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Decompression Sickness Indicators in Traditional Divers in Bajo, Boalemo District

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Abstract

Decompression is a health problem due to changes in ambient pressure in the body due to the accumulation of nitrogen which forms bubbles in the body when the dive takes place. The bubbles are not released which leads to the clogging in the blood flow and the nervous system of the diver. This study aims to determine the indicators of decompressionoccurence in traditional divers in BajoVillage, Boalemo District. This was a cross sectional study with a population of 69 people (exhaustive sampling). Data collection is conducted through interviews and physical examinations on divers. The instruments used were questionnaires, history sheets, height and weight measurements. Multivariate data analysiswas carried out using smart PLS applications. The results of this study indicate that of 69 respondents, 41 people (59.4%) of them experienced symptoms of decompression sickness, both at mild and severe level. From the results of multivariate data analysis, it is obtained the results of variables that have a significant relationship (> 1.96) with the incidence of decompression problems, namely the duration of diving (2.453), rising to the surface attitude (3.703) and depth (3.516). It is concluded that the length of diving, the way the diver rise to the surface and depth of divingwere some of indicators of the incidence of decompression in traditional divers in Bajo Village, Boalemo District. It is suggested that divers carry out dives in accordance with safe procedures.

Keywords: *Decompressionsickness,traditional divers, duration of diving, rise to the surface*

Introduction

Indonesia is the largest maritime country in the world. Its sea area covers 5.8 million km2 or around 2/3 of the entire territory of the Republic of Indonesia. The area of Indonesia's Exclusive Economic Zone (EEZ) reaches 2.7 million km2 with a total of 17,504 islands. Apart from that, marine resources in the form of fisheries are also very abundant. There are about 8,500 species of fish, 555 species of seaweed, 950 species of coral reef biota[1].

One type of occupation that we often encounter in coastal or island communities is traditional divers. It is estimated that there are around 7 million divers worldwide(Lee an ye, 2013). In Indonesia, these traditional divers generally still apply the traditional methods. This traditional traditional diver is often called the Compressor Fisherman, a diver who uses very limited equipment [2,3].

The submersion of divers into the water will affect the condition of divers. Evenmore, it may have a high risk to their health, such as pain, paralysis, disability, and death. The risks in question are not only due to the dive itself, but are also influenced by the underwater environment, the diving technique used and the mental and physical condition of the divers [4].

One of the many diseases that occur in divers is decompression sickness or also known as Caisson Disease. This disease is a disease caused by the formation and increase in bubble size when the partial pressure of inert gases in the blood and tissues that exceeds ambient pressure [5].

The formation of air bubbles will block blood flow and the nervous system and eventually cause symptoms such as pain in the joints, headaches, itching,

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numbness, paralysis and even death. The incidence rate of decompression disease based on the Divers Alert Network (DAN) report on commercial dives was reported as many as 35.3 cases per 10,000 dives [6]. In addition, in the United States, the incidence of Caisson Disease for type II (severe) was 2.28 cases per 10,000 divers.In Timilnadu, India, there were 21 deaths due to diving within a period of 2 years, namely in 2012 and 2013 [7].

In Indonesia, decompression is a sickness that is often experienced by traditional divers. The Ministry of Health's research on accidents and diseases that occur in traditional fishermen and divers shows that 57.5% of fishermen on Bungin Island, West Nusa Tenggara experience joint pain and 11.3% experience hearing loss. Whereas in the KepulauanSeribu, DKI Jakarta, 41.4% of fishermen experienced barotrauma and 6.9% experienced decompression sickness[8].

In Makassar, particularyon the island of BarrangLompo, the results of research conducted on 47 people with decompression sickness. Risk factors that influence statistically with the incidence of decompression in traditional divers are the period of work and how to rise to the surface, while rest periods do not affect statistically with the incidence of decompression in traditional divers. Multivariate analysis shows that tenure is the variable most at risk of decompression in traditional divers on BarrangLompo Island[9].

From the data above shows that in Indonesia there are many cases of occupational diseases experienced by traditional divers. Furthermore, there may be more cases that are similar but have not been reported or have not been found. In BoalemoDistrict, Gorontalo province, there is a village where most of the residents' livelihoods are fishermen, including traditional divers who use compressors, namely Bajo Village. Most of the residents are of Bajo tribe. We often encounter people with disabilities and are paralyzed as a result of diving work. Some of them do not go to health service facilities resulting in unrecorded number of cases. Consequently, this problem has not become a targetto be intervened by the parties concerned. Based on the above, a study the indicators of the incidence of decompression sickness in traditional divers is needed in Bajo Village, Boalemo District.

