

Safety behaviour and healthy diving: a qualitative study in the traditional diverse fishermen

Kusnanto Kusnanto¹, La Rakhmat Wabula², Bambang Purwanto³,
 Hidayat Arifin², Yulia Kurniawati²

¹Department of Fundamental, Medical-Surgical and Critical Nursing, Faculty of Nursing, Universitas Airlangga, Kampus C, Mulyorejo, Surabaya, Indonesia

²Master of Nursing Study Programme, Faculty of Nursing, Universitas Airlangga, Kampus C, Mulyorejo, Surabaya, Indonesia

³Department of Medical Science, Faculty of Medicine, Universitas Airlangga, Kampus A, Surabaya, Indonesia

ABSTRACT

Background: Traditional divers from the Maluku Province of Indonesia have not received formal education and training related to standard diving tools. They only become accomplished at diving generation by generation. The use of non-standard diving tools increases the risk of injury and illness. This study aimed to get an overview of the health and safety behaviours of traditional divers.

Materials and methods: The study was qualitative, involving 15 traditional divers who used compressors for at least 1 year and who'd had decompression sickness and barotrauma as a result of diving. The data was obtained through in-depth interviews, analysed through the Colaizzi method.

Results: The participants' diving health and safety behaviour is triggered by the perception of the risk of diving. This is supported by the reinforcing social and environmental factors leading to the form of health and safety behaviour when diving. These behaviours include diving without planning, using a compressor, and making "sesajen" (kind of food, leaves, and water that are believed to be a form of surrender to the creator) which is an offering or present to the gods or ancestors. This behaviour causes complaints such as trauma and an increased economic burden. Some participants consider complaints as a threat and plan to stop diving. The participants made a plan before dive and declared that they would change their behaviour to ensure safety.

Conclusions: Health and safety behaviour related to diving must be socialised and facilitated. The establishment of a divers' community that cares about health and safety behaviour needs to become important as a support system.

(Int Marit Health 2020; 71, 1: 56–61)

Key words: health and safety behaviours, diving incident, traditional divers

INTRODUCTION

Traditional divers are spread across the territory of Indonesia, especially in the Coastal and Archipelago areas [1]. The diving expertise of traditional divers is obtained from generation to generation. Traditional divers have not received any formal diving education and training. The health and safety behaviour for diving is not standard. The risk of injury and illness due to non-standard behaviour when diving is increased [2].

Traditional divers total 1694 (29%) of fishermen who can dive to a 20 m depth or more. The limitations within

the existing facilities and infrastructure cause the using of compressors to be an alternative to Self-Contained Underwater Breathing Apparatus (SCUBA) diving equipment. Data from 2014 to 2017 on the prevalence of barotrauma, paralysis, and the bites of marine animals increased by 25% due to the non-compliance with the health and safety diving standards [2].

Diving is a high-risk job. The increasing of work productivity refers to excellent, safe diving standards and the knowledge of the traditional divers about the risk of hazards

✉ Dr. Kusnanto Kusnanto, S. Kp., M. Kes., Department of Fundamental, Medical-Surgical and Critical Nursing, Faculty of Nursing, Universitas Airlangga, Kampus C, Mulyorejo, Surabaya, Indonesia, Postal address: 60112, tel: (031) 5913257, 5913754, fax: (031) 5913257, e-mail: kusnanto@fkn.unair.ac.id

in high-pressure environments [3]. Non-adherence to safety has fatal consequences such as hearing loss [4, 5]. The prevalence of ear barotrauma, which includes pain (47.9%), transient deafness with tinnitus (27.5%) and vertigo (9.9%), are some of the side-effects of non-compliance with the standard diving rules [3].

This study aimed to get an overview of the health and safety behaviour of traditional divers. The results of this study are expected to provide factual information about the health and safety behaviour of traditional divers. Health care providers will thus be able to provide interventions according to the participant's needs.

MATERIALS AND METHODS

RESEARCH DESIGN

The study used a qualitative design through semi-structured in-depth interviews.

