

Determinants of Work Accidents in Traditional Divers in the Wakatobi Tourism Area of Southeast Sulawesi

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ABSTRACT

This research aimed to examine the determinants of work accidents in traditional divers, such as their knowledge, medical history, availability of equipment as well as frequency, duration and depth of diving to the risk of work accidents.

This study was carried out in Wakatobi Tourism Area in Southeast Sulawesi Province. The method used was quantitative research with a cross-sectional study design. The total of samples used was 139 traditional fishermen, who were obtained by using statistical analysis through cross tabulation, followed by Chi-Square test and logistic regression.

The results showed that knowledge ($p=0,000$), medical history ($p=0,000$), equipment ($p=0,018$), diving frequency ($p=0,003$) and depth of dive ($p=0,000$) were significantly related to the risk of workplace accidents. In contrast, diving duration ($p = 0,670$) did not show a significant correlation with the risk of work accidents in traditional divers. The results of logistic regression analysis showed that the most correlated variable with work accidents in traditional divers was knowledge ($OR=0,012$). Thus, to prevent work accidents in traditional divers, it is necessary to have coaching clinic or dissemination of information about the determinants of work accidents and diving training about correct and safe diving for traditional fishermen.

Keywords: Work Accident Determinant, Risk Work Accident

INTRODUCTION

Diving is an activity done underwater, with or without the equipment,

to reach certain goal (Irene, 2015). Indonesia as the archipelago has 2/3 of the area consists of sea, so it is common to see people who work on or related to sea.

Diving activity must be seen an activity to make a living in a diving work environment. So far, the fishermen community has not been equipped with sufficient knowledge about safety dive, which is important to make them dive properly and do not endanger their health. Numbers of fishermen divers suffered from several diseases due to unsafe diving, even some of them died due to lack of quick and appropriate medical treatment (Kemal 2005 in Sukbar, 2016).

Diving activity which is done by traditional fishermen is full of challenge and uncertainty, one of which is the accidents at sea. In 2007, International Maritime Organization (IMO) reported that the one of main cause of deadly sea accidents is human error.

According to the Final Report of Marine Accident Trend Analysis in 2003-2008, the causes of workplace accidents at sea were caused by human error for 37%, technical errors for 23%, force major for 38%, and others for 2%. National Transportation Safety Committee assessed that 90% of accidents at sea was caused by human factor.

A study by Paskarini (2010) found that during 2000 to 2006, there were 13 fishermen died due to health problems caused by diving. A research conducted by Bove (2013) stated that common health

problems experienced by fishermendivers in addition to generalhealth problems in on land, added by hyperbaric problem which is a high-pressure environment in more than one atmosphere. One of the accidents caused by diving is barotrauma, that is caused by air pressure in the body due to quick changes in diving depth.

Wakatobi islands are located in the Southeast of Sulawesi, Indonesia. The islands are in the middle of the coral triangle, which is said to be the largest marine plant species in the world which has huge diversity of coral, fish, and mollusks (Equator Initiative, 2017).

There are more than 100,000 residents live in the tourism area of Wakatobi National Park, and most of them are fishermen. Some fishermen catch fish by using traditional as well as modern methods. Resource competition among fishermen leads some of them to destructive and excessive fishing practices. Some of the fishermen still use the diving method to take their catch. Unfortunately, it is known that diving without using good equipment will cause health risks.

The preliminary study showed that the number of traditional fishermen inWakatobi tourism area was unknown, because the number can change anytime either increasing or decreasing. Besides fishing, some fishermen also had some other jobs such as trading and gardening. However, it was estimated that there were ± 213 traditional fishermen who were still actively fishing traditionally or bydiving. Some fishermen suffered from health problems including hearing disorder and respiratory problems. According to the result of the interview, the symptoms appear when they have been diving for years. According to the worker from one of *Puskesmas*(translated as Community Health Center) inWakatobi National Park, only a few fishermen who came and complained about their health problems, so that there was no exact data of health problems caused by diving. However, it was further explained that there were cases of fishermen

who died due to decompression and respiratory failure caused by unsafe diving, but the people did not know exactly of the illness had by the fishermen.

Based on the explanation, in-depth analysis was needed regarding the determinants of work accidents in traditional divers, especially divers in Wakatobitourism area in Southeast Sulawesi Province.

RESEARCH METHOD

This research was quantitative research by using cross sectional study, which is a research method that emphasizes on measurement time or one-time variable observation assessed simultaneously (Nursalam, 2016). This research was taken place in Wakatobitourism area in Southeast Sulawesi, involving 139 people.