Materials and Methods

Research location and design

This research was conducted in Bajo Village, BoalemoDistrict, Gorontalo Province. The type of research is an observational analytic using a cross sectional study design.

Population and sample

The population in this study was all traditional divers who at that time were domiciled in Bajo Village, Boalemo District and the entire population was used as the object of this study (exhaustive sampling) of 69 people.

Data Collection Method

Data was collected by researchers and physicians through questionnaires, history sheets, height and weight measurements. Data on symptoms of decompression were measured by history and physical examination by the examining physician, age, length of work (tenure), length of diving, depth and how the diver rises to the surface are measured by interview using a list of questions and body mass index data measured by body scales and height measurement tools.

Data Analysis

Data from interviews and measurements were analyzed using several computer softwares. Univariate analysis was conducted using SPSS for Windows 25 to determine the frequency distribution while multivariate analysis uses the Smart PLS software to determine the relationship between variables.

Results

Frequency distribution

Table 1 shows that based on the age of divers, there are 29 people in the category of risk of decompression and 40 people who are not at risk of decompression.

Table 1. Frequency distribution of risk factors for decompression in traditional divers in Bajo Village, Boalemo District

Variables	DCS-Risk		DCS- Non Risk	
	Criteria	n	Criteria	n
Age	<16 / >35 y.o	29	16-35 y.o	40
Body Mass Index (BMI)	> 25	51	≤ 25	18
Tenure	≥ 5 year	57	< 5 year	12
Length of Dive	> 1 hour	64	≤ 1 hour	5
Depth	≥ 15 m	56	< 15 m	13
Rise to the Surface	Fast	57	Slowly	12

Based on body mass index, there are 51 people in the category of risk of decompression and 18 people who are not at risk of decompression. Based on the working period of the divers there are 57 people in the category of risk of decompression and 12 people who are not at risk of decompression.

Table 2. The Relationship Between Variables in Traditional Divers in Bajo Village, Kab. Boalemo

	Original Sample	p-value
AgeàDecompression Sickness (DCS)	0.128	0.227
BMIàDecompression Sickness (DCS)	0.134	0.103
TenureàDecompression Sickness (DCS)	0.151	0.239
Length of Dive à Decompression Sickness (DCS)	0.243	0.015
Rise to the Surface àDecompression Sickness (DCS)	-0.309	0.000
Depth àDecompression Sickness (DCS)	0.350	0.000

Based on the duration of the dive, there are 64 people in the category of risk of decompression and 5 people who are not at risk of decompression. Based on depth, there are 56 people in the category of risk of decompression and 13 people who are not at risk of decompression. Based on how the diver rises to the surface, there are 57 people in the category of risk of decompression and 12 people who are not at risk of decompression.

Relationship Between Variables

Figure 1 shows the relationship between variable length of diving, how to rise to the surface and depth with decompression disease which have significant relationships (> 1.96).

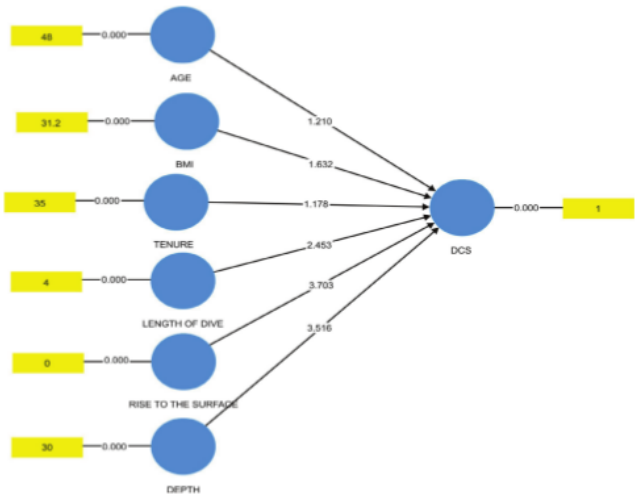

Figure 1.Relationship between variables in traditional divers

In detail, the duration of diving (2.453), how to rise to the surface (3.703), and depthof dive(3.516)with the p-value of each dive time (0.015), how to rise to the surface (0.000), and depth of dive (0.000).