SAMPLE

The participants of this study were the traditional divers and fishermen residing in Ambon City, West Seram District and Buru Regency Maluku Province, East Indonesia. The inclusion criteria were as follows: 1) participants with decompression sickness and barotraumias caused by diving; 2) a history of diving using a compressor; 3) a history of working as a traditional diver for at least 1 year; 4) 25–64-year-old ; 5) communicate verbally well. Based on the recruitment results, 15 participants met the inclusion criteria.

INSTRUMENT

The researcher was an instrument of the qualitative study. This means that from the beginning through to the end of the study, the researcher was actively involved in the research. The data collection was assisted by a recording device and an in-depth interview guideline list. The interview questions included: 1) the perception of the diving risks; 2) the supporting factors for the diving health and safety behaviour; 3) the form of health and safety behaviour when diving; 4) any perceived impact due to the diving action; 5) behaviour after-effects. Field notes are also used to record situations and events including the non-verbal expressions that were shown by the participants during the interviews.

TIME AND PLACE

The study was conducted from 15th January to 15th February 2019. The location of the interview was at the participant's homes. The interview was carried out in three phases: preparation, implementation, and termination.

DATA ANALYSES

The results of the data collection were examined immediately after the interview process. The interview data

was analysed using the Colaizzi method consisting of seven stages, namely: 1) describing the phenomena; 2) marking keywords; 3) formulating meaning; 4) determining the theme groups; 5) integrating the theme and sub-theme descriptions; 6) formulating descriptions for a complete set of themes; 7) the validation of the research results with the participants.

ETHICAL CONSIDERATIONS

All of the participants gave their informed consent to be involved in the study. This study has been registered and it passed the research ethics committee of the Health Research Ethics Commission of the Faculty of Nursing, Airlangga University with letter number: 1244-KEPK published on 31st December 2018.

RESULTS

PARTICIPANTS' CHARACTERISTICS

In-depth interviews were carried out with the 15 participants for 30–40 min. All of the participants were men aged 22–62 years old. The length of their use of compressor varied between 2 and 40 years. The history of paralysis experienced also varied between 1 and 6 times. The characteristics of the participants have been summarised in Table 1.

THEMES

A total of 5 themes emerged from the results of the in-depth interviews. The themes include: 1) the perception of the diving risk; 2) the supporting factors of diving; 3) the form of work-based health and safety behaviour; 4) the impact of occupational health and safety behaviour; 5) the behaviour after being affected. The themes and sub-themes have been summarised in Table 2.

Perception of diving risk

This theme explains the initial views on the risks of diving. The participants considered diving at a depth of more than 100 m to be familiar to a person known to them, so the participant did the same. They think there are no health and safety risks (Table 3, quotes 1–3). Some of the participants think that their work as a diver has risks to do with health and safety, but the risk can be eliminated by prayers and "sesajen" (food, leaves, and water that is believed to be a form of surrender to the creator) which is an offering or present to the gods or ancestors (Table 3, quotes 4–5).

Supporting factors of the diving health and safety behaviour

This theme focuses on the participants' and their family's perceptions of the things that are known, experienced,

Table 1. Characteristics of respondents

Code	Gender	Age [year]	Compressor usage [year]	Paralysis history [time]
P01	Male	48	8	2
P02	Male	44	21	3
P03	Male	80	40	6
P04	Male	43	10	2
P05	Male	46	29	3
P06	Male	46	15	5
P07	Male	50	2	1
P08	Male	47	2	1
P09	Male	47	23	2
P10	Male	35	6	2
P11	Male	32	2	1
P12	Male	22	3	1
P13	Male	38	5	1
P14	Male	29	4	1
P15	Male	33	2	1

Table 2. Summary of themes and sub-themes

Themes	Sub-themes
Perception of diving risk	1. No risk 2. Risk, but can minimize by “sesajen”
Supporting factors of diving health and safety behaviour	1. Improper knowledge 2. Material support 3. Generation-to-generation habit
Form of diving health and safety behaviour	1. Without planning 2. Compressor usage 3. “Sesajen” or prayer
Impact of occupational health and safety behaviour	1. Trauma 2. Economic burden 3. Perceived health complaint
Behaviour after being affected	1. Stop diving 2. Behavioural change

and considered to strengthen the health and safety behaviour when diving. Knowledge about the risks of diving is improper. Generation-to-generation behaviour when diving causes the participant to maintain inadequate health and safety behaviour when diving (Table 3, quotes 6–7). Material support from the couples includes preparing “sesajen” before diving. This becomes a reinforcing factor for the participant to maintain their health and safety behaviour when diving (Table 3, quote 8). The strengthening factors for the participants to maintain health and safety behaviour when diving include the familial generation-to-generation habits (Table 3, quote 9).

