

THE ASSOCIATION BETWEEN LEVEL OF EXPERIENCE AND KNOWLEDGE, ATTITUDE, PREVENTIVE PRACTICE OF DECOMPRESSION SICKNESS AMONG DIVING INSTRUCTORS AND DIVERS IN BALI

Putu Ayu Diah Laksmi Utami¹, I Made Muliarta², Luh Putu Ratna Sundari², I Putu Adiartha Griadhi²

¹. Bachelor of Medicine, Faculty of Medicine, Udayana University, Bali, Indonesia,

². Department of Physiology, Faculty of Medicine, Udayana University, Bali, Indonesia

e-mail: made_muliarta@unud.ac.id

ABSTRACT

Introduction: Behavioral factors such as knowledge, attitudes, and preventive practices have an important role in health outcomes, as seen in decompression sickness, which can affect quality of life. This study aimed to determine the association between experience level with knowledge, attitude, and preventive practices of DCS among beginner divers and experienced divers in Bali. **Methods:** This cross-sectional study was conducted from January to October 2024 among divers and dive instructors in Bali aged 18-65 years old and had been actively diving in past two years. A 54-item questionnaire was developed to evaluate knowledge (17 items), attitude (18 items), and preventive practice (19 items) related to DCS. KAP scores were categorized as good or poor, based on 80% cut-off. The association between experience level and KAP scores was assessed by Chi-Square and Spearman's rho correlation. **Results:** The proportion of both beginner divers and experienced divers with a good knowledge was 88.0%, a good attitude was 84.0%, and a good preventive practice was 85.0%. Divers who have a higher experience level were more likely to achieve better KAP score. Level of experience was significantly and positively associated with a good knowledge ($r=0.606$, $P<0.001$), a good attitude ($r=0.623$, $P<0.001$), and a good preventive practice ($r=0.769$, $P<0.001$) among beginner divers and experienced divers in Bali, although variations among individuals must be considered. **Conclusion:** There is an association between experience level with knowledge, attitude, and preventive practice of decompression sickness among beginner and experienced divers in Bali, with experienced divers having a higher KAP score.

Keywords : decompression sickness, knowledge, attitude, preventive practices, divers, diving instructors.

INTRODUCTION

Decompression sickness (DCS) is an abnormal condition characterized by the formation of gas bubbles in the blood or tissues as a result of a significant drop in ambient pressure, potentially causing poor tissue perfusion in a variety of locations, including joints, lungs, blood vessels, and bones, and resulting in a range of clinical symptoms that develop gradually within one to six hours of the surface^{1,2}. Although DCS can occur at any age and in varying degrees of severity, it has the potential to impair cardiovascular, respiratory, neurological, and even death³. Data on the prevalence of DCS cases is difficult to get because the symptoms are minor, causing most people to disregard them as suggestive of a specific ailment. The severity can be adjusted by diving methods that allow divers to mitigate dangers. According to the Divers Alert Network (DAN), the global DCS incidence is 35.3 per 10,000 commercial divers⁴. Type II DCS affects 2.28 out of 10,000 dives in the United States, although type I data is less well documented. According to investigations conducted by the Indonesian Ministry of Health on Bungin Island, West Nusa Tenggara, 57.5% of traditional divers reported joint pain, 11.3% experienced mild hearing loss, and numerous other symptoms

were observed, including paralysis and unconsciousness. There was also a study with 251 replies that found that 56.6% of conventional divers used breath-hold techniques, 33.9% of compressor divers, and 9.6% used SCUBA. The recorded complaints were 21.2% headache, 12.6% malaise, 12.5% reduced hearing, 10.8% joint pain, and others reported nose bleeding, chest tightness, decreased vision, red spots on the skin, paralysis, and loss of consciousness⁵⁻⁹.

Bali, a popular diving destination with a coastline of 633.35 kilometers and a breathtaking underwater landscape has the potential to become an aquatic tourism destination that can be used by the local people to support the economy. The increase in tourism in coastal areas undoubtedly benefits the community's economy, but it must be done with workers' safety and security in mind¹⁰. Furthermore, the safety of diving methods, instruments used, and the understanding of connected actors must all comply with laws to reduce the risk of diving-related injuries, such as DCS. Divers and dive instructors who perform repetitive dives as part of their jobs may be exposed to DCS, thereby jeopardizing their quality of life^{1,11,12}. As diving activities, such as recreational and technical diving, grow in popularity, a thorough understanding of DCS will become increasingly important.