RESULTS

Correlation between knowledge and risk of work accidents in traditional fishermen

According to table 1, all 27 respondents (100%) who were in category of at risks, 40,7% of them had sufficient knowledge and 59,3% of them was lack of knowledge. On the other hand, from 112 respondents (100%) who were not at risk of having work accident, 92,9% of them was having sufficient knowledge while 7,1% of them did not have sufficient knowledge. The result of statistical analysis had p value for 0,000 which means that knowledge was the determinant that influence work accidents in traditional divers in Wakatobi tourism area.

Table 1: Correlation between knowledge and risk of work accidents in traditional divers

| Risk of Work Accidents | Knowledge | | | | Total | | P |
|------------------------|------------|------|------|------|-------|-----|-------|
| | Sufficient | | Lack | | n | % | |
| | N | % | N | % | | | |
| At risk | 11 | 40,7 | 16 | 59,3 | 27 | 100 | 0,000 |
| No risk | 104 | 92,9 | 8 | 7,1 | 112 | 100 | |
| Total | 115 | 82,7 | 24 | 17,3 | 139 | 100 | |

Source: Primary Data 2019

Correlation between medical history and the risk of work accidents in traditional fishermen

Table 2 : Correlation between medical history and risk of work accidents in traditional divers

| Risk of Work Accidents | Medical History | | | | Total | | P |
|------------------------|-----------------|------|------|------|-------|-----|-------|
| | Good | | Poor | | n | % | |
| | N | % | N | % | | | |
| At risk | 18 | 66,7 | 9 | 33,3 | 27 | 100 | 0,000 |
| No risk | 111 | 99,1 | 1 | 0,9 | 112 | 100 | |
| Total | 129 | 92,8 | 10 | 7,2 | 139 | 100 | |

Source: Primary Data 2019

Based on table 2, 27 respondents (100%) who were in category of at risks were divided into 66,7% of them who had good medical history and 33,3% of them who had poor medical history. In contrast, from 112 respondents (100%) who were not at risk of having work accident, 99,1% of them had good medical history and 0,9% of

them had poor medical history. The result of statistical analysis had p value for 0,000 which means that medical history was the determinant that influence work accidents in traditional divers in Wakatobi tourism area.

Correlation between equipment and the risk of work accidents in traditional fishermen

Table 3 shows that from all the respondents at risk, all of them did not have equipment. In contrast, from the respondents with no risk, 17,9% of them has complete equipment and 82,1% of them did not have complete equipment. After statistical analysis, the p value was 0,018 which means that equipment was the determinant that influence work accidents in traditional divers in Wakatobi tourism area.

Table 3: Correlation between equipment and risk of work accidents in traditional divers

| Risk of Work Accidents | Equipment | | | | Total | | P |
|------------------------|-----------|------|---------------|------|-------|-----|-------|
| | Complete | | Less Complete | | n | % | |
| | N | % | N | % | | | |
| At risk | 0 | 0 | 27 | 100 | 27 | 100 | 0,018 |
| No risk | 20 | 17,9 | 92 | 82,1 | 112 | 100 | |
| Total | 20 | 14,4 | 119 | 85,6 | 139 | 100 | |

Source: Primary Data 2019

Correlation between frequency of diving and the risk of work accidents in traditional fishermen

Based on table 4, 29,6% of at risk respondents was frequently dive, and the other 70,4% was rare. In the no risk category, 61,6% of them was frequently dive while 38,4% of them was rare. After the statistical analysis, the p value was 0,003 which means that the frequency of diving became one of the the determinants that influence work accidents in traditional divers in Wakatobi tourism area.

Table 4: Correlation between frequency of diving and risk of work accidents in traditional divers

| Risk of Work Accidents | Frequency of diving | | | | Total | | P |
|------------------------|---------------------|------|--------|------|-------|-----|-------|
| | Frequently | | Rarely | | n | % | |
| | N | % | N | % | | | |
| At risk | 8 | 29,6 | 19 | 70,4 | 27 | 100 | 0,003 |
| No risk | 69 | 61,6 | 43 | 38,4 | 112 | 100 | |
| Total | 77 | 55,4 | 62 | 44,6 | 139 | 100 | |

Source: Primary Data 2019

Correlation between duration of diving and the risk of work accidents in traditional fishermen

In table 5, the category of at risk for work accidents had 18,5% of respondents who had a long duration of diving and the other 81,5% had a short duration of diving. In the other category, 15,2% of them had a long duration of diving and the other 84,8% had a short duration of diving. The statistical value obtained p value for 0,670 hich means that the duration of diving was not the determinants that influence work accidents in traditional divers in Wakatobi tourism area.

