ABSTRACT

Objective: to describe the sociodemographic and epidemiological characteristics of artisanal fishermen who suffered decompression sickness treated at a Naval Hospital in the Northeast of Brazil. Method: an exploratory study with quantitative approach carried out in a Naval Hospital of the Northeast during the period of February to April 2014. The population was made up of 28 fishermen who have suffered decompression sickness between 2009 and 2013. The project has the approval of the Research Ethics Committee, CAAE 20818913.0.0000.5537. Results: all individuals were male and 53.6% were aged between 31 and 40 years. The highest number of cases happened in 2010 (42.9%) in low season (75.0%) and in the North Coast (96.4%). The paresthesia and pain in upper and lower limbs appeared in 67.9% cases and 57.1% were using protective equipment. Conclusion: male sex and ages between 31 and 40 years predominated. The greatest number of cases occurred in 2010, during the low season, and victims were coming from the North Coast. Descriptors: Occupational Accidents; Decompression; Diving.

RESUMO

Objetivo: descrever as características sociodemográficas e epidemiológicas dos pescadores artesanais atendidos em um Hospital Naval do Nordeste Brasileiro que sofreram doença descompressiva. Método: estudo exploratório, com abordagem quantitativa, realizado em um Hospital Naval do Nordeste, no período de fevereiro a abril de 2014. A população foi composta por 28 pescadores que sofreram doença descompressiva entre 2009 e 2013. O projeto foi aprovado pelo Comitê de Ética em Pesquisa, CAAE 20818913.0.0000.5537. Resultados: todos eram do sexo masculino e 53,6% na faixa etária entre 31 e 40 anos. O maior número de atendimentos foi em 2010 (42,9%), na baixa estação (75,0%) e acidentes no Litoral Norte (96,4%). A parestesia e dor em membros superiores e inferiores ocorreram em 67,9% dos casos e 57,1% usavam equipamentos de proteção. Conclusão: predominou o sexo masculino, na idade entre 31 e 40 anos. O maior número de atendimentos foi em 2010, na baixa estação, e as vítimas eram provenientes do Litoral Norte. Descriptors: Acidentes de Trabalho; Descompressão; Mergulho.

Method

FISHERMEN VICTIMS OF DECOMPRESSION SICKNESS: STUDY IN A NAVAL HOSPITAL

PESCADORES VÍTIMAS DE DOENÇA DESCOMPRESSIVA: ESTUDO EM HOSPITAL NAVAL

Cavalcante ES, Freire ILS, Dantas BAS et al.

ABSTRACT

Objective: to describe the sociodemographic and epidemiological characteristics of artisanal fishermen who suffered decompression sickness treated at a Naval Hospital in the Northeast of Brazil. Method: an exploratory study with quantitative approach carried out in a Naval Hospital of the Northeast during the period of February to April 2014. The population was made up of 28 fishermen who have suffered decompression sickness between 2009 and 2013. The project has the approval of the Research Ethics Committee, CAAE 20818913.0.0000.5537. Results: all individuals were male and 53.6% were aged between 31 and 40 years. The highest number of cases happened in 2010 (42.9%) in low season (75.0%) and in the North Coast (96.4%). The paresthesia and pain in upper and lower limbs appeared in 67.9% cases and 57.1% were using protective equipment. Conclusion: male sex and ages between 31 and 40 years predominated. The greatest number of cases occurred in 2010, during the low season, and victims were coming from the North Coast. Descriptors: Occupational Accidents; Decompression; Diving.