According to data from Prof. Ngoerah General Hospital in Bali, there were 250 instances of DCS in 2018. However, between 2020 and 2022, the number of cumulative cases decreased to 19 cases.

Lawrence Green's health paradigm emphasizes behavioral and non-behavioral factors that influence health. Diving instructors and divers with extensive knowledge and a positive attitude toward DCS prevention are expected to consistently implement preventive practices to reduce the risk of DCS, such as adhering to decompression procedures, staying within dive time limits, and monitoring themselves or dive groups. Based on this, and given the urgency of DCS cases, it is critical to investigate the relationship between experience level and the degree of knowledge, attitude, and practices of decompression sickness prevention among dive instructors and divers in Bali, to create a safer diving environment by increasing risk awareness and lowering the incidence of DCS among divers, resulting in better long-term health outcomes during dives.

Knowledge, Attitude, and Preventive Practice of Decompression Sickness in Diving Instructors and Divers

Knowledge is the result of human perception of an object and plays a critical role in shaping actions. According to Notoatmojo, knowledge within the cognitive domain consists of six levels: knowing, comprehension, application, analysis, synthesis, and evaluation. These levels range from defining and interpreting principles to applying, analyzing, synthesizing, and assessing materials or objects. Knowledge about DCS includes understanding and evaluating its definition, causes, symptoms, risk factors, preventive measures, and first-aid management. A good level of knowledge forms the foundation for safe decision-making during diving. Attitude refers to the evaluation or emotional response, either supportive or unsupportive, toward objects, events, people, or ideas. It encompasses feelings, beliefs, and behavioral tendencies. Positive attitudes toward DCS prevention involve adhering to safe diving protocols, such as observing physiological limits and conducting safety stops. Attitudes develop through stages that include receiving, responding, valuing, and assuming responsibility. Shaped by values and experiences, attitudes influence compliance with safety protocols and can lead to actionable practices. Preventive practice is defined as the response to stimuli through preventive actions informed by knowledge and attitude¹³. The development of practice begins with perception, progresses to guided responses following instructions, and eventually becomes automatic and accurate execution. Over time, these practices can be adopted and modified for improved quality. Knowledge, attitude, and preventive practice in DCS are influenced by both internal and external factors. Internal factors include education, experience, health status, risk awareness, and interest. Higher levels of education, whether formal or through specialized training, enhance understanding of safety protocols. Repeated dives improve practical knowledge and foster disciplined behaviors toward risk prevention. Awareness of physical health conditions strengthens adherence to safety protocols, while understanding the

consequences of DCS often motivates deeper engagement in preventive practices. External factors include access to information, environmental influences, and cultural or social support. Advances in technology, training resources, and literature provide divers with better tools to understand and apply preventive measures. Social interactions within supportive communities and diving teams reinforce safe practices, while environments with strict safety policies foster greater adherence to protocols.

The assessment of knowledge, attitude, and practice levels is typically conducted through questionnaires or interviews, with scores categorized based on Bloom's taxonomy. A score of 80%–100% is classified as good, 60%–79% as moderate, and below 60% as poor. This structured understanding highlights the significance of both individual and external factors in fostering effective DCS prevention among divers.

Decompression Sickness

Decompression sickness, also known as caisson disease, is a syndrome caused by the accumulation of inert gas bubbles resulting from an imbalance in gas exchange due to significant environmental pressure changes¹⁴. This condition is closely linked to occupational hazards for divers, underwater workers, astronauts, and individuals exposed to high-pressure environments. According to Henry's Law, the concentration of a dissolved gas in a liquid is proportional to the gas's partial pressure. During a dive, elevated environmental pressure causes more gases to dissolve in blood and tissues to maintain equilibrium. For divers, this means that the deeper they dive, the higher the environmental pressure, resulting in increased dissolved gas concentrations in their blood. A rapid ascent disrupts this equilibrium, leading to bubble formation in tissues and circulation, similar to opening a soda bottle. These bubbles can obstruct blood flow, irritate tissues, and induce inflammation. Tissue damage may result from blood flow blockages, vascular spasms, and endothelial injury, triggering clotting cascades and inflammatory responses. In severe cases, nitrogen under high partial pressures (above 4 ATA, equivalent to a 30-meter depth) can act as an anesthetic, causing nitrogen narcosis, a temporary mental disturbance similar to nitrous oxide intoxication.

Risk factors for DCS are categorized into activity-related, environmental, and individual factors. Activity-related risks include dive frequency, duration, decompression speed, and the type of gas used¹⁵. Environmental factors encompass challenging conditions such as greater dive depths and colder water temperatures, which increase nitrogen absorption and bubble formation during ascent. Individual factors, such as age, gender, occupation, congenital abnormalities, and physical condition during the dive, also influence DCS susceptibility, as individual tolerance to diving conditions varies.

