



## Scuba Diving – What Are the Risks?

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Recreational diving is a very popular sport and it is frequently disclosed by people applying for Life and Disability insurance. As scuba diving is very diverse in its practice and may harbour a variety of risk factors, it can be a very challenging risk for insurance underwriters to assess. The present article aims to provide an overview on key risks associated with diving and to help the insurance underwriter discriminate between “standard” and “sub-standard” divers from a Life and Disability insurance perspective.

### Scuba diving research

Despite the popularity of scuba diving, there is limited medical research on diving-related morbidity and mortality and there is no systematic data collection on how or why scuba divers die. The most reliable sources of information are annual diving incident reports published by diving associations – such as Diver’s Alert Network (DAN), Professional Association of Diving Instructors (PADI) and British Sub Aquatic Club (BSAC) – describing individual circumstances of diving fatalities that were reported to them. In these reports, worldwide data are collected from private and official sources. The latest reviews of these reports, summarising diving incidents in a period of 11 – 19 years, formed the basis of the current study on suspected risk factors associated with diving (DAN: 947 diving fatalities between 1992 and 2003; PADI: 409 diving fatalities between 1989 and 2008; BSAC: 187 fatalities between 1998 and 2009).<sup>1,2,3</sup>

It should be noted that it is unknown how many fatalities this reporting system misses and that in almost one third of all diving fatalities, causal factors leading to death are unknown. Furthermore, “drowning” is stated as the third most common cause of death in autopsy reports – which does not provide any hint about the underlying trigger that caused the event leading to death. Therefore, “true” fatality rates and causes of death remain elusive, and the following analyses focus on published fatality rates and diving incidents in which a cause was identified.

### The average diver

The average diver’s extra mortality is fairly low, ranging from 0.5 to 1.2 deaths per 100,000 dives.<sup>4</sup> Table 1 aims to put the diving risk into perspective by comparing it with other activities.

### Content

Scuba Diving – What Are the Risks?	1
Scuba diving research	1
The average diver	1
What makes diving risky?	2
Medical problems	2
Entrapment risk	2
Deep diving	3
Solo diving	3
Rebreather diving	3
Summary	4

### In the complete issue:

How Extreme Are Extreme Sports?
Editorial
Sporting Life – Giving Poor Health the Runaround
Scuba Diving – What Are the Risks?
Risk Assessment for Mountaineering – New Guidelines
How Safe Is Flying as a Hobby? New Evaluations Provide Answers
Sport Risks – Case Examples
Seminar Dates

From these numbers, it seems that scuba diving is not a particularly dangerous sport – which is true! And this is why we can accept most scuba divers at standard rates. However, there are certain diving activities that increase a diver’s accident risk and, subsequently, mortality and morbidity, which we have defined via literature research. Those findings will be outlined in the following sections.

### What makes diving risky?

There is a large diversity of factors leading to fatal diving incidents and the majority of factors are not predictable (see Figure 1). For example, we cannot predict the risk of running out of gas or the risk of rapid ascent or separation from the buddy. But there are some variables that may be predictable.

### Medical problems

Studies consistently show that the main cause of diving-related death is a medical problem encountered under water. There are numerous factors that increase a person’s medical risk of a fatal diving incident: Poor fitness, chronic diseases, structural abnormalities of the heart and lungs and multiple risk factors for cardiovascular disease (obesity, diabetes, hypertension, smoking, etc.). It is important to note that stressors of exercise, pressure, cold and emotional stress are all present during a dive and increase the possibility of cardiovascular disease manifesting itself – with heart disease being the main cause of death in divers.<sup>10,11</sup> To date, numerous diseases have been reported as contraindications for diving. We do not aim to describe the details here as it would go beyond the scope of this article. However, we would like to refer the interested reader to excellent publications available online (e.g. Eichhorn & Leyk, 2015; Smith, 1995; Godden, 2003).<sup>12,13</sup>

In the present article, we want to alert underwriters to combine medical and non-medical assessments in people disclosing a diving pursuit. To put it simply, if a person is sick and has been assessed with significant extra mortality as per medical assessment, the death risk gets much more severe when this person dives, and we should carefully consider whether we want these risks in our insurance portfolio.

### Entrapment risk

Entrapment describes the situation when a diver gets caught in fishing nets, caves, wrecks, mooring lines or under ice – and this risk is a relevant

trigger of fatal diving accidents. Wreck diving and cave diving, for example, are identifiable entrapment risks.