Forms of diving health and safety behaviour

This theme explains how the forms of health and safety behaviour when diving have been carried out by the participants and how they have become part of life as a traditional diver. The participants dive without planning because their abilities and diving habits get transmitted from generation to generation (Table 3, quote 10). All of the participants use compressors as diving equipment because it is the only thing that is available and economically affordable for them (Table 3, quotes 11–12). Some of the participants prepare “sesajen” before diving. The “sesajen” is considered to be an acceptance and tribute during diving and fishing (Table 3, quotes 13–14).

Impact of occupational health and safety behaviour

This theme focuses on the participants’ experience of the perceived impact on their health and safety behaviour when diving. All of the participants had experienced a history of paralysis (Table 3, quote 15). The effects of diving using a compressor were joint pain, hearing loss, and paralysis (Table 3, quote 16–17). The participants experienced disability and trauma after losing their ability to walk (Table 3, quote 18). The participants felt the economic burden due to disability. They had also increased their spending on medical treatment (Table 3, quotes 19–20). The participants had previously taken medication but stopped for financial reasons (Table 3, quote 21).

Behaviour after being affected

This theme illustrates how the participants decide on their behaviour after interpreting the impact of their health and safety behaviour on diving. The participants feel trauma

Table 3. Summary of quotes

1. "...I'm used to it and it's my routine. No, it's not dangerous..." (P01)
2. "...the diving was a generation-to-generation habit and procedure..." (P05)
3. "...there is no risk. My parents were a diver. Not gradually in-depth, but directly 100 metres, and usually dive 10–12 hours without any rest..." (P12)
4. "...it's risky. But before leaving, we prayed first and gave "sesajen"..." (P09)
5. "...offer "sesajen" done by my wife before leaving for fishing" (P15)
6. "...still been a diver with a compressor for many years because my parent and grandparent used to be like that, so it seems safe..." (P03)
7. "...using a compressor is enough, "sesajen" have been helped to survive..." (P14)
8. "...the wife prepared "sesajen" before diving as a prayer to be saved..." (P13)
9. "...I don't know. Just follow along, grandfather, parents, older adults too. It's been descending..." (P08)
10. "... If I want to find fish, go to the sea and dive. Diving planning procedures do not exist. Apart from that, I think there is no..." (P07)
11. "...Use the compressor first. Parents also use compressors..." (P09)
12. "...use compressors, people here also use compressors..." (P07)
13. "...Preparation before diving only food and "sesajen". My wife was prepared..." (P08)
14. "...before leaving, my wife prepares "sesajen" for the prayers and offerings of sea dwellers..." (P01)
15. "...I've been paralyzed. Almost all fishermen who dive here have been paralyzed..." (P05)
16. "...most often it's ear aches and pains in my leg joints ..." (P11)
17. "...ear ache, leg pain, the worst experienced by fishermen divers here is being paralyzed..." (P14)
18. "...Many times paralyzed. Trauma, afraid that if I dive again, I will be paralyzed again..." (P06)
19. "...After this paralysis adds to the economic burden. Add expenses for the treatment..." (P01)
20. "...the need for treatment and daily necessities is more expensive, more and more..." (P13)
21. "...previously had been treated but stopped, there was no money anymore..." (P13)
22. "...Trauma, do not want to dive again. I've had ear scars, joint pain, until paralysis. Trauma..." (P06)
23. "...I think I still want to continue. Yes what should I do, the only work that can be done is that if my wife permits me..." (P13)
24. "...Still, want to dive again. Yes actually afraid if it hurts again. Yes, it will do the right planning before diving..." (P04)

and they won't dive again after the paralysis (Table 3, quote 22). Some of the participants still want to dive because of their economic demands (Table 3, quote 23). Participants who plan to keep on diving again will draw up a diving plan (Table 3, quote 24).