Decompression sickness can be classified into two primary types based on the severity and affected systems, such as type I and type II^{16,17}. Type I DCS primarily involves the skin, musculoskeletal system, or lymphatic system, with symptoms such as muscle pain (myalgia), joint pain (arthralgia), skin rashes, itching, nausea, and general discomfort (malaise). These

symptoms are considered mild to moderate and typically resolve within 4-5 days. Type II DCS, in contrast, is more severe and affects the central nervous system, cardiovascular system, and respiratory system. Symptoms may include breathing difficulties, chest pain, and neurological issues such as paresthesia, paraplegia, ataxia, visual disturbances, and even loss of consciousness. These symptoms often appear more quickly after surfacing and can result in permanent damage if untreated. Arterial gas embolism (AGE) is another critical condition associated with DCS, caused by trapped compressed gas rupturing the alveolar-capillary membrane and entering the pulmonary bloodstream. If untreated, this can lead to severe endothelial damage, inflammation, and plasma leakage, posing a fatal risk. Diagnosis of DCS is primarily clinical, incorporating patient history (e.g., recent diving activities, depth, and decompression procedures), physical examination (musculoskeletal, respiratory, cardiovascular, neurological systems), and supplementary tests. These may include blood gas analysis, urine analysis, ultrasound, radiology (X-ray), and neuroimaging (MRI or CT scans) to confirm the diagnosis and severity^{16,18,19}. Prognosis depends on the severity, timely diagnosis, and treatment. Mild type I DCS generally has a good prognosis, while type II DCS, particularly with neurological involvement, carries a more uncertain outlook, potentially resulting in permanent damage or fatal outcomes.

Management of DCS involves a combination of definitive treatment, non-pharmacological, and pharmacological approaches to address symptoms, prevent worsening, and improve outcomes. The gold standard treatment is hyperbaric oxygen therapy (HBOT), which involves administering pure oxygen under high pressure to dissolve nitrogen bubbles, enhance oxygen delivery to tissues, and promote healing^{20,21}. Non-pharmacological treatment include immediately ceasing further diving, ensuring adequate hydration, keeping the patient calm, and avoiding significant pressure changes to prevent exacerbation. While not the primary approach, pharmacological treatments can be used to alleviate symptoms and are often combined with HBOT for a more comprehensive management strategy.

MATERIAL AND METHODS

A cross-sectional study was conducted in several diving sites in Bali, Indonesia, from January to October 2024. This study's aim was to determine the association between the experience level and knowledge, attitude, and preventive practices of decompression sickness within a sample of beginner divers and experienced divers in Bali. This study included both divers and dive instructors aged 18-65 who had been actively diving in the past two years. The samples were categorized into beginner divers and experienced divers, where professional divers and diving instructors were included in the experienced diver category. The appropriate sample size was determined for hypothesis testing of two different proportions (Lemeshow, 1997), with a minimum required sample size (n) of 74 samples and an acceptable margin of error of 0.5% at 95% confidence. The volunteers were given a briefing on the procedure in clear language before completing the questionnaire, and they were given 30 minutes to complete the

questionnaires. The sampling of this study used a two-stage sampling method, the first stage of non-probability sampling by taking consecutive sampling or all subjects who matched the inclusion criteria would be included in the study until the required number of subjects was met, then continued with the second stage of simple random sampling using a randomization tool to select the final sample, so that it was expected that each subject had the same opportunity to be selected as a research sample.

The KAP questionnaire was created based on previous research²², and it has been tested for validity with a reliability value of 0.937. A 54-item questionnaire was used to assess DCS-related knowledge (17 items), attitude (18 items), and preventive practices (19 items). KAP scores were categorized as good or poor levels, based on 80% Bloom's cut-off. The level of knowledge, attitude, and practices of DCS prevention among beginner divers and experienced divers was assessed using a scoring system. Knowledge level scores ranging from 0 to 13 (<80%) received poor criteria, while scores 14 to 17 (>80%) received good criteria. Attitude scores ranging from 18 to 61 (<80%) received deficient criteria, while scores 62 to 72 (>80%) received good criteria. Prevention practice scores ranging from 0 to 30 (<80%) received insufficient criteria, while scores 31 to 38 (>80%) received good criteria.