Discussion

Relationship between length of diving and decompression sickness

The results of this study indicate that the duration of diving has a significant relationship with the incidence of decompression in traditional divers in Bajo Village, Boalemo District (p-value = 0.015). Every individual has different abilities in terms of the length of diving in the water. The duration of the dive will affect the absorption and release of gases in the body's tissues and blood, especially nitrogen gas. Changing the composition of the gas will cause decompression and barotrauma.

This research is in line with that conducted by [9](Wijaya, 2018) stating that diving duration is a risk factor for the occurrence of decompression. The study is also in line with the results of research conducted by [10](Jusmawati, 2016) and [8](Duke, 2017). However, the results are in the contrary to the study conducted by [11](Sukmajaya2010) where the results of the study showed no significant relationship between the duration of the dive with decompression sickness. This is likely due to the relatively small number of samples in the study so that it cannot state an association with the effect factor.

The diving, the divers in Bajo Village must pay attention to the duration of this dive, the dives should be carried out in a well-planned manner, taking into account the time of the dive and it is best to avoid diving with of high-risk duration. In the current practice, divers do not dive according to the initial plan, but based on the number of catches obtained in the sea. If the catch is deemed insufficient, then the divers will remain in the water as long as their bodies are deemed able to sustain.

Diving using a compressor as an air source is very potentially lead to decompression sickness due to a long dive. The air supplied by compressor is not limited with time where as long as the air tank in the compressor tube is still available, or the compressor engine is still on, the air supply will still be available.

Relationship betweendepth with decompression sickness

The results of this study indicate that depth of diving has a significant relationship with the incidence of decompression in traditional divers in Bajo Village, Boalemo District (p-value = 0.000). This study is in line with research conducted by [9](Wijaya, 2018), [8](Duke, 2017) dan[12](Alaydrus, 2014)which found that depth is a risk factor that significantly influences the incidence of decompression in diver.

When a diver submerges into the water, there are two pressures that burden his body, namely the pressure of the air above the water and the pressure from water

itself. The amount of atmospheric pressure varies depending on the altitude of the surface of the sea or lake, while the water pressure is the pressure caused by the weight of the water that is above the body of the diver [13].Every 10meter depth increase, there is an increase in 1 ATA pressure (absolute atmosphere). The deeper a person dives, the greater the pressure received and the risk of decompression will also be even greater.

The deeper a person dives, the higher the pressure towards by the body so that more nitrogen will be dissolved and absorbed by the blood and organs of the body. If the body cannot adjust to this pressure, squeese or trauma can occur. This trauma usually occurs at depths of more than 10 meters. In addition, the deeper the dive, the lower the temperature in the water. Therefore, divers can lose body heat followed by other disorders such as tingling, cramps, etc. [14].

Relationship between how to rise to the surface with decompression

The results of this study also indicate that the behavior by which the diver rises to the surface after diving has a significant relationship with the decompression sickness in traditional divers in Bajo Village, Boalemo District (p-value = 0.000). This study is in line with previous studies conducted by [15](Rahmadayanti, 2017), [16](Linggayani, 2017), [9] (Wijaya, 2018) dan[17](Wahab, 2008)which found that there was a significant relationship between the way the diver rises to the surface and the incidence of decompression.

When a diver rises to the surface after a rapid dive, it will cause air pressure outside the body to be lower than air pressure in the body so that nitrogen dissolved in the blood will come out of the body and form larger nitrogen bubbles and can compress or clog some blood vessels and nerveus system of the body. Lack of knowledge of divers causes them not to carry out proper and correct diving procedures[15-19].Another aspect that usually causes a diver to rise to the surface quickly is if the diver encounters a wild or poisonous sea animal or if the compressor hose is twisted and clogged or the compressor is experiencingdamage.

Based on the results of interviews with traditional divers in Bajo Village, several divers conducted something that was believed to reduce the risk of decompression; once arrive to the surface, the diver did not directly get on the boat, but first dwelled on the surface of the water while holding on the edge of the boat waiting time to feel like urinating, and after urinating then the diver climbed onto the boat.

Conclusions and Recommendations

Decompression sickness indicators in traditional divers in Bajo Village, Boalemo district are the duration of diving with t statistics (3.703), the way the divers rise to the surface with t statistics (3,516) and the length of work with t statistics (2,453)

.Thus, it is recommended for divers to carry out diving activities in accordance with safe diving procedures and it is recommended that the marine service conduct counseling or training on how to dive safely on these traditional divers. Further research should specify more on the different types of decompression sickness namely type 1 and type 2. It is recommended to research about the effects of using a compressor on divers

Ethical Clearance- Taken from University ethical committee

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Conflict of Interest - Nil

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