DISCUSSION

PERCEPTION OF THE DIVING RISK

Participants assume that diving does not pose a risk to their health. This was because diving has been done generation to generation in the family [6]. Some of the other participants consider "sesajen" to reduce the risk of diving. "Sesajen" is believed to be a form of surrender to the creator. "Sesajen" is considered to be a means of earning God's protection [7]. Diving is targeted as a danger as a result of the changes in pressure, water temperature and to other underwater life [8].

SUPPORTING FACTORS OF DIVING HEALTH AND SAFETY BEHAVIOUR

The participants' perceptions of diving were not risky and "sesajen" is seen of as a means of requesting protection from God. This inaccuracy of knowledge is contradictory to the results of the research that found that the older workers have better health and safety behaviour [9]. It turns out that age is not the primary determinant of work health and safety

knowledge and behaviours. Providing periodic education about the importance of health and safety behaviours also plays an important role [10].

Their wife's support in terms of "sesajen" preparation is also a reinforcing factor. Wife provides food, drinks, advice, and prayers. Most wives tend to be passive and obedient related to earning money in family [11]. This encourages the need for social support outside of the family which objectively pays attention to work-based health and safety behaviours.

Diving is the job of the participants and it is passed on from generation to generation. The participants dive according to the experience of their parents or the settlement residents around them [6]. The ability and diving procedure is learnt from the generation before and the absence of skill upgrading has become a reinforcing factor of the participants' health and safety preparation behaviour so far.

FORMS OF DIVING HEALTH AND SAFETY BEHAVIOUR

The participants dive without planning the related health and safety behaviour when diving. What they prepared was related to most of their logistical needs during the dive. This is associated with the traditional divers generally. They only dive according to the generation to generation procedure or they follow others. They were not equipped with an adequate knowledge of health and safety behaviour on diving [3].

The participants only use a compressor as their diving equipment. This is consistent with other studies stating that in general, traditional divers use a compressor [3]. The reasons for this were economic factors and an improper knowledge of safe diving procedures. Traditional divers use a compressor as an alternative [12]. The results showed that all of the traditional divers did not use complete health and safety equipment. This is one of the factors causing disease or disorders due to diving. There is a significant relationship between the use of personal protective equipment and the incidence of decompression [13].

The other supporting factor for health and safety behaviour was “sesajen”. Traditional divers generally prepare “sesajen” before going diving as a form of surrender to God. It asks for abundant marine products and they can avoid catastrophe while diving. “Sesajen” consists of the food, leaves and water [14].

IMPACT OF OCCUPATIONAL HEALTH AND SAFETY BEHAVIOUR

Health problems such as hearing loss, joint pain, and paralysis were reported as being experienced by all participants. The data showed that 29.8% suffered from joint pain, 39.5% suffered from hearing loss, and 10.3% suffered from paralysis [15]. Hearing loss is caused by the failure of the process of the middle ear pressure to equalise to changes in environmental pressure. The diving technique used by traditional divers involves diving by holding their breath and taking air from the surface of the seawater. The air then flows into the compressor [3]. Decompression increases with many factors such as temperature, especially cold temperatures [16].

Several of the participants also experienced paralysis. This was related to the characteristics of the participants in the form of spending a long time becoming a traditional diver. The time from becoming diver can determine the length of a person’s exposure to the risk factors [3, 17]. The longer a person works as a diver, the more they are exposed to a hyperbaric environment which can cause health problems such as paralysis [18]. In addition, diving without preparation such as a certain level of bodily fitness also contributes to the risk of paralysis. Participants who have a history of illness or disability have a risk that is 15.9 times higher when it comes to experiencing health problems that can lead to paralysis [18]. The age of the diver can also be a contributing factor to paralysis. Most of the participants were aged over 35 years old. The ideal age limit for diving is 16–35 years old, while those who are younger than 16 years old or older than 35 years old have higher risks when diving [18].

All of the participants had done more than 12 hours of diving without a resting phase. The longer the time spent

diving, the more nitrogen is absorbed by the body. This can lead to undesirable things such as weakness while in the water, dizziness and feeling cold [19]. In most cases, the symptoms of decompression occur after 6 hours and they often occur within the first hour after diving [5]. The length of time spent while diving in a stressed environment is one of the risk factors for the occurrence of diving disorders, especially decompression [20].