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Method
INTRODUCTION

Brazil has a long coast line parallel to a wide interior space which is irrigated by a large range of hydrographical basins with many rivers, of diverse volumes of water, with predominantly tropical climate characterized by high temperatures in most parts of the country and during more than half the year. These factors favor fishing activity.1

Workers of these coast areas live in a situation of precariousness and danger, where accidents and death are frequent events, whether by typical diseases of diving such as drownings and shipwrecks, or by decompression sicknesses. It was probably due to these conditions that fishing making use of compressors was banned in 1995 by the Ordinance No. 43,3,3

Decompression sickness, also known as decompression illness, air embolism or paralysis of divers, occurs when gases dissolved in the blood and tissues form bubbles that block the flow of blood, causing pain, neurological symptoms that range from mild confusion to abnormal brain functioning.4

It is noteworthy that other areas of the body such as the spinal cord are especially vulnerable to this injury. The symptoms that may seem less important such as paresis in the arm or leg may precede irreversible paralysis unless the case is treated immediately with oxygen and recompression. The inner ear may be affected in a manner that the person feels severe vertigo. These signs and symptoms may appear immediately or during the first 60 minutes after the return to the surface, but some symptoms may appear up to 48 hours after diving.4

Certain precautions can prevent decompression sickness. For instance, the diver must ascend at the maximum pace of 10 meters per minute, making pauses of three minutes every five meters; the diver must avoid more than one dive per day; maintain hydration and respect intervals of 24 hours between diving and flying. Moreover, the diver must know the basic and physiological principles of diving and decompression tables and must learn the exact time needed and depth involved.4

It is also important that rescuers know the disorders related to diving, to provide initial care and initiate as soon as possible the preparation for transport to the emergency room or treatment in the hyperbaric chamber, which consists of a procedure of introducing the patient in a closed chamber where the person is subjected to pressures up to three times higher than the atmospheric pressure.

METHOD

Descriptive exploratory study with quantitative approach performed at a Naval hospital in the northeastern of Brazil, which is configured as a technical body of the Health System of the Navy, whose activities and organizations are regulated by the Naval Operations Command.

Data collection took place from February to April 2014. The population was made up by all artisanal fishermen who suffered decompression sickness and were treated at a Naval Hospital in Northeast Brazil.

This mechanism causes a strong increase of oxygen pressure in the blood resulting in the reduction of nitrogen pressure, which is considered the causative agent of this type of injury. Hyperbaric sessions last, in average, 20-30 minutes.3,4

Taking into account the abovementioned considerations, the following research question was posed: what are the demographic and epidemiological characteristics of artisanal fishermen who suffered decompression sickness treated at a Naval Hospital in Northeast Brazil?

There is a situation of concern in this context, since these fishermen carry often irreversible consequences, remaining without medical social and hospital assistance and, thus, becoming relegated to poverty and family dependence. The results of this study will certainly raise awareness among health professionals of the need to prevent this occurrence.

In order to understand more deeply this reality, this study is proposed and aims at describing the sociodemographic and epidemiological characteristics of artisanal fishermen who suffered decompression sickness and were treated at a Naval Hospital in Northeast Brazil.
The survey was conducted by researchers using as basis the secondary data related to the accidents treated in hospital decompression chamber, which were tabulated and analyzed using descriptive statistics. Subsequently, results were organized in tables and graphs and presented in terms of relative and absolute frequencies.

The study met the ethical principles governing research involving human beings, as recommended by Resolution no. 196/96 of the National Health Council, supplemented and updated by Resolution no. 466/12. The project was previously submitted to ethical evaluation by the Research Ethics Committee of the Federal University of Rio Grande do Norte (REC/UFRN) and approved under the Certificate of Presentation for Ethics Assessment (CPEA) No. 20818913.0.0000.5537.

The study population consisted of 28 male artisanal fishers, most of them (53.6%) belonged to the age group between 31 and 40 years old and were married (35.7%), as shown in Table 1.

### Table 1. Sociodemographic characterization of fishermen who have suffered decompression sickness, 2015.

<table>
<thead>
<tr>
<th>Sociodemographic Characterization</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 - 30</td>
<td>5</td>
<td>17.9</td>
</tr>
<tr>
<td>31 - 40</td>
<td>15</td>
<td>53.6</td>
</tr>
<tr>
<td>41 - 50</td>
<td>6</td>
<td>21.4</td>
</tr>
<tr>
<td>&gt; 50</td>
<td>2</td>
<td>7.1</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>10</td>
<td>35.7</td>
</tr>
<tr>
<td>Single</td>
<td>7</td>
<td>25.0</td>
</tr>
<tr>
<td>Stable union</td>
<td>1</td>
<td>3.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>28</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Figure 1 shows the occurrence of decompression sickness according to the year and it shows the highest number of events occurring in 2010 (n = 12), followed by the year 2009 (n = 8).