### Wreck diving

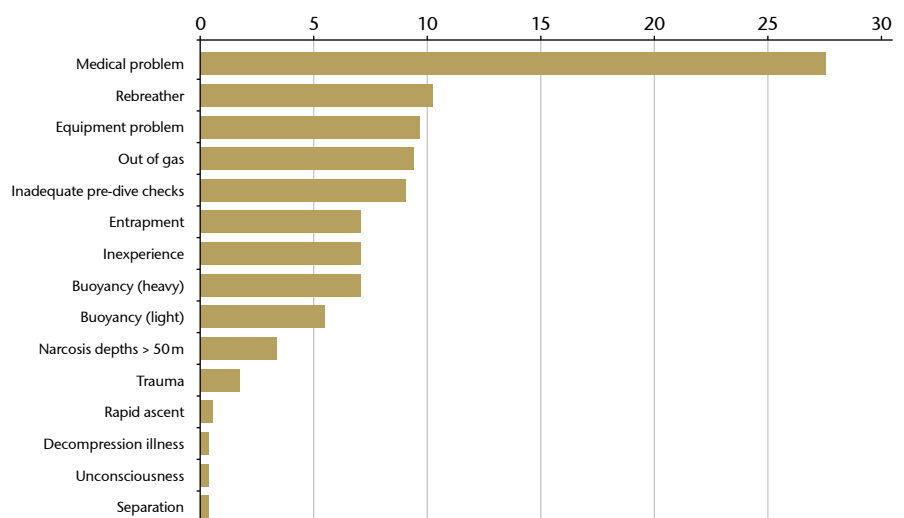
Wrecked ships and aeroplanes act as artificial reefs attracting a variety of marine life and offering archaeological and historic appeal for divers. Increasingly, ships are deliberately sunk and diver safety is improved with many of the hazards



**Table 1 : Average risk of death as a consequence of an activity<sup>5,6,7,8</sup>**

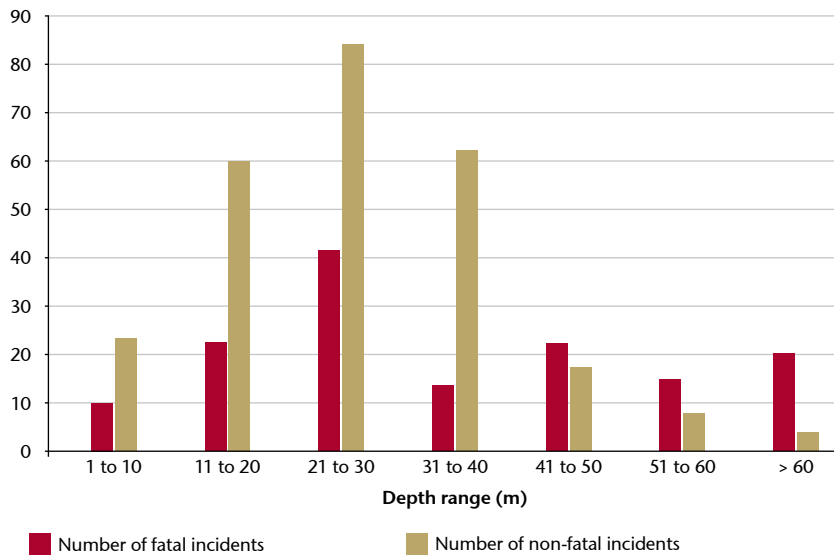
	Death per activity	
Base jumping	1 in 2,314	Jumps
Kite surfing	1 in 16,666	Hours of practice
Diving with closed-circuit rebreather	1 in 18,750	Dives
Sky diving	1 in 101,000	Jumps
Hang gliding	1 in 116,000	Flights
Horse riding	1 in 175,418	Rides
Surgical anaesthesia	1 in 185,000	Operations
Scuba diving (all diving activities)	1 in 200,000	Dives
Rock climbing	1 in 320,000	Climbs
Canoeing	1 in 750,000	Outings
Aircraft accident	1 in 125,000,000	Passenger journeys

**Figure 1: Causal factors leading to fatal diving incidents<sup>9</sup>**



Source: After Cumming, Peddie & Watson, 2009, BSAC – British Sub-Aqua Club

**Figure 2: A comparison of the depths of fatal and non-fatal diving incidents.<sup>16</sup>**



Source: Cumming, Peddie & Watson, 2009, BSAC – © British Sub-Aqua Club

removed. Wreck diving is usually done under controlled conditions and in guided tours and can be considered as a standard risk.

### Cave diving

This sport involves the exploration of natural or artificial caves that are totally or partially filled with water and present a number of hazards. Typically, there is only a single point of entry or exit, and visibility can be low due to missing daylight or vision can be exacerbated by stirred up mud or sand. Underwater navigation through a cave system can be difficult particularly as routes are often complex and strong currents can be encountered. Cave divers are considered a high-risk group<sup>14</sup> and are clearly to be rated as a sub-standard risk.

With people who disclose cave diving, it is important that the underwriter notes the difference between caves and caverns. Caverns are defined as permanent, naturally occurring overhead environments in which the entrance remains within sight. Daylight floods caverns and no artificial lights are needed for

exploration and emergency ascent is possible. We consider cavern diving as a standard risk.