Table 5: Correlation between duration of diving and risk of work accidents in traditional divers

| Risk of Work Accidents | Duration of diving | | | | Total | | P |
|------------------------|--------------------|------|-------|------|-------|-----|-------|
| | Long | | Short | | n | % | |
| | N | % | N | % | | | |
| At risk | 5 | 18,5 | 22 | 81,5 | 27 | 100 | 0,670 |
| No risk | 17 | 15,2 | 95 | 84,8 | 112 | 100 | |
| Total | 22 | 15,8 | 117 | 84,2 | 139 | 100 | |

Source: Primary Data 2019

Correlation between the depth of diving and the risk of work accidents in traditional fishermen

Table 6: Correlation between depth of diving and risk of work accidents in traditional divers

| Risk of Work Accidents | Depth of Diving | | | | Total | | P |
|------------------------|-----------------|------|---------|------|-------|-----|-------|
| | Deep | | Shallow | | n | % | |
| | N | % | N | % | | | |
| At risk | 11 | 40,7 | 16 | 59,3 | 27 | 100 | 0,000 |
| No risk | 12 | 10,7 | 100 | 89,3 | 112 | 100 | |
| Total | 23 | 16,5 | 116 | 83,5 | 139 | 100 | |

Source: Primary Data 2019

According to table 6, all 27 respondents (100%) who were in category of at risks, 40,7% of them dived in depth and 59,3% of them had a shallow dive. On the other hand, from 112 respondents (100%) who were not at risk of having work accident, 10,7% of them dived in depth while 89,3% of them had a shallow dive. The result of statistical analysis had p value for 0,000 which means that depth of dive

was the determinant that influence work accidents in traditional divers in Wakatobi tourism area.

Result of final model of multivariate analysis

Based on table 7, the final model of multivariate analysis in this study showed that the variable which was most related or influential to the risk of work accidents in traditional divers is knowledge with an Odds Ratio (OR) of 0.012. It means that a traditional diver who had sufficient knowledge would reduce the risk of work accidents by 0.012 times compared to traditional diver who had poor knowledge after being controlled with other determinants such as medical history, equipment, frequency of diving and depth of diving.

Table 7 : Final model of multivariate analysis (n = 139)

| No. | Variable | B | p value | OR | 95% CI |
|-----|---------------------|--------|---------|-------|---------------|
| 1 | Knowledge | 4,455 | 0,000 | 0,012 | 0,002 – 0,074 |
| 2 | Medical history | 4,692 | 0,001 | 0,009 | 0,001 – 0,134 |
| 3 | Equipment | 18,155 | 0,998 | 0,000 | 0,000 – 0,063 |
| 4 | Frequency of diving | 2,070 | 0,019 | 1,126 | 0,022 – 0,716 |
| 5 | Depth of diving | 1,692 | 0,074 | 5,430 | 0,846 – 4,840 |

*Excluded from model

DISCUSSION

Correlation between knowledge and risk of work accidents in traditional fishermen in Wakatobi Tourism Area in Southeast Sulawesi

Based on the results of the study, the majority of traditional divers was in the category who had sufficient knowledge for 82.7%, and only a small part in the category of knowledge who had lack of knowledge. Based on the bivariate test results, the p value was 0,000 which was less than 0.05. Thus, it is concluded that knowledge is significantly related to the risk of work accidents in traditional divers in the Wakatobi Tourism Area, Southeast Sulawesi.

Traditional divers' diving knowledge was obtained through the daily experience of traditional fishermen. In addition, traditional divers also often had coaching clinic from government agency to

improve the economic quality of fishermen and also about diving education and fishing. Therefore, the combination of daily experience and diving coaching clinic about diving had an impact on increasing the knowledge of traditional fishermen in order to avoid the risk of work accidents due to diving. This result is in line with the results of the study in which the majority of respondents are well-informed and have less risk of work accidents.

According to Lucrezi, et al. (2018), it is necessary to increase awareness of divers by providing education through active participation in campaigns, training and caching clinics about the risk of accidents when diving. It is further explained that divers with good diving knowledge will avoid the risk of accidents when diving.

Traditional fishermen have a high risk of having an accident at sea. To avoid the

danger, one method of prevention is to provide work safety education to traditional fishermen (Widjasena, 2017).

Several researches have shown consistent results, including Gold (2017) who stated that fisherman's knowledge plays an important role in their safety when fishing, especially when diving. Duke, et al. (2016) stated that knowledge is significantly related to accidents in traditional divers.

