swimming australia

ascta
Australian Swimming
Coaches & Teachers Association

Position Statement
Hypoxic Training

1.0 Executive Summary

It has been identified that Hypoxic Training, particularly when coupled with certain underwater swimming skill development drills, can present an unacceptable high risk. Consequently, and with the welfare and safety of swimmers foremost, ASCTA and Swimming Australia have developed this Position Statement and Policy. Extensive research was undertaken to arrive at this Position.

This document articulates the risk and lists practices that should be followed by coaches, swimmers, parents and others associated with aquatic environments to reduce the risk to acceptable levels. Activities that should be banned are also detailed.

2.0 Key Points:

Loss of consciousness is brought on by low oxygen. Hypoxia is the cause of blackout and may –result from as competitive, repetitive, or prolonged breath-holding which is often prefaced by hyperventilation. This results in hypocapnia which is a state of low carbon dioxide (CO_2) in the blood. This low CO_2 in the blood reduces the stimulus to breath and results in a state of hypoxia which can lead to loss of consciousness.

Hypoxic training is used to improve tolerance of an oxygen debt. In a competitive swimming training sense, it is generally coupled with underwater swimming practice, with that skill being vital for competitive starts and turns.

In all aquatic environments:

1. **Never swim alone.**
2. **Never hyperventilate prior to any swimming activities.**
3. **Never ignore the urge to breathe.**
4. **Never play breath-holding games or challenges.**

Hypoxic training has no place in the learn to swim environment.

Hypoxic training has no place in recreational swimming.

As hypoxic training has a role to play in the development of competitive swimmers to become successful in the sport, it must be performed only when following appropriate protocols, under the strict supervision of a properly qualified coach. These principles are:

1. Coaches should stress to athletes that they should never ignore the urge to breathe.
2. Hypoxic training should involve progressive overload, in line with the athlete's physical and skill development – for example, beginning with efforts over 5m, 10m, then 15m etc - as the swimmer develops the appropriate skills and physiological capacity.
3. Coaches should ensure adequate rest between hypoxic efforts to ensure full recovery.
4. Athletes should not hyperventilate (take multiple, deep breaths) prior to any underwater or other hypoxic efforts.
5. Hypoxic training should not involve competitive efforts of maximum duration, or distance covered.

3.0 Background:

Hypoxia is defined as a condition in which the body or a region of the body is deprived of adequate oxygen supply.

Hypoxia may be classified as either generalized, affecting the whole body, or local, affecting a region of the body. Although hypoxia is often a pathological condition, variations in arterial oxygen concentrations can be part of the normal physiology, for example, during hypoventilation training or strenuous physical exercise.

In a swimming sense, hypoxic training is a technique used by swimmers to improve their tolerance of an oxygen debt. This is usually done by swimming short distances without breathing.

A state of hypoxia is also associated with swimmers in an aquatic setting when they undertake self-initiated or instructed breath-holding and underwater swimming activities.

Like all physical activity there is an inherent risk associated with the activity. Risks increase in when limits are pushed.

4.0 Risks:

Shallow Water Blackout ("SWB"), better described as Breath-holding Blackout ("BHB") or Hypoxic Blackout, is a term describing loss of consciousness arising from oxygen deprivation brought about by extended breath-holding, often associated with pre-submersion hyperventilation. The term hypoxic blackout was first described in breath hold divers who blacked out as they neared the surface after being underwater for a period of time. However, it can and does occur without submersion.

It is the level of carbon dioxide (CO_2) in the body that triggers breathing. The body produces CO_2 as a waste product through metabolism and there are sensors in the brainstem that monitor the rising level in the blood and trigger breathing when the CO_2 level rises sufficiently. At the same time as the CO_2 is rising, the oxygen levels are falling and the rise in CO_2 should stimulate breathing before the person becomes hypoxic.

In swimming and breath-hold diving, voluntary hyperventilation occurs when a swimmer intentionally takes a series of deep breaths venting off carbon dioxide with the greater than normal exhalations. This significantly reduces the blood CO_2 level (resulting in hypocapnia) while only marginally increasing oxygen concentrations in the blood, thus increasing the potential for blackout. Involuntary hyperventilation can occur as a result of stress and physical exertion during a workout that pushes the swimmer beyond his/her maximum aerobic capacity ($\dot{V}O_2$ max).

