



Naval Safety Center

LESSONS LEARNED



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SHALLOW WATER BLACKOUT

Breath-hold diving, also known as freediving, is the practice of holding one's breath until resurfacing rather than using breathing apparatus such as scuba gear. One common hazard of freediving is *shallow water blackout* (SWB), which is an underwater "faint" due to lack of oxygen (hypoxia) to the brain brought on by holding one's breath over long periods. Freedivers often use hyperventilation techniques to "blow-off" carbon dioxide, which involves more than just taking two or three deep breaths. Hyperventilation is breathing at an abnormally rapid rate, which removes carbon dioxide (CO₂) from the bloodstream more quickly. CO₂ buildup in the bloodstream from holding your breath is what causes you to want to breathe. Without that urge to breathe, a freediver unknowingly depletes oxygen, which can lead to SWB (unconsciousness) and death. Not a freediver? Read on because SWB can occur in your backyard pool too. Hyperventilating followed by long underwater swimming or breath-holding can cause SWB just as quickly at any depth.



Another cause of blackouts specific to freediving is sometimes referred to as *ascent blackout*, which occurs when oxygen to the brain is depleted during ascent from depths of usually 30 feet or deeper. According to the U.S. Navy Dive Manual, as the freediver descends, the air in the lungs is compressed, which forces more oxygen into the bloodstream and to the brain. At that point, the diver is getting plenty of oxygen. Unfortunately, the reverse happens as the diver ascends, rapidly reducing the pressure of the remaining oxygen in the blood, leading to unconsciousness. This danger is heightened when the diver hyperventilates first.

According to the Centers for Disease Control and Prevention, there was an average of 3,536 fatal drownings annually from 2005 – 2014, ranking fifth among the leading causes of accidental death in the U.S. Approximately one in five of those fatalities were children 14 and younger, with 75% occurring in a residential pool. In a survey of 24 confirmed SWB incidents by the Aquatic Safety Research Group, 16 occurred in pools, resulting in 11 of 17 fatalities. Only seven of the 24 SWB victims in the survey survived.

While our database does not record mishaps involving civilian dependents, the numbers above should be enough to show that the hazard is real. The following on and off-duty examples of SWB demonstrate that even trained divers can be at risk.

- An instructor lost consciousness for a brief period at the completion of a working breath-hold dive in a 12-foot deep pool.
- Two instructors drowned after practicing breath-hold diving training. The facility manager previously briefed them that breath-holding was not allowed at the pool.
- A qualified Navy diver died from drowning while conducting an unauthorized breath-hold dive in the vicinity of an ongoing diving operation. He was observed hyperventilating prior to the dive.

Note: The above tragedies happened to qualified military divers who must adhere to strict policies. According to the U.S. Navy Dive Manual, "Breath-hold diving is a dangerous practice that may lead to unconsciousness and death and shall be limited to operations and training that cannot be effectively accomplished with UBA (Underwater Breathing Apparatus) such as, free ascent and escape training, SCUBA confidence training, shallow water inspections or object recovery and obstacle / ordnance clearance." The manual states that "breath-hold diving shall be supervised by a qualified diving supervisor and the breath-hold diver(s) shall be tended where practical," and "ORM, dive briefs, emergency action plans, and notifications relevant to Navy dives apply to breath-hold diving."

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If the U.S. Navy Dive Manual cites the dangers of breath-hold diving, we should definitely take pause to consider the risks in off-duty freediving and swimming activities. Here are two examples of off-duty mishaps where shallow water blackout was indiscriminate of duty status.



- A service member died while engaged in "breath-holding games" while snorkeling with two fellow squadron mates while off duty at a well-known snorkeling and diving location frequented by locals, tourists, and locally stationed service members.
- Two servicemen chartered a professional guide to take them on an all-day spearfishing trip. After approximately five hours of spearfishing, diver 2 (on the surface) observed diver 1 dive to a depth of 60 feet (yes, 60!), and start looking for fish. After 45 seconds, diver 1 dove deeper. Diver 2 started swimming against the current to get a better visual on diver 1. After another 20 seconds, diver 2 observed diver 1 swimming toward the surface. Halfway to the surface, diver 1 started convulsing and stopped moving. Diver 2 sprinted across the surface, losing one fin in the process. Once on location, diver 2 took two quick breaths and dove to assist diver 1 to the surface. Diver 2 remembered being close to resurfacing when shallow water blackout occurred. The boat crew recovered diver 2 and successfully rendered CPR. Diver 1 could not be seen from the surface, and scuba divers later recovered his body.

Lessons Learned / Key Takeaways

Shallow water blackouts can happen anywhere, even in a controlled training environment. So why are there mishaps? Poor ORM or supervision could be the answer. Symptoms of Hypercapnia (high carbon dioxide) or Hypoxia (low oxygen) in the blood, can show no signs — until it's too late. Know the activities that create the conditions for SWB, and don't take unnecessary risks.

1. **Don't let your ego drive poor decisions.** Anytime you hear or think "Betcha I can hold my breath for..." or "Watch how far I can swim underwater," a mental alarm should go off. Follow tested practices, policies, proper training, and sound judgment to avoid a potentially deadly outcome. We're not saying don't swim underwater; we're saying do it wisely.
2. **Know the risks.** Shallow water blackouts don't just affect those participating in recreational activities like spearfishing, freediving, and snorkeling. It is also the single biggest killer of competent swimmers of all ages, according to the Aquatic Safety Research Group. The best way to prevent SWB is to educate yourself (and your family) on the hazard, and apply real-time risk assessment, both on and off duty. Don't play breath-holding games or hyperventilate before swimming underwater.
3. **Don't swim or dive alone.** If SWB occurs, recovery and prompt resuscitation are critical, which is impossible when you're by yourself. Since the brain is depleted of nearly all oxygen during SWB, brain damage can start in as little as two minutes, whereas a typical drowning victim has 6-8 minutes before brain damage begins. This rapid onset of mortality makes it crucial that adults provide supervision to youth (and other adults) swimming in pools that may be holding their breath or having underwater races with friends. Children and adults alike should never swim alone.

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and on our public website at <https://navalsafetycenter.navy.mil/Safety-Promotions/Lessons-Learned/>

And remember, let's be careful out there...