Data analysis was performed using SPSS software, including descriptive statistics, Chi-Square, and Spearman's rho correlation. The correlation test was conducted to quantitatively describe direction and strength of the association between experience level and KAP scores. This study has been received ethical approval by the Ethics Committee of the Faculty of Medicine at Udayana University/Prof. Ngoerah Hospital in Denpasar, Bali, under the reference number 0422/UN14.2.2.VII.14/LT/2024.

RESULTS

Table 1. Characteristics of the research sample the association between level of experience and level of knowledge, attitude, and prevention practice of decompression sickness in diving instructors and divers in Bali

Variables	f (%)
Age	
Early adulthood (18-35 years)	26 (26.0)
Late adulthood (36-45 years)	59 (59.0)
Middle age (46-60 years)	15 (15.0)
Gender	
Male	88 (88.0)
Female	12 (12.0)
Level of Education	
Elementary school	2 (2.0)
Junior high school	0 (0)
Senior high school	88 (88.0)
University	10 (10.0)
Level of Experience	
Beginner diver (<2 years)	19 (19.0)
Experienced diver (>2 years)	81 (81.0)
Smoking history	
Yes	75 (75.0)
No	25 (25.0)

There were 100 research samples from 120 respondents who met the inclusion criteria and did not meet the exclusion criteria obtained through the two-stage sampling method. The characteristics of the research sample in the form of age, gender, education level, experience level, and smoking history are presented in the table.

Table 2. Distribution of level of knowledge, attitude, and prevention practice of decompression sickness among beginner divers and experienced divers in Bali

Variables	f (%)
Knowledge	
Poor (<80%)	12 (12.0)
Good (>80%)	88 (88.0)
Attitude	
Poor (<80%)	16 (16.0)
Good (>80%)	84 (84.0)
Prevention Practices	
Poor (<80%)	15 (15.0)
Good (>80%)	85 (85.0)

Most of the answers to measure the level of knowledge of respondents regarding the definition of etiology (items 1, 2, and 4), risk factors (items 3, 5, 8, 10, 11, and 13), clinical symptoms (items 15 and 16), preventive measures (items 6, 7, 9, and 14), and DCS management (items 12 and 17) can be answered correctly and obtained an average knowledge level score of 16.01 (SD: 1.96, Range: 8-17). This is also consistent with the responses from respondents regarding

their attitude towards various statements, including risk factors (items 4, 6, 11, and 13), clinical symptoms (items 3 and 10), preventive measures (items 1, 2, 7, 8, 9, 14, 15, 16, and 18), and therapeutic management and DCS first aid (items 5, 12, and 17). These responses yielded an average attitude score of 65.33 (SD: 4.21, Range: 50-71). Meanwhile, the average score of prevention practice is 35.15 (SD: 4.30, Range: 20-38).

The analysis results indicate that respondents with experienced divers tend to have higher levels of knowledge, attitude, and preventive practices than beginner divers. Based on the knowledge level of all beginner divers, only 47.4% had good knowledge. This is also reflected in better attitude and prevention practices in experienced divers compared to beginner divers, with the proportion of all beginner divers, there are only about 36.8% who have good attitude and 26.3% who are classified as having good prevention practices. In the percentage of knowledge level in the good category, there was a considerable difference between beginner divers (47.4%) and experienced divers (97.5%) by 50.1%. In addition, the p-value was found to be <0.05, which means it is significant that the proportion of knowledge level between beginner divers is a statistically significant difference between experienced divers. This also aligns with the attitude and preventive practices suggested by the table's findings.

Table 3. Associations between levels of experience and level of knowledge, attitude, and prevention practice of decompression sickness among beginner divers and experienced divers in Bali

Variables	Good	Poor	PR	95% CI	P Value
	f (%)	f (%)			
Level of experience with level of knowledge					
Beginner divers (<2 years)	9 (47.4)	10 (52.6)	21.316	5.083-89.395	.000
Experienced divers (>2 years)	79 (97.5)	2 (2.5)			
Level of experience with attitude					
Beginner divers (<2 years)	7 (36.8)	12 (63.2)	12.789	4.633-35.302	.000
Experienced divers (>2 years)	77 (95.1)	4 (4.9)			
Level of experience with prevention practice					
Beginner divers (<2 years)	5 (26.3)	14 (73.7)	59.684	8.354-426.385	.000
Experienced divers (>2 years)	80 (98.8)	1 (1.2)			

Abbreviations: PR : prevalence ratio; CI : confidence interval

The results show that a good level of knowledge will tend to have good attitude and prevention practices as well, namely 93.2% and 92.0%, while a poor level of knowledge will tend to have poor attitude and prevention practices, namely 83.3% and 56.3%. This is also in line with attitude

towards prevention practices, where good attitude will tend to have good prevention practices as well, and vice versa. Of all respondents who had good attitude, only 5.9% had poor prevention practices.

