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

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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 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.

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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 use 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...
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 de-
compression sickness and barotraumas caused by diving;
2) a history of diving using a compressor; 3) a history of work-
ing as a traditional diver for at least 1 year; 4) 25–64 year-
-old; 5) communicate verbally well. Based on the recruit-
ment 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 work-based 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 im-
mediately after the interview process. The interview data
was analysed using the Colaizzi method consisting of seven
stages, namely: 1) describing the phenomena; 2) mark-
ing 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, Air-
langga 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 histo-
ry 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 fami-
ly’s perceptions of the things that are known, experienced,
Table 1. Characteristics of respondents

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

Table 2. Summary of themes and sub-themes

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

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...
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].

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**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. “...I don’t know. Just follow along, grandfather, parents, older adults too. It’s been descending...” (P08)
7. “...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)
8. “...the wife prepared “sesajen” before diving as a prayer to be saved...” (P14)
9. “...use compressors, people here also use compressors...” (P07)
10. “...use compressors, people here also use compressors...” (P07)
11. “...Preparation before diving only food and “sesajen”. My wife was prepared...” (P08)
12. “...before leaving, my wife prepares “sesajen” for the prayers and offerings of sea dwellers...” (P01)
13. “...I've been paralyzed. Almost all fishermen who dive here have been paralyzed...” (P05)
14. “...most often it's ear aches and pains in my leg joints...” (P11)
15. “...ear ache, leg pain, the worst experienced by fishermen divers here is being paralyzed...” (P14)
16. “...Many times paralyzed. Trauma, afraid that if I dive again, I will be paralyzed again...” (P06)
17. “...After this paralysis adds to the economic burden. Add expenses for the treatment...” (P01)
18. “...the need for treatment and daily necessities is more expensive, more and more...” (P13)
19. “...previously had been treated but stopped, there was no money anymore...” (P13)
20. “...Trauma, do not want to dive again. I've had ear scars, joint pain, until paralysis. Trauma...” (P06)
21. “...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)
22. “...Still, want to dive again. Yes actually afraid if it hurts again. Yes, it will do the right planning before diving...” (P04)
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.

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