Correlation between medical history and the risk of work accidents in traditional fishermen in Wakatobi Tourism Area in Southeast Sulawesi

Based on the results of the study, the majority of respondents (92.8%) was in a good medical history and only a small proportion of respondents (7.2%) who was in the unhealthy category. Based on the bivariate test results, the p value was 0,000 which was less than 0.05. Thus, it was concluded that the medical history was significantly related to the risk of work accidents in traditional divers in the Wakatobi Tourism Area of Southeast Sulawesi.

The medical history of traditional divers was quite good because most of them have not shown any health problems while fishing by using diving techniques. The results also showed that the majority of respondents came from the Bajo (Bajau) tribe, for 81.3%, where according to some documents, the Bajo tribe had special uniqueness in terms of immunity formed from the marine environment so that they rarely suffered from health problems.

This finding is in line with the National Geographic report (2018) which stated that Bajo tribe is one of the world's tribes which rarely encountered health problems. They can dive for 13 minutes at a depth of 200 feet without significant interruption. Further explained that Bajo tribe has a larger and proportional size of the spleen, wherein it is known that the spleen is one of the organs that helps to support the immune system and recycles red blood cells.

According to Mallapiang (2015), health problems in traditional divers generally occur if the divers have a history of certain diseases which can be worsen when diving. Meanwhile, according to Ekawati (2015), the risk of work as a traditional fisherman varies greatly depending on the type of dive carried out and their medical history. However, most health problems come from unsafe safety diving activities.

Several studies have shown consistent results, including Zaheer, et al. (2016) who studied the health problems with long work periods on traditional divers. The results of his study showed that health problems were found in respondents who worked as divers for a long time. Likewise, the study of Cristian, et al. (2012) stated that there is a significant correlation between medical history and hearing loss in traditional divers. It is further explained that although a person has never had a history of a particular disease, by often being exposed to pressure and for a long period of time, the divers may be at risk of getting an occupational accident in the form of a health disorder.

Correlation between equipment and the risk of work accidents in traditional fishermen in Wakatobi Tourism Area in Southeast Sulawesi

The results showed that the majority of traditional diving equipment in the Wakatobi tourism area was incomplete (85.6%) and only a small proportion was in the complete category (14.4%). Based on the bivariate test results, the p value was 0.018 which was less than 0.05. Therefore, it was concluded that the availability of equipment was significantly related to the risk of work accidents in traditional divers in the Wakatobi tourism area of Southeast Sulawesi.

The availability of equipment will support the fishermen to avoid the risk of work accidents as divers. The results showed that most respondents did not have complete diving equipment because complete diving equipment was only used

for diving activity. They also stated that they were accustomed to use makeshift diving equipment to get marine products. Besides, most fishermen did not complete their diving equipment because of limited funds. The price of diving equipment is very expensive. Unfortunately, most of the respondents only work as fishermen and did not have any other job besides fishing. Nevertheless, limited equipment was not a significant obstacle to the respondents in getting the risk of work accidents. It can be seen from the results of the study that 66.2% of respondents with incomplete equipment was not at risk of having a work accident.

Paskarini, et al. (2010) found that traditional divers usually catch sea products at a depth of more than 20 meters, which become a risk to the safety and health of the divers. This is consistent with the results of this study which found that 19.4% of respondents with incomplete equipment was at risk of work accidents.

It is in line with Massi's study (2015) who stated that safety diving is an absolute requirement for diving workers to avoid work accidents such as decompression. Another study by Kunaefi (2013) explained that equipment is one of the requirements for a diver to avoid the risk of work accidents.

Correlation between frequency of diving and the risk of work accidents in traditional fishermen in Wakatobi Tourism Area in Southeast Sulawesi

Based on the results of the study, 55.4% of respondents was frequently dive and 44.6% of respondents was rarely dive. Based on the bivariate test results, the p value was 0.003 which was less than 0.05. Thus, it was concluded that the frequency of diving was significantly related to the risk of work accidents in traditional divers in the Wakatobi tourism area of Southeast Sulawesi.

High frequency of diving will increase the risk of work accidents if the divers do not pay attention to other things such as equipment and health conditions.

However, a rare frequency of diving may also be at risk of workplace accidents. This is consistent with the findings of the study which found that a person with a high frequency of diving was 5.8% at risk of experiencing workplace accidents, while those with rare frequency of diving was 13.7% at risk of work accidents.

