Drowning deaths in Australia caused by hypoxic blackout, 2002–2015

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Hypoxic blackout, also called apnoeic hypoxia or shallow water blackout,[1] is a distinct and largely preventable cause of drowning.[2] This fatal syndrome is often the consequence of voluntary pre-submersion hyperventilation, which downregulates CO_2 brainstem chemoreceptors, with the result that consciousness may be lost (because of apnoeic hypoxia) before protective breakpoints (driven by CO_2 and O_2 chemoreceptors) are reached.[3] Inspiration thus begins while the person is submerged and unconscious. Given the paucity of population-level analyses,[4] in this study we examined hypoxic blackout-related fatal drownings in Australia to in order to inform development of prevention strategies.

Cases were identified in the Royal Life Saving National (Australia) Fatal Drowning Database, which draws (privileged) cases from the Australian National Coronial Information System (www.ncis.org.au). Case finding identified all instances of unintentional drowning deaths in which "hypoxic blackout" or similar terms were mentioned, the coroner's findings or police narratives of pre-incident events referred to pre-submersion hyperventilation, or associated activities that employ hyperventilation, such as freediving, were recorded. This study was approved by the Victorian Department of Justice and Regulation Human Research Ethics Committee (references, CF/07/13729; CF/10/25057, CF/13/19798).

Between 1 July 2002 and 30 June 2015, hypoxic blackout was implicated in 22 drowning deaths. All involved males; 17 were aged 18–34 years. The most common scenarios were recreation in domestic or public swimming pools (12 cases) and diving in ocean or harbour locations (nine cases: five while spearfishing, four while freediving). Four of those who drowned in swimming pools had pre-existing medical conditions (predominantly cardiac conditions), and blood alcohol levels exceeded 0.05 g/dL in three.

Preventing hypoxic blackout deaths is challenging. In the absence of exposure denominators, risk cannot be quantified. Attributing drowning deaths to hypoxic blackout is difficult without specific pathological features that characterise the condition; pre-existing comorbidities, such as ischaemic heart disease and arrhythmia, may also contribute to such deaths. Given the uncertainty about those at specific risk, another challenge is that the number of pre-submersion hyperventilation inspirations that increase the risk of drowning also remains unknown. In fact, there is evidence that hypoxic blackout can also occur after extended breath holding in the absence of hyperventilation, especially after exercise.[5] Finally, the identified fatalities may constitute only a proportion of all hypoxic blackout drowning events.

It is therefore prudent to make the entire swimming and diving population aware of the risks.[6] Novel strategies are needed for effective prevention, including education during swimming classes and heightened risk-informed supervision (constant monitoring) during training and competition, as well as medical examination of those who engage in breath holding. Activities that involve increased risk include freediving, underwater hockey, synchronised swimming, and professional activities such as mollusc collection. Education about the syndrome of hypoxic blackout is important for all involved in supervision and training in aquatic sports. Prevention stratagems for freedivers are more complex, but the core message, as in all aquatic safety, is that training for competition should never be accompanied by unwarranted risk.

Hypoxic blackout, while rare, results in an average of two deaths (including children) each year in Australia. These deaths can be prevented.

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