Table 4. Associations between level of knowledge, attitude, and prevention practice of decompression sickness among beginner divers and experienced divers in Bali

Variables	Good f (%)	Poor f (%)	PR	95% CI	P Value
Level of knowledge with attitude					
Good	82 (93.2)	6 (6.8)	12.222	5.422-27.551	.000
Poor	2 (16.7)	10 (83.3)			
Level of knowledge with prevention practice					
Good					
Poor	81 (92.0)	7 (13.2)	8.381	3.708-18.945	.000
	4 (33.3)	8 (66.7)			
Attitude with prevention practice					
Good	78 (92.9)	6 (7.1)	7.875	3.254-19.060	.000
Poor	7 (43.7)	9 (56.3)			

Abbreviations: PR : prevalence ratio; CI : confidence interval

The analysis showed a moderate positive association between the level of experience and the level of knowledge which proved significant ($r=0.606$, $p<0.001$), the result was also consistent with an association between the level of experience and attitude ($r=0.623$, $p<0.001$). However, the association between the level of experience and preventive practices showed a strong positive association ($r=0.796$, $p<0.001$). The analysis revealed a moderate positive

association between the level of knowledge and attitude, which was statistically significant ($r=0.678$, $p<0.001$). A similar moderate positive association was found between the level of knowledge and preventive practices ($r=0.534$, $p<0.001$). Additionally, a moderate positive correlation was observed between attitude and preventive practices ($r=0.504$, $p<0.001$).

Table 5. Correlation level of experience, level of knowledge, attitude, and prevention practice of decompression sickness among beginner divers and experienced divers in Bali

Variables	Total n = 100 Spearman's correlation (r)	P Value
Level of experience with level of knowledge	0.606*	.000
Level of experience with attitude	0.623*	.000
Level of experience with prevention practice	0.796*	.000
Level of knowledge with attitude	0.678*	.000
Level of knowledge with prevention practice	0.534*	.000
Attitude with prevention practice	0.504*	.000

* $p<0.01$ was considered statistically significant.

DISCUSSION

Awareness of the risk factors of decompression sickness can be reflected through the level of knowledge, attitude, and preventive practices during diving. A good level of knowledge regarding DCS is expected to reduce the risk of its occurrence by enabling dive instructors and divers to understand its etiology, risk factors, symptoms, preventive measures, and necessary management, divers can take a stance to identify high-risk situations, appropriate precautions, and respond effectively when DCS occurs^{16,23}. This study describes the association between the level of experience and the knowledge, attitude, and practice of DCS prevention among beginner divers and experienced divers in Bali. The proportion of research samples based on the level of experience may affect the variability of data obtained regarding the level of knowledge, attitude, and preventive practices of DCS.

The results showed that most respondents had a good level of knowledge (88.0%), this is in line with research in Makassar City, which also found that divers' knowledge level regarding DCS was categorized as good²². The results of the level of knowledge in this study can be influenced by the characteristics of the sample, which mostly came from the group of professional divers and diving instructors with more than two years of experience (81.0%). This result is also supported by research on the level of knowledge of divers in Saudi Arabia, where 94.27% of divers have a good level of knowledge²⁴. The chi-square test showed there is a significant association between the level of experience and the level of knowledge related to DCS (PR=21.316; 95% CI: 5.083-89.395; $p<0.05$). Based on correlation analysis of the two variables, it was found that there is a possibility that the level of experience variable affects the level of knowledge about DCS, but it is not the only factor that determines the level of knowledge, so it must still consider several factors, such as individual variation²⁵.

Based on attitude, most respondents had a good attitude (84.0%), with the majority of them having experience levels as professional divers and diving instructors. This result was inversely proportional to the attitude at the beginner diver experience level, where 63.2% scored poor attitude out of all beginner diver respondents. This difference in attitude results from experience level could be due to practical experience, risk awareness, or professional interests. Divers with more than two years of experience tend to develop a more positive attitude due to exposure to real risks and the realization that if safety protocols are not followed, there is the potential for certain consequences²⁶⁻²⁸. Analysis of the association between experience level and attitude showed significant results (PR=12.789; 95% CI: 4.633-35.302; $p<0.05$), and a moderate positive correlation was obtained through the correlation test that there is a possibility that the experience level variable can influence attitude. In addition, a good level of knowledge can also influence a positive attitude toward DCS prevention (PR=12.222; 95% CI: 5.422-27.551; $p<0.05$). The analysis results indicate that as many as 93.2% of respondents with a good level of knowledge have a positive attitude toward DCS prevention. In-depth knowledge of DCS leads to an awareness of the risks so that divers tend to have a positive attitude towards DCS. Conversely, some beginner divers have less knowledge about the potential risks of DCS, resulting in an attitude that tends to be lacking, which is supported by several related studies^{29,30}.