![Figure 1. Distribution of cases of decompression sickness among fishermen assisted at the Naval Hospital from 2009 to 2013, 2015.](image)

The Figure 2 presents data on the occurrence of decompression sickness according to seasons, which are known as high season (summer) and low season (other seasons). It was observed that most of the events occurred in the low season (75.0%).
Regarding occurrences of decompression sickness distributed by location, there were more occurrences reported for the North Coast (96.4%), as seen in Figure 3.

Regarding signs and symptoms experienced by fishermen who suffered from decompression sickness, paresthesia and pain in arms and legs prevailed, reported in 67.9% cases, followed by spinal cord injury in 57.1% cases. A notable rate of 25.0% of deaths among fishermen was found. Notable too was the fact that more than half of the fishermen had made use of personal protective equipment (PPE) (57.1%) and claimed to be in dive depths between 21-30 fathoms (32.1%) at the time of the accident, followed by 11 to 20 fathoms (28.6%) (Table 2).

Table 2. Characterization of the time of accident, 2015.

<table>
<thead>
<tr>
<th>Accident Characterization</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grievances presented</td>
<td>19</td>
<td>67.9</td>
</tr>
<tr>
<td>Pain and paresthesia in arms and legs</td>
<td>16</td>
<td>57.1</td>
</tr>
<tr>
<td>Spinal cord injury</td>
<td>7</td>
<td>25.0</td>
</tr>
<tr>
<td>Death</td>
<td>3</td>
<td>10.7</td>
</tr>
<tr>
<td>Other (convulsion, ischemic injury and AMI)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of Personal Protective Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>16</td>
<td>57.1</td>
</tr>
<tr>
<td>No</td>
<td>12</td>
<td>42.9</td>
</tr>
<tr>
<td>Depth of the accident (in fathoms)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 10</td>
<td>1</td>
<td>3.6</td>
</tr>
<tr>
<td>11 - 20</td>
<td>8</td>
<td>28.6</td>
</tr>
<tr>
<td>21 - 30</td>
<td>9</td>
<td>32.1</td>
</tr>
<tr>
<td>31 - 40</td>
<td>4</td>
<td>14.3</td>
</tr>
<tr>
<td>41 - 50</td>
<td>1</td>
<td>3.6</td>
</tr>
<tr>
<td>61 - 70</td>
<td>1</td>
<td>3.6</td>
</tr>
<tr>
<td>Not informed</td>
<td>4</td>
<td>14.3</td>
</tr>
<tr>
<td>TOTAL</td>
<td>28</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Acute myocardial infarction.
DISCUSSION

Concerning the profile of researched individuals, the unanimous presence of male sex was expected and it is observed in other studies. This fact leads to reflection on the sexual division of labor in the context of asymmetric power relations existing between men and women, anchored in a series of elements considered to be specific of “man” and “woman”. 4,6

Artisanal fishing is still one of the main economic activities and livelihood for most households in coastal communities of the Northeast, thus justifying the marital status and productive age of the majority of fishermen who have suffered decompression sickness. However, the presence of young people in fishing activities is determined by social and cultural factors, where passing the knowledge of fishing activities on from parents to children is considered a family tradition. In addition to this explanatory fact, labor market still offers insufficient opportunities in certain cities or regions, causing young people to look for fishing activities to survive. 7

The reduced number of fishermen in older ages has scientific basis. Studies show that after the age of 40 years, the number of morbidities associated with this type of work reaches significant values. These problems include ergonomic causes and even injuries that cause disability in fishermen. 8

