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Acute occupational phosphine intoxications in the maritime shipping sector: Belgian and French reported cases

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ABSTRACT

Background: *During ship transport of organic cargo e.g. soybeans in bulk or textiles in containers, there is a risk of pests damaging the cargo during transport as well as of unwanted global spread of organisms. Consequently, fumigation of the shipped goods is recommended. While aiming to protect the cargo from being damaged by pests during the transport time, fumigation constitutes a risk to the health of seafarers and port workers and even fatal cases are seen. Phosphine gas is increasingly applied for fumigation. Based on former experiences this article aims to describe the risk and to provide recommendations for prevention.*

Materials and methods: *All reports of acute occupational exposures to phosphine in the maritime shipping industry to the Belgian Poison Centre were analysed and compared to reports in a study by ANSES (Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail), which collected data from the French Poison Centres. Data were registered and analysed between the 1st of January 1999 and the 31 of December 2018.*

Results: *The reported incidents have so far been rather few but seem to have increased over the last years. Symptoms are gastro-intestinal, neurologic and respiratory and often seem "vague" and non-specific and are often difficult to recognise for first responders. In the cases where the aetiology of the incident is known, there often seems to be a lack of clear information about the risk and options for mitigation in workplaces and among the workers. Twelve publications of case reports were included from the literature review that showed the same patterns as found in the registered incident reports.*

Conclusions: *There seems to be an increase in incidents of acute poisoning from phosphine worldwide. This increase could be linked to the phasing out of methyl bromide in the Montreal Protocol but may also have other explanations. Strict precautions are needed when using phosphine for fumigation of ship cargoes and containers. Since symptoms are often vague, first-responders need to pay attention to the possible occurrence of acute phosphine intoxication as it may be life threatening. Phosphine intoxication remains a diagnosis nor to underestimate not to miss. Further monitoring and research is needed. Preventive actions are mandatory. It is essential to implement in a strict way the existing legislation of an in-transit fumigation with phosphine. Training of the crew and good communication between the different actors during an in-transit fumigation (ship-owner, captain, fumigator, crew, longshoremen) is the key of a good prevention of accidents.*

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Key words: acute phosphine intoxication, occupational, maritime, incidence reports, shipping

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INTRODUCTION

The maritime shipping sector has known an exponential growth over the last 20 years.

United Nations Conference on Trade And Development reports that worldwide, in 2017, 753 million twenty-foot equivalent units of containers were handled in ports [1]. World container port throughput grew by 6 per cent between 2016 and 2017. They also report an increase of 7% for grain transport [2]. The intercontinental liner shipping travel between Europe, America and Eastern and South-Eastern Asia is very high [2]. The International Chamber of Shipping reports that 90% of the world trade is carried by the international maritime shipping industry which makes maritime shipping the "life blood of the global economy" [3].

To prevent the spreading of unwanted organisms, the Food and Agriculture Organisation recommends the shipped goods to be fumigated [4]. On the one hand with the aim to protect the cargo from being damaged by pests during the transport time, and on the other hand — and even more important — with the aim to prevent the spread of pests all over the world and thus to protect human health. Marine fumigation or in-transit fumigation is a process of fumigation where fumigant is applied to the ship's hold at the port of loading the cargo. The technical process of marine fumigation has been described in an earlier article [5]. During the voyage, the ship's Master is responsible for maintaining safe conditions in all occupied area.

An important element is that at the discharge port, before unloading the cargo, there is a process of phosphine degassing.

According to International Maritime Organisation (IMO) Recommendations on the safe Use of Pesticides in Ships, the only fumigant which can be used for this is type of fumigation is phosphine [6].

There is a strict legislative framework for marine in transit fumigation with phosphine [7]: At sea the Recommendations on the Safe Use of Pesticides in ships has to be implemented, but also the IMO International Dangerous Goods code, the International Convention for Safe Containers, and the code of Practice for Packing of Cargo Transport Units (CTU code) have to be followed. While European Union regulations and various national rules are dominant in port or at the end-user, the IMO, Safety Of Life At Sea, United Nations and International Convention for the Prevention of Pollution from Ships MARPOL regulations and recommendations, are limited to circumstances at sea.

Phosphine, when used as a fumigant, is applied in two physical forms: as a gas from pressurised cylinders or as a metallic phosphide, such as aluminium phosphide, magnesium phosphide, calcium phosphide, or zinc phosphide which react with ambient moisture to release phosphine gas [6].