Prevention practices result from attitude converted into actions, which are influenced by supporting factors like experience. The results aligned with the level of knowledge and attitude, indicating that the majority of respondents (85%) had effective prevention practices. Based on the level of experience, 98.8% of all experienced divers had good prevention practices, while only 26.3% of all beginner divers had good prevention practices. Analysis of the association between experience level and prevention practices showed significant results (PR=59.684; 95% CI: 8.354-426.385; $p<0.05$). Based on Spearman's rho correlation analysis of the two variables, a strong positive association was obtained, so there is a possibility that the experience level variable affects DCS prevention practices. A good level of knowledge can also influence DCS prevention practices, as evidenced by the fact that up to 92.0% of respondents with a high level of knowledge have effective DCS prevention practices. The results of the correlation test also revealed a moderate positive correlation, which proved to be significant. This result is also in line with research that states that there is a level of knowledge that has an indirect influence on diving behavior³⁰. In addition, a positive attitude towards DCS can also affect prevention practices, where it was found that 92.9% of respondents with good attitude had good prevention practices as well. The association between these two variables was proven significant with a moderate positive correlation. A good attitude plays an important role in determining how well a diver implements DCS prevention practices. A positive attitude toward dive safety not only demonstrates an awareness of risk, but also encourages divers to practice more effective and disciplined prevention measures.

CONCLUSION AND RECOMMENDATION

This study confirmed that there is an association between experience level and knowledge, attitude, and preventive practice of decompression sickness among beginner divers and experienced divers in Bali, with professional divers and diving instructors having a higher KAP score. This study focuses on both beginner divers, experienced divers to provide a comprehensive view of how experience influences knowledge, attitude, and practices. However, due to the disproportionate sample distribution, which included more experienced divers, the results may have been overestimated. Furthermore, self-reported questionnaires can lead to the possibility of information bias and potentially exaggerating positive results, however, this has been minimized by conducting the questionnaire method with supervision. In addition, this research also did not further assess internal and external factors that could potentially affect the results of the study, such as diving behavior and DCS history. The research can be continued with a larger, more diverse sample size, and balanced sample representation to obtain more comprehensive results.

ACKNOWLEDGEMENT

The author gratefully acknowledges the volunteers, Scuba Go Dive Center, and Baruna Scientific Diving Club Udayana University, whose participation was essential to this study.

REFERENCES

1. Kohshi K, Denoble PJ, Tamaki H, Morimatsu Y, Ishitake T, Lemaître F. Decompression Illness in Repetitive Breath-Hold Diving: Why Ischemic Lesions Involve the Brain?. *Frontiers in Physiology* [Internet]. 2021 Sep 3 [cited 2024 Nov. 16];12:711850. Available from: <https://doi.org/10.3389/fphys.2021.711850>
2. Tawar A, Gokulakrishnan P. Decompression Illness. *Journal of Marine Medical Society* [Internet]. 2019 Dec [cited 2024 Nov. 16];21(2):112-115. Available from: https://doi.org/10.4103/jmms.jmms_32_19
3. Chevasutho P, Premmaneesakul H, Sujiratanana A. Descriptive Study of Decompression Illness in A Hyperbaric Medicine Centre in Bangkok, Thailand from 2015 to 2021. *Diving Hyperb Med* [Internet]. 2022 December 20 [cited 2024 Nov. 16];52(4):237-244. Available from: <https://doi.org/10.28920/dhm52.4.277-280>
4. Pollock NW, Buteau D. Updates in Decompression Illness. Vol. 35, *Emergency Medicine Clinics of North America* [Internet]. 2017 May [cited 2024 Nov. 16];35(2):301-319. Available from: <https://doi.org/10.1016/j.emc.2016.12.002>
5. Dewi NW, Sutanegara KDP, Praramdana MN, Kasiron R Al, Zulkarnaen DA. Decompression Sickness Tipe 1 pada Nelayan Tradisional: Sebuah Tinjauan Pustaka. *Biocity Journal of Pharmacy Bioscience and Clinical Community* [Internet]. 2023 Apr 30 [cited 2024 Nov. 16];5(1):1-10. Available from: <https://doi.org/10.30605/bjpp.v5i1.12345>