Regarding the classification of the number of related accidents per year, period and location, there is evidence of direct connection to climatic conditions, besides the social behavior of local population and visitors. The high percentage of accidents in 2010 is explained by the increase in fish production in that year, that is, with increasing production amounts, working hours also increase, as well as exposure to the risks typical of these activities. The lack of use of PPE also contributes to this, which was observed in 42.9% of the studied population. 9

Large boats destined to various functions often use precautions to minimize the risk of accidents such as the use of Personal Protective Equipment (PPE). It is noteworthy that the occurrence of accidents or any other grievance at sea generates by itself a number of problems to be faced by the crew of these vessels. A range of problems are involved in accidents that happen at the sea, beginning from the lack of resources for an alleged first aid until the time needed to make such grievance is resolved. No less usual, in the case of small boats of fishing or diving, the worst conditions of vessels, difficult access to fishing sites, and lack of adequate knowledge of other fishermen to act promptly during these grievance contribute to the problem. 10

Artisanal fishing exposes fishermen to ergonomic (posture problems), natural (incidence of sunlight on the skin and eyes, chills, cold winds, strong waves), physical (lesions on the hands and feet), chemical (contact with poisonous secretions or chemicals) and biological (contact algae and fecal coliforms) hazards. 11

The PPE is intended to fulfill an important role in health and safety of the worker and, however, the fact is that when the equipment is not adjusted to users, it generates discomfort and in some cases, this discomfort causes rejection of its use. In this sense, the Regulatory Norm NR-6 defines PPE as any device or product for individual use by the worker intended to protect against risks that may threaten their safety and health. 12,13

The use of PPEs among fishermen is considered as unexplored resource, besides the fact that there is no supervision of the use of these devices by any public institution, this way leaving the responsibility for fishermen themselves. 11,14

The period of year is relevant in the sense of classification by dates. During the period of low season (April to September) climate favors fishing practice, leading to intensification of activities. In addition, there is little tourism on the beaches what, in turn, contributes to pollution of the coast, adding to the increase of waste thrown into the sea through underground sewers that hinder the practice in high summer. In the state of Rio Grande do Norte, production of fish is economically important in the North Coast of the state. Thus, the practice of fishing is also enhanced in this region, what is reflected in the findings of this research. 9

Diverse types of grievances related to decompression sickness were observed in this research. Several factors predispose the diver to these diseases, among them those related to equipment failures and improper technique, such as violation of decompression tables that increase nitrogen input in the tissues during the dive and delay its release during the ascendance, trouble to float, rapid ascendance, lack of air and failure of the regulator. 5

There are factors that have to do with the condition of the diver, such as poor fitness, advanced age, female gender, hypothermia and the use of alcohol or drugs. Other factors are linked to the environment, such as extreme temperatures, revolved waters,
traveling by airplane after diving, intense physical exercise in the deep, narcosis by nitrogen and altered carbon dioxide blood partial pressure.  

Among the results presented here regarding grievances of fishermen, pain and paresthesia of the arms and legs were prevalent. This form of decompression sickness results from the formation of bubbles in the musculoskeletal system, typically occurring in one or more joints. The joints most commonly involved are shoulders, hands and ankles. The pain is described as intense articulate, with sensation of friction while in movement. The pain begins gradual, then deep, inconvenient, of mild to high intensity. Victims often try to relieve the pain flexing the joints. Although this form of decompression sickness presents no risk of death, it indicates that there are bubbles in the venous circulation and it can lead to more severe forms if not treated.  

The second most important injury affecting the investigated fishermen was spinal cord injury. The white matter of the spinal cord is considered vulnerable to blistering and nitrogen is highly soluble in myelin. The most common location of this decompression sickness is the lower thoracic spine, followed by the lumbar/sacral and cervical regions. The most common signs and symptoms are pain in the low back and heaviness in the legs. In this form of decompression sickness, the patient usually gives vague statement in an attempt to describe strange sensations or paresthesia which can progress to weakness, numbness and paralysis. Intestinal and bladder dysfunctions are also referred, leading to urinary retention.  

