotomy of certification-focused programs. This also prevents a sense of failure for students unable to complete certification and may relieve some of the pressure parents place on instructors to certify students.

**Wakely:** Every child differs, but between the ages of 7 and 11 children's cognitive abilities change in two ways. First, concrete thinking occurs. This is the ability to solve logical problems that apply to actual objects or events. Second, children become less egocentric and develop the ability to view things from others' perspectives. So the average 10-year-old should have the mental maturity to understand the concept of risk and be able to solve concrete gear-related problems. However, the formal operational stage of thinking — using abstract thought and applying it to problems that have not even occurred yet — does not manifest in most children until ages 11 to 15. The major dive training agencies' programs for young divers do a good job of reflecting these stages of cognitive development.

**What characteristics do you consider necessary for a child to be a good candidate for scuba diving?**

**Mitchell:** The most important thing is that the child wants to dive. It is also vitally important that the parents are supportive and wholly involved in the decision to allow diving, acting as informed risk-acceptors on the child's



behalf. The child should exhibit a level of emotional, intellectual and physical maturity compatible with the scope of diving prescribed for his age group. Note that these characteristics cannot be adequately assessed in an office-based consultation. Thus, the evaluation of a child's suitability for diving is substantially the responsibility of the diving instructor who sees the child perform in the water, rather than the doctor.

**Charash:** There are five components that suggest that a given child is a good candidate for scuba: medical fitness (absence of any medical condition that could affect safety), psychological fitness (appropriate motivation for diving and achievement of relevant developmental milestones), physical fitness (capability to manage equipment and swim against a current), knowledge (knowing how to respond to situations appropriately) and skills (ability to clear a mask, buddy breathe, etc.).

**March:** Demonstrated surface skills such as breathing through a snorkel without anxiety are minimal requirements for undertaking instruction. Poor attention span, overconfidence and anxiety would seem to be exclusionary criteria. Pediatric patients do well with incrementally increasing responsibility. Unfortunately age alone is not a good indicator of developmental capabilities, and tailoring advancement based on the individual's readiness requires skills on the part of the instructor and mentors. As we consider the potential risks and harm that can be done, we must also balance this with the opportunities for enriching the appreciation of the underwater world and developing confidence and skills in our future generations of divers.

**Wakely:** Several factors should be considered when assessing a child scuba student.

*Psychological maturity:* Candidates should be calm and rational, not prone to extreme emotional outbursts and not prone to anxiety in unfamiliar situations. They need to understand risk and risk avoidance.

*Educational maturity:* The child should be able to learn independently. Learning scuba theory is a big undertaking, and the students must be able to concentrate on the material and know when to ask questions. They should be able to understand what they are reading enough to apply the principles described to situations they see around them in daily life.

*Physical maturity:* The child should be able to swim and should be very comfortable in and around water. Currently dive equipment for very small children is hard

to find, so the child should be physically large enough to wear the available gear correctly and safely.

*Desire to dive:* The desire to dive must come from the child, not the parent. A dad asking an instructor to teach his son is very different from a child who wants to learn to dive like his dad.

*Medically fit:* Asthma, ADHD and morbid obesity are prevalent today, and these three conditions commonly disqualify children from diving. If you are considering arranging for your child to learn to dive, discuss your plans with a doctor familiar with dive medicine.

### What has been your biggest challenge in training young divers?

**Margo Peyton:** My biggest job is educating parents. Parents frequently fail to disclose important information on medical forms because they worry their child will be prevented from diving. Full disclosure of all medical conditions is crucial — not only to maximize the child's safety but also so the dive operator can accommodate any special needs the child may have.

For example, we once had a child with autism in our program and were unaware of his condition until he panicked during his first open-water dive. He became very agitated and aggressive. Thankfully no one was hurt, but the child had to be removed from the program, which was humiliating for him. Had we known about his autism we would have provided him with his own private instructor who had experience teaching children with autism.

Parents should be aware, however, that not all dive operators have experience working with children. Adequate oversight should not be taken for granted. I recommend that parents ask dive operators the following questions before their children go diving:

- Is a first aid kit and oxygen unit on board or nearby?
- Is a radio or cell phone available?
- Are all staff divers current and active divemasters or instructors? (Don't hesitate to ask to see their C-cards.)
- What are the depths and conditions of the dives? (Make sure the child won't be diving deeper than what is recommended for his or her age.)
- Do any of the instructors have training or experience working with kids?
- Does the boat have a safety tank, dropline and dive flag on board?

Parents should request a refresher course for children who have not been diving in 12 months, and they should not hesitate to ask that a divemaster accompany them if they aren't comfortable diving alone with their child. **AD**