- 16];1(2):81-88. Available from: <https://doi.org/10.30812/biocity.v1i2.2523>
6. Duke HI, Rahayu Widyastuti S, Hadisaputro S, Chasani S. Pengaruh Kedalaman Menyelam, Lama Menyelam, Anemia Terhadap Kejadian Penyakit Dekompresi Pada Penyelam Tradisional. *J Kesehat Masy Indones* [Internet]. 2017 [cited 2024 Nov. 16];12(2):12–18.
7. Jusmawati, Arsin AA, Naiem F. Risk Factors of Decompression Sickness in Traditional Divers of a Fishing Community in Saponda Island. *Jurnal MKMI* [Internet]. 2016 Jun [cited 2024 Nov. 16];12(2):63-69.
8. Hutomo FP, Prasetyo MZ, Fariqhan DZ, Atmaja IMB, Ambarah GZ, Utomo DH, et al. Stroke Terkait Penyakit Dekompresi pada Penyelam. *Lombok Medical Journal* [Internet]. 2023 Mar 21 [cited 2024 Nov. 16];1(3). Available from: <https://doi.org/10.29303/lmj.v1i3.848>
9. Russeng SS, Saleh LM, Syafar M, Rais M. Decompression Sickness Indicators in Traditional Divers in Bajo, Boalemo District. *Medico Legal Update* [Internet]. 2020 Jul 24 [cited 2024 Nov. 16];20(3):794-799. Available from: <https://doi.org/10.37506/mlu.v20i3.1498>
10. Sudiarta IK. Evaluation of Service Quality of Diving Tourism in Bali, Indonesia. *E-Journal of Tourism* [Internet]. 2024 Mar 30 [cited 2024 Nov. 16];11(1):55–66. Available from: <https://doi.org/10.24922/eot.v11i1.111114>
11. Dunford RG, Denoble PD, Forbes R, Pieper CF, Howle LE, Vann RD. A Study of Decompression Sickness Using Recorded Depth-Time Profiles. *Undersea Hyperb Med* [Internet]. 2020 [cited 2024 Nov. 16];47(1):75-91. Available from: <https://doi.org/10.22462/01.03.2020.9>
12. Blogg SL, Tillmans F, Lindholm P. The Risk of Decompression Illness in Breath-Hold Divers: A Systematic Review. *Diving and Hyperbaric Medicine* [Internet]. 2023 Mar 31 [cited 2024 Nov. 16];53(1):31-41. Available from: <https://doi.org/10.28920/dhm53.1.31-41>
13. Putri LKM, Damayanti PAA, Diarthini NLPE. Pengetahuan, Sikap, dan Perilaku Terhadap Demam Berdarah Dengue pada Wisatawan di Kecamatan Ubud, Gianyar, Bali. *E-Jurnal Medika Udayana* [Internet]. 2022 Mar 21 [cited 2024 Nov. 16];11(3). Available from: <https://ojs.unud.ac.id/index.php/eum/article/download/66880/43634>
14. Mitchell SJ, Bennett MH, Moon RE. Decompression Sickness and Arterial Gas Embolism. *N Engl J Med* [Internet]. 2022 Mar 31 [cited 2024 Nov. 16];386(13):1254-1264. Available from: <https://doi.org/10.1056/NEJMr2116554>
15. Ahmad A, Gobel FA, Mahmud NU. Faktor Risiko Terjadinya Dekompresi pada Penyelam di Kabupaten Kepulauan Selayar. *J Muslim Community Heal* [Internet]. 2023 [cited 2024 Nov. 16];4(4):23-35. Available from: <https://doi.org/10.52103/jmch.v4i4.1313>
16. Cooper JS, Hanson KC. Decompression Sickness [Updated 2023 Dec 13]. In: *StatPearls* [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan [cited 2024 Nov. 16]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK537264/>
17. Savioli G, Alfano C, Zanza C, Piccini GB, Varesi A, Esposito C, et al. Dysbarism: An Overview of an Unusual Medical Emergency. *Medicina* [Internet]. 2022 Jan 10 [cited 2024 Nov. 16];58(1):104. Available from: <https://doi.org/10.3390/medicina58010104>
18. Moon RE, Mitchell SJ. Hyperbaric Oxygen for Decompression Sickness. *Undersea Hyperb Med* [Internet]. 2021 Second Quarter [cited 2024 Nov. 16];48(2):195-203. PMID: 33975411.
19. Kirby JP. The Diagnosis of Decompression Sickness in Sport Divers. *Mo Med* [Internet]. 2019 May-Jun [cited 2024 Nov. 16];116(3):195-197. PMID: 31527940.
20. Rosyanti L, Hadi I, Rahayu DYS, Birawida AB. Mekanisme yang Terlibat dalam Terapi Oksigen Hiperbarik: theoretical review hyperbaric oxygen therapy/HBOT. *Health Information : Jurnal Penelitian* [Internet]. 2019 Dec [cited 2024 Nov. 16];11(2):180–202. Available from: <https://doi.org/10.36990/hijp.v11i2.144>
21. Mitchell SJ, Bennett MH, Bryson P, Butler FK, Doolette DJ, Holm JR, et al. Pre-Hospital Management of Decompression Illness: Expert Review of Key Principles and Controversies. *Diving Hyperb Med* [Internet]. 2018 Mar 31 [cited 2024 Nov. 16];48(1):45-55. Available from: <https://doi.org/10.28920/dhm48.1.45-55>
22. Harisa A, Yodang, Mifta IS. Knowledge, Attitude, and Practices of Prevention of Decompression and Barotrauma by Communities in Untia, Makassar City: Observational Study. *Health Information Jurnal Penelitian* [Internet]. 2023 Apr 5 [cited 2024 Nov. 16];15(1):49–57. Available from: <https://doi.org/10.36990/hijp.v15i1.755>
23. Fitriasari E, Sri Dewi Untari NK, Annisa Fitra N. Risk Factors for Decompression Sickness. *Jurnal Multidisiplin Indonesia* [Internet]. 2024 Mar 4 [cited 2024 Nov. 16];3(2). Available from: <https://doi.org/10.58344/jmi.v3i2.1095>
24. Jamjoom M, Altirkistani B, Al-Jadani F, Mirza H, Alhijjy M, Alharthi RA, et al. The Level of Knowledge of Decompression Sickness among Divers in Saudi Arabia – A Cross-sectional Study. *Journal of Marine Medical Society* [Internet]. 2024 Aug [cited 2024 Nov. 16];26(2):270-277. Available from: https://doi.org/10.4103/jmms.jmms_145_23
25. Embuai Y, Denny HM, Setyaningsih Y. Analisis Faktor Individu, Pekerjaan dan Perilaku K3 pada Kejadian Penyakit Dekompresi pada Nelayan Penyelam Tradisional di Ambon. *Jurnal Penelitian Kesehatan Suara Forikes* [Internet]. 2019 Jan [cited 2024 Nov. 16];11(1). Available from: <https://dx.doi.org/10.33846/sf11102>