All of the participants felt the economic burden as a result of their health problems. After the participants experience paralysis, they are unable to work. Spending money increases for the treatment of disease. This can be a new economic burden for the family. Because of the economic burden, the participants chose traditional medication from a healer. Self-medication was the first action taken by the individuals in developing countries to deal with the disease [21]. Traditional therapies used include salt compresses, trampling therapy on the seabed, and treatment such as using sago palm fronds to hit their paralyzed legs.

BEHAVIOUR AFTER BEING AFFECTED

The participants, after experiencing the effects of diving, choose to stop and some continue to become traditional divers after some consideration. The participants who decided to stop did so because of health and trauma considerations. Trauma is emotional and psychological pressure because of unpleasant events or experiences. Participants who continue to be divers with consideration will undertake health and safety planning before diving. Individual actions to prevent disease are driven by the seriousness and threat of disease to their health [22]. Perception about the severity of the threat of disease gives rise to a perception of self-vulnerability. Understanding vulnerability encourages people to adopt healthier behaviours [23]. The higher the perceived risk, the higher the chance of engaging in behaviour to reduce the said risk.

CONCLUSIONS

This research shows that the health and safety behaviour of traditional divers is sparked by the participants’ perceptions of the risks of diving on their health. This is supported by the internal and external reinforcement factors of participants. Their perceptions and any reinforcing factors ultimately shape the health and safety actions of the divers. Diving without a plan, using only a compressor and “sesajen” has an impact on the health of the participants. The impact is experienced in the form of health problems, paralysis and economic burden. After being affected, the participants choose to stop being a traditional diver. Some choose to remain a diver with the consideration of making plans before diving. Health and safety when diving must be socialised and facilitated. The development of a diver’s

community that cares about health and safety behaviour when diving becomes important as a support system.

ACKNOWLEDGEMENTS

The researcher would like to thank the Chair of STIKes Maluku Husada for their moral and material support and all of the participants who participated as well.