Brunner (2014) stated that a diver who frequently dives will more often experience a repetitive trauma, so the risk is more common in divers with frequent diving. Meanwhile, Cole (2015) stated that the person with low frequency of diving is also at risk of an accident if they does not pay attention to the safety dive factor.

The results of this study are in line with Eckenhoff's (2010) study which stated that most barotrauma is experienced by divers with high diving intensity. Paskarini's research (2010) concluded that the frequency of diving is associated with health problems in some traditional divers.

Correlation between duration of diving and the risk of work accidents in traditional fishermen in Wakatobi Tourism Area in Southeast Sulawesi

Based on the results of the study, the majority of respondents who had long short duration of diving was 84.2%, and minority of respondents in the long duration category that is equal to 15.8%. Based on the bivariate test results, the p value was 0.670 which was less than 0.05. Thus, it was concluded that the duration of the dive was not significantly related to the risk of work accidents in traditional divers in the Wakatobi Tourism Area, Southeast Sulawesi.

The duration of diving is counted started from diving until going back to the surface, before going the next dive. The longer a person stay under the surface, the higher the risk they will have. However, the results of the study showed different result. From a total of 15.8% of respondents with a long duration of diving, only 3.6% who were at risk of having a work accident. According to the researchers, it was because some fishermen who had long duration of

diving, they used proper equipment. In contrast, those at high risk of having work accidents were respondents who dived without adequate equipment, so that the results of the study did not show significant results.

Fahlman (2006) stated that the longer a diver stay under sea surface, the higher they will be exposed to the risk. The long dive will affect the absorption and release of gases in the body's tissues and blood, especially nitrogen gas, which changes the composition of the gas which will cause decompression. The length of the diving duration will affect the pressure received by the diver according to its depth. The results of this study are in line with the study of Marcy (2011) which stated that the duration of diving does not significantly influence the risk of danger and accident in traditional divers. Likewise, Kartono's research (2007) stated that there is no significant relationship between the duration of diving with barotrauma in traditional divers.

Correlation between the depth of diving and the risk of work accidents in traditional fishermen in Wakatobi Tourism Area in Southeast Sulawesi

Based on the results of the study, the majority of respondents for 83.5% had shallow dive and the rest of 16.5% did deep dive. Based on the bivariate test results, the p value of 0,000 was less than 0.05. Therefore, it was concluded that the depth of the dive was significantly related to the risk of work accidents of traditional divers in Wakatobi Tourism Area, Southeast Sulawesi.

According to researcher, the deeper a person dives, the greater the atmospheric pressure which will be received, and with increasing depth of diving the greater the risk of accidents. It was in line with the results of the study where 7.9% of respondents were at risk of work accidents in deep diving categories. However, there was still a possibility for shallow dives to give a risk of accidents to diver. In 83.5% of respondents in the shallow dive category,

there were 11.5% at risk of work accidents, but the potential danger of shallow dives was lighter compared to divers who did deep dives. Therefore, the results of the study showed significant results.

According to Duke (2016), every 10 meter increase in sea depth there is an increase in 1 ATA. Divers who dive with a depth of 30-60 meters, the risk of accident is 0.54%. According to Mitchell (2005), a diver, the deeper the dive will give the greater the atmospheric pressure received. By the increase of depth, the possibility of decompression and barotrauma is higher.

This result is in line with the study of Al Saady (2010) which stated that the duration of the dive and the depth of the dive are related to the risk faced by the traditional divers for a diving accident by 4.122 times. Likewise, Duke's research (2016), stated that the depth of the dive affects the diving accident and increases the high risk of decompression by 14.4 times.

CONCLUSION AND SUGGESTION

According to the results and discussion, the researchers drew several conclusions, among others: from the six variables studied, 5 variables had a significant correlation to the risk of workplace accidents in traditional divers, namely knowledge, medical history, availability of equipment, frequency of diving, and depth of diving. Only the variable of duration of diving which did not show a significant correlation with the risk of work accidents in traditional divers in the Wakatobi Tourism Area, Southeast Sulawesi. There is a need for education from related institutions to the traditional fishermen, with the aim to increase the knowledge and understanding of fishermen to prevent the risk of work accidents when diving. To prevent work accidents in traditional divers, it is necessary to provide coaching clinic or dissemination of information about the determinants of work accidents, as well as proper and safe diving training for traditional fishermen in collaboration with agencies or organizations

which expert in diving field. Periodic medical check-up is needed for fishermen to examine the long-term symptoms they had during the profession as traditional fishermen in order to improve the health of the fishermen. In-depth research is needed to get more significant results especially regarding the determinants of work accidents in traditional divers by using different research methods.

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