26. Kirkbride-Smith AE, Wheeler PM, Johnson ML. The Relationship between Diver Experience Levels and Perceptions of Attractiveness of Artificial Reefs - Examination of a Potential Management Tool. *PLoS One* [Internet]. 2013 July 23 [cited 2024 Nov. 16];8(7):e68899. Available from: <https://doi.org/10.1371/journal.pone.0068899>
27. Ira T, Dahlan S, Faisal S. Hubungan Tingkat Pengetahuan Dan Sikap Nelayan Dengan Gejala Penyakit Dekompresi Di Dusun Tanah Goyang RT06 Kecamatan Huamual Kabupaten Seram Bagian Barat. *J Chem Inf Model*. 2017;53(9):1689–1699.
28. Lucrezi S, Milanese M, Cerrano C, Palma M. The Influence of Scuba Diving Experience on Divers' Perceptions, and Its Implications for Managing Diving Destinations. *PLoS One* [Internet]. 2019 Jul 5 [cited 2024 Nov. 16];14(7):e0219306. doi: 10.1371/journal.pone.0219306.
29. Kongkamol C, Kongkamol P, Phanlamai C, Sathirapanya P, Sathirapanya C. Role of Health Locus of Control in Preventing Occupational Decompression Sickness Among Deep-Sea Fisherman Divers. *Heal Psychol Behav Med* [Internet]. 2022 Dec 29 [cited 2024 Nov. 16];11(1):2156345. doi: 10.1080/21642850.2022.2156345
30. Ahdar ARF, Wahyu A, Salmah AU, Mallongi A, Yanti IH. Of Divers Characteristics and Knowledge with Decompression Sickness Through Diving Behavior on Traditional Divers. *Enfermeria Clinica* [Internet]. 2020 Jun [cited 2024 Nov. 16]; 30(4):411-414. Available from: <https://www.sciencedirect.com/science/article/pii/S1130862120302291>