REFERENCES

1. Ministry of Health of the Republic of Indonesia. Indonesian Health Profile. Bali Province Health Profile. Jakarta: Kementerian Kesehatan RI; 2016, pp. 1–220.
2. Office MP. Maritime and fishery profiles of Banten province. Banten, Indonesia 2018.
3. Prasetyo AT, Soemantri JB, Lukmantlya L. Effect of depth and duration of diving on traditional hearing-threshold divers with ear barotrauma. *Oto Rhino Laringol Indones*. 2012; 42(2): 69–76.
4. Indonesia INI of HR and D. Main Result of Baseline Health Research 2018. Jakarta: Ministry of Health of the Republic of Indonesia; 2018, p. 66.
5. Goplen FK, Grønning M, Aasen T, et al. Vestibular effects of diving - a 6-year prospective study. *Occup Med (Lond)*. 2010; 60(1): 43–48, doi: [10.1093/occmed/kqp148](https://doi.org/10.1093/occmed/kqp148), indexed in Pubmed: [19854795](https://pubmed.ncbi.nlm.nih.gov/19854795/).
6. Ruslam RDC, Rumampuk JF, Danes VR. Analysis of Hearing Loss in Divers at Lake Tondano Watumea Village Eris District Minahasa Regency North Sulawesi Province 2014. *J e-Biomedik*. 2015; 3(1).
7. Salawati B. The Creation Process of A “Biring Bone in Kunyi Village” Bahorea Village Bontosikuyu District Selayar Islands Regency Sulawesi. *Greget J Pengetah dan Pencipta Tari*. 2014; 13(1): 1–11.
8. Uher-Koch B, Rizzolo D, Wright K, et al. A suspended dive-net technique for catching territorial divers. *Ring Migration*. 2016; 31(1): 19–22, doi: [10.1080/03078698.2016.1190615](https://doi.org/10.1080/03078698.2016.1190615).
9. Siu OI, Phillips DR, Leung Tw. Age differences in safety attitudes and safety performance in Hong Kong construction workers. *J Safety Res*. 2003; 34(2): 199–205, doi: [10.1016/s0022-4375\(02\)00072-5](https://doi.org/10.1016/s0022-4375(02)00072-5), indexed in Pubmed: [12737959](https://pubmed.ncbi.nlm.nih.gov/12737959/).
10. Anjuman-i Bii, Tavakoli R, Ghofranipour F, et al. Evaluation of Knowledge, Attitude and Behavior of Workers towards Occupational Health and Safety. *Iran J Public Health*. 2009; 38(2): 125–129.
11. Sumeekar PP, Denny HM, Kusumawati A. Unsafe Behavior Assessment in the Informal Sector of Agate Craftsmen in the New Dargo Market, Semarang. *J Kesehat Masy Univ Diponegoro*. 2017; 5(1): 405–413.
12. Lutfhi OM, Yamindago A, Dewi CSU. Improved safety standards for dive fishermen in the famous peacock compressor, unfortunate with the use of self-contained underwater breathing apparatus scuba. *J Innov Appl Technol*. 2015; 1(2): 1–5.
13. Lucrezi S, Egi SM, Pieri M, et al. Safety Priorities and Underestimations in Recreational Scuba Diving Operations: A European Study Supporting the Implementation of New Risk Management Programmes. *Front Psychol*. 2018; 9: 383, doi: [10.3389/fpsyg.2018.00383](https://doi.org/10.3389/fpsyg.2018.00383), indexed in Pubmed: [29628904](https://pubmed.ncbi.nlm.nih.gov/29628904/).
14. Asruddin NS. The Tradition of Sea Fishing of Muhammadiyah Coastal Fishermen of Gorontalo Province. In: *Konferensi Nasional Ke-8 APPPTMA*. Gorontalo: Center for Oen Science; 2018, pp. 153–161.
15. Health DG. of DC and E. Technical guidelines for diving and hyperbaric health worker for province, district / city and Puskesmas. Jakarta: Health Ministry of The Republic of Indonesia. 2008.
16. Zhang C, Zheng X, Huang H, et al. A Study on the Applicability of the Health Action Process Approach to the Dietary Behavior of University Students in Shanxi, China. *J Nutr Educ Behav*. 2018; 50(4): 388–395.e1, doi: [10.1016/j.jneb.2017.09.024](https://doi.org/10.1016/j.jneb.2017.09.024), indexed in Pubmed: [29276018](https://pubmed.ncbi.nlm.nih.gov/29276018/).
17. Jeong JH, Kim K, Cho SH, et al. Sphenoid sinus barotrauma after scuba diving. *Am J Otolaryngol*. 2012; 33(4): 477–480, doi: [10.1016/j.amjoto.2011.10.017](https://doi.org/10.1016/j.amjoto.2011.10.017), indexed in Pubmed: [22133966](https://pubmed.ncbi.nlm.nih.gov/22133966/).
18. Jusmawati J, Naiem F. Risk Factors for Decompression Sickness Occurrence in the Traditional Diving Community of Saponda Island. *Media Kesehat Masy Indones Univ Hasanuddin*. 2016; 12(2): 63–69.
19. Kane SM, Davis J. Cardiac arrest and death attributable to the “diving response” triggered during incision and debridement of an abscess of the forehead. *J Craniofac Surg*. 2018; 29(5): e507–e509, doi: [10.1097/SCS.0000000000004555](https://doi.org/10.1097/SCS.0000000000004555), indexed in Pubmed: [29608477](https://pubmed.ncbi.nlm.nih.gov/29608477/).
20. Harris RJd, Frawley G, Devaney BC, et al. A 10-year estimate of the incidence of decompression illness in a discrete group of recreational cave divers in Australia. *Diving Hyperb Med*. 2015; 45(3): 147–153, indexed in Pubmed: [26415066](https://pubmed.ncbi.nlm.nih.gov/26415066/).
21. Budijanto D, Roosihermiatie B. Healthy-sick perceptions and patterns of seeking community support in the port area (a qualitative study in the Tanjung Perak port area). *Bul Penelit Sist Kesehat*. 2006; 9(2 Apr).
22. Purwaningsih, Armini NKA. Susanti. Health Believe Model Implementation on the Analyze of Family Decision to Visit the Public Health Center. *J Ners*. 2009; 4(1): 68–78.
23. Hayden J. *Introduction to Health Behavior Theory*. Massachusetts: Jones and Bartlett Publishers 2009.