The results of the present research also revealed that the percentage of deaths was significant among the artisanal fishermen. Fishermen often lack knowledge of techniques and security measures in diving, many suffer decompression illness and several have died, according to local reports, especially those who are dedicated to lobster fishing. Besides illegal under Brazilian law, fishing with compressor is done in a dangerous manner, where divers breathe through a hose connected to a gas cylinder provided with oxygen and coupled to the engine of the boat.  

Despite being considered informal work, accidents and deaths resulting from the practice of fishing are not excluded from official statistics. This reality came to call attention after a National Campaign for Accident Prevention for this group of workers, which showed that official results gave the false impression that the number of occupational accidents in the state of Rio Grande do Norte was minimal. However, anecdotal reports warned that the use of compressed air in the lobster fishery would generate large number of serious accidents, including fatal accidents.  

A research conducted by the regional police station of Rio Grande do Norte pointed out that 86.4% of divers have already suffered at least one accident as a result of pressure changes from the dive. Data show that 12 deaths were reported due to decompression sickness within a period of two years in only two of the 32 lobster producer communities of the state.  

Fishermen were injured mainly at depths between 21 to 30 fathoms or the 46.62 to 66.6 meters, besides instances in even greater depths. The account held by the Labor auditor inspector in Rio Grande do Norte in 2003 reports that the shortage of lobster contributes to make the worker immerse in ever greater depths. Although the vast majority of dives are carried out at 30 or 35 meters deep, there are reports of dives of 80 meters, with exclusive use of nitrogen. To avoid the effects of narcosis, nitrogen should be replaced by helium gas in the mixture with oxygen (heliox) in diving more than 50 meters, but this does not occur.  

Besides the gravity of diving deep without the use of proper equipment, the pace at which the dives are performed add to the problem. On this point, literature states that this should occur at most once or twice a day, followed by appropriate rest period. In the coast of Rio Grande do Norte, divers report more than ten daily individual dives. The frequency is determined by the need to catch lobsters, never by the diver's safety. The time of duration of dives is also exceeded.  

It is noteworthy also that the grievances caused by fishermen practices can cause a series of intensive care demands, toward severe patients, resulting in a process often aggressive and painful, and generate high costs and low percentage of full recovery of damages.  

CONCLUSION  

With respect to sociodemographic characterization, there was a predominance of males, mostly aged between 31 and 40 years and married. Regarding the number of calls for decompression sickness, it was found that the highest number was in 2010, during the low season and victims mainly coming from the North Coast.  

When it comes to the characterization of the accident, it was observed paresthesia and
pain in the arms and legs in most cases. In addition, more than half of the victims were wearing personal protective equipment. Most of accidents happened between 21 and 30 fathoms of depth.

The economic factor is present, in a relevant way, in the sense of limited labor market, with no other prospects for employment and income in the cities studied. With the economic potential generated by the fishing practice associated with the financial deficit of this group of workers, production in the activities tends to be intense at certain periods. Consequently, the workload increases proportionally, predisposing these workers to risks and injuries generated by the practice in unhealthy environments and without adequate support. In this context, the proper use of PPE was absent in most cases of accidents.

Findings of this study corroborate the assumption that all aspects checked in the practice of these fishermen determine the exposure and the level of harm attributed to the studied fishers. Thus, the presence of deaths and serious injuries indicate the level of exposure in which fishermen are working or are being subjected to. However, this context imposes on them the continuity of their habits, given the prevailing low academic level, leading to lack of knowledge about the real and potential risks, staying still stuck to its financial difficulties and the high cost of adequate PPEs.

Additionally, one of the extremely significant difficulties for the preparation of this study was insufficient quantity of publications in the scientific literature that address the theme.

ACKNOWLEDGEMENTS

We express our thanks to the Legal Advisor of the Capitania dos Portos, Mr. Cicero Resende (Capitão-de-Corveta - RM1 - T), for allowing our access to legal files of the fishermen submitted to hyperbaric decompression after diving accident on the coast of RN state.

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