### Deep diving

A study from BSAC shows that a diver's risk of death increases the deeper a person dives. Figure 2 depicts maximum depths in which diving incidents occurred. The numbers show that 89% of all diving activities take place in 0–40 metres depth and 62% of the fatalities occur in this range. Depths below 40 metres are entered by only 11% of divers whereas 38% of diving deaths occur in these depths.<sup>15</sup> Based on these numbers, the risk of dying is 3.5 times higher when diving deeper than 40 metres. Thus, there seems to be a clear bias towards the deeper depths and people who dive in great depth should be rated as a sub-standard risk.

### Solo diving

It has been reported that solo diving has a ten times higher fatality rate compared to pair diving and we recommend rating solo divers as a sub-standard risk.

### Rebreather diving

A rebreather is a breathing apparatus that absorbs the carbon dioxide in the diver's exhaled breath to enable rebreathing of the unused oxygen content of each breath. Additional oxygen is added to replace the amount metabolised by the user. Before 1999, rebreathers were used only by military and professional divers but they are today widely available to recreational divers. They are increasingly popular as they enable longer, deeper dives. Rebreather divers have recently been classified as a high-risk diving group by the Diver's Alert Network.<sup>17</sup> Rebreathers have a 25-fold increased risk of component failure and fatalities have increased since 2000, accounting for about 6% of known diving deaths. A comprehensive study comparing closed-circuit rebreather diving with open-circuit



scuba diving states that rebreather divers have a fatality rate between three and seven deaths per 100,000 dives;<sup>18</sup> this is around ten times higher than “normal” scuba diving! In view of the increasing trend in terms of popularity and fatality, we would recommend to accept rebreather divers as a sub-standard risk.

## Summary

Divers with the smallest accidental risk are experienced divers who are physically fit, do not dive in great depth, have no history of being risk takers, do not have any health problems, do not dive with a rebreather and do not partake in any technical dives, e.g. in caves or under ice. Speaking in insurance terms, these people can be offered standard rates.

The loadings for the sub-standard risks are not specified in the present article; detailed rating suggestions based on the above outlined literature research will be provided in the next update of our underwriting manual CLUE.

## Endnotes

- 1 Richardson, D. (2010). Training scuba divers: A fatality and risk analysis. DAN Diving Fatality Workshop 8–10 April, 2010. <http://d35gjurz1vdcl.cloudfront.net/ftw-files/Day1/Evidence/5.pdf> (accessed 2 October 2015).
- 2 Cumming, B., Peddie, C., Watson, J. (2009). A review of the nature of diving in the UK and of diving fatalities in the period 1998–2009. British Sub-Aqua Club (BSAC).
- 3 Denoble, P.J. et al. (2008). Common causes of open circuit recreational diving fatalities. Undersea Hyperbaric Medical Journal (UHM), 35 (6), 393–406. <http://www.diversalertnetwork.org/files/DivingFatalityCauses.pdf> (accessed 2 October 2015).
- 4 Ibid at Note 1, 2 and 3.
- 5 Bandolier (2010). Risk of dying and sporting activities. <http://www.medicine.ox.ac.uk/bandolier/booth/Risk/sports.html> (accessed 2 October 2015).
- 6 HSE Books. (2001). Reducing risks, protecting people: HSE’s decision-making process. [http://www.hse.gov.uk/risk/theory/r2\\_p2.pdf](http://www.hse.gov.uk/risk/theory/r2_p2.pdf) (accessed 2 October 2015).
- 7 Fock, A.W. (2013). Analysis of recreational closed-circuit rebreather deaths 1998–2010, Diving and Hyperbaric Medicine, 43 (2), 78–85.
- 8 Nickel, C. et al. (2004). A prospective study of kitesurfing injuries. The American Journal of Sports Medicine, 32 (4), 921–927.
- 9 Ibid at Note 2.
- 10 Eichhorn, L. & Leyk, D. (2015). Diving Medicine in Clinical Practice. Deutsches Ärzteblatt International, 112, 147–58. <http://www.aerzteblatt.de/int/archive/article?id=168301> (accessed 2 October 2015).
- 11 Smith, N. (1995). Scuba Diving: how high is the risk? Journal of Insurance Medicine, 27 (1). <http://aaim.developmentwebsite.ca/journal-of-insurance-medicine/jim/1995/027-01-0015.pdf> (accessed 2 October 2015).
- 12 Ibid at Note 12 and 13.
- 13 Godden, D. (2003). British Thoracic Society guidelines on respiratory aspects of fitness for diving. Thorax, 58 (3). <http://thorax.bmj.com/content/58/1/3.full> (accessed 2 October 2015).
- 14 Brock, D. (2006). The Learning Curve: A Quantitative Analysis of Fatal British Cave Diving Incidents from 1980 to 2005. <http://www.cavedivinggroup.org.uk/Articles/TheLearningCurve060427.pdf> (accessed 2 October 2015).
- 15 Ibid at Note 2.
- 16 Ibid at Note 2.
- 17 Diver’s Alert Network (2015). Research Updates. <https://www.diversalertnetwork.org> (accessed 2 October 2015).
- 18 Ibid at Note 8.

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