When a person suffers hypoxic blackout they have generally held their breath and become unconscious through lack of oxygen before the level of CO_2 has built up to the critical level to trigger the signal to breathe. If this occurs on land, the person will re-commence breathing once the CO_2 level is restored. However, in the water, the involuntary breathing by an unconscious person often results in drowning. There are documented cases of competent swimmers who lost their lives to hypoxic blackout. This is a serious issue.

Swimmers are at higher risk by doing repeat efforts of 'lung busters' or extended underwater swims, especially over set distances or times that are outside their comfort zone.

5.0 Actions:

This danger that is hypoxic blackout of otherwise healthy, accomplished swimmers should be considered by every swimming and water safety Teacher, swimming Coach, aquatic supervisors and aquatic program Manager when developing programs and when swimmers undertake hypoxic training.

Aquatic programs should follow a risk management approach to address safety and liability concerns presented by hypoxic blackout. An evaluation of the risk should occur before selecting a risk aversion or risk management strategy.

It is important to differentiate between underwater drills and those conducted on the surface of the water. As both drills can lead to hypoxic blackout, an evaluation must be made as to the likelihood or frequency of hypoxic blackout resulting from such drills as well as the possible severity of such occurrence.

6.0 Variations:

Hypoxic Training – On the Surface and/or Underwater

The risk of a swimmer losing consciousness when on the surface is lower than during underwater swimming drills. Whilst on the surface, swimmers are more likely to take a breath when needed whereas underwater they may resist the urge to breathe. Further, any loss of consciousness while swimming on the surface is more likely to be noticed by swimming Coaches or aquatic supervisors, allowing for a faster rescue response. If a swimmer loses consciousness underwater, that swimmer may go unnoticed for a period of time thereby increasing the likelihood of injury.

Common risk reduction strategies include:

- Hypoxic training should involve progressive overload, in-line with the swimmer's physical and skill development – for example, beginning with efforts over 5m, 10m, then 15m etc - as the swimmer develops the appropriate skills and physiological capacity.
- Adequate aquatic supervision is provided. Swimmers should never swim alone.
- Don't hyperventilate (take multiple, deep breaths) prior to any hypoxic training or efforts or before any underwater swims.
- Structuring sessions to minimize involuntary hyperventilation immediately prior to a hypoxic set.
- Encouraging swimmers to breathe as needed and to stay within their comfort zone
- Ensuring adequate rest for full recovery between hypoxic efforts. Recovery time will vary from swimmer to swimmer.
- Hypoxic training should not involve competitive efforts of maximum duration, or distance covered.

Underwater Drills

- Common underwater activities that can lead to hypoxic blackout include repeated underwater swims or underwater kicking drills as well as stationary breath holding competitions for time. In all instances, the nature of the risk can be high. Even with successful resuscitation, complications including hypoxic brain damage and respiratory infection can occur.
- The following considerations must be factored into hypoxic underwater training:
- Teachers and Coaches should be aware of the dangers and understand the risks of hypoxic training
- Swimmers should be instructed to surface and breathe when they feel it necessary when swimming underwater. Never resist the urge to breathe.
- Only one deep breath should be allowed prior to submersion. Hypoxic blackout is closely linked to hyperventilation.
- Underwater drills should be at the start of a workout when swimmers are not close to their maximum aerobic capacity ($\dot{V}O_2$ max).
- Allow adequate time for recovery, which will vary from swimmer to swimmer. At least a two minute recovery time should be allowed before attempting another underwater swim.
- No competitions or challenges; eg, how can swim the greatest distance underwater or hold their breath for the longest time.

Hypoxia with Age

Lung capacity is one of the functions that begin to diminish with age. Hypoxic training is unsuitable for aging athletes since no amount of hypoxic training will reverse this diminishing capacity. The hypoxic effect of breathing every seven strokes for a young athlete may be similar to that of an older person breathing every three strokes.

7.0 Conclusions:

Hypoxic training most often involves well-conditioned swimmers. Hypoxic blackout occurs without warning even in well-conditioned experienced swimmers.

Swimming Coaches should only undertake hypoxic training appropriately and must be very alert for the real and present risks associated with this activity.

Swimming and water safety Teachers should not promote or encourage breath-holding, underwater challenges or hyperventilation activities. There is no place for hypoxic training in the learn to swim environment.

Hypoxic blackout is a danger with any water activity that involves breath-holding. The dangers and risks increase when hyperventilation is undertaken prior to the activity and when the activity is underwater rather than on the surface.

As such, anyone in water is potentially at risk. Swimming and water safety Teachers, swimming Coaches and pool supervisors must remain vigilant to the precursor activities that lead to hypoxic blackout.

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