In harbours the exposure to phosphine mostly occurs when dock workers unload the cargo from a fumigated container or bulk carrier or when customs officers inspect goods. Different very interesting studies have been done with measurements of gases in imported containers in European harbours [8–15] and European Union-Occupational and Safety Health (EU-OHSA) published in 2018 a bibliographic and analytic report pointing out quite some problems [16].

EU-OHSA concludes in the report that the occupational exposure limit (OEL) of phosphine is exceeded in 0.4% to 3.5% of the analysed containers. They realised that most containers are never labelled, that there is often absence of standardised protocols (measurement technology/strategy, degasification/ventilation and personal protective equipment and that incidents affecting the worker's health are underreported.

Those studies concern all fumigants, but the scope of this article is to study exclusively acute exposure to phosphine seen taken into account its frequent use for in-transit fumigation. In France, measurements have been done in harbours exclusively for phosphine and the OEL of phosphine was as well exceeded which indicates that there is a risk in our European harbours [5].

The aim of this study is to explore if accidents with acute occupational exposure to phosphine happen in the Belgian and French shipping industry.

The subsequent research questions are:

- If those incidents happen, what is the frequency?
- Is there an increasing trend in the frequency of those incidents?
- What is the extent, the nature and the severity of those incidents?
- Is it possible to explore the background of those incidents in order to explore a better prevention?

MATERIALS AND METHODS

Observational, routinely collected health data were used and reported according to the RECORD Statement [17].

This is a cross-sectional study. In this study data only included the cases officially reported to the Belgian Poison Centre. Cases are anonymous. For each case, we collected data listed below.

PARTICIPANTS

Only occupational exposures and exposures in the maritime shipping industry have been included. Data were registered between the 1st of January 2000 and the 31 of December 2018. An incident is defined as an accidental occupational exposure. Whether the narrative tells when it is linked to the maritime industry, whether the emergency services from the port areas (Antwerp, Zeebrugge) which contacted the Belgian Poison Centre have been retraced. A victim or case has been defined as the object of an ac-

cidental exposure. Victims with or without symptoms were included as cases.

VARIABLES

In the Belgian Poison Centre every call is registered, and a file is made. When we have several calls for the same incident, we connect the files.

DIAGNOSTIC CRITERIA

The clinical severity of the incident has been evaluated by the "Poisoning Severity Score' (PSS) [18]. The global clinical severity of an incident corresponds to the highest severe clinical symptom mentioned in an incident. The PSS has been reviewed with a member of the board of the European Association of Poisons Centres and Clinical Toxicologists.

- the PSS is 0 if there are no symptoms;
- the PSS is 1 or minor if there are mild, transient and spontaneously resolving symptoms;
- the PSS is 2 or moderate if there are pronounced or prolonged symptoms;
- the PSS is 3 or severe if there are severe or life-threatening symptoms;
- the PSS is 4 if symptoms are fatal.

Those data will be compared to a study of the Agence Nationale de Sécurité Sanitaire de l'alimentation, de l'environnement et du travail, France (ANSES) [19, 20]. ANSES did as well as a cross-sectional study, including the cases of acute occupational exposure to phosphine which have been reported to the French Poison Centres. They reported all occupational exposures, thus not only those in the maritime shipping industry. The time frame of their study was 1999–2017. They only included symptomatic exposures.

LITERATURE REVIEW

For discussion, we also performed a literature review. It was performed in PubMed between September 2017 and April 2018. The search terms included a combination of phosphine and derivatives of phosphine, seafarers, different types of ships and fumigation. It was constructed as a block-analysis which consisted of three blocks-columns-divided by the Boolean operator "AND". The words in the same block were divided by the Boolean operator "OR" with "Phosphine", "Ships", "Boats" and "Fumigation(s)" as MESH-terms.

STATISTICAL METHODOLOGY

Chi-square trend analysis in SPSS was used to evaluate the trend of incidences over the years.

RESULTS

In total, we retrieved 34 calls for occupational exposure to phosphine covering 24 incidents with 26 victims. Of the overall occupational exposure to phosphine, 16 of the 24 (66.6%) incidents happened in ports. Those 16 incidents occurring in the maritime shipping industry covered 18 victims which is 69.2% of the total number of victims having been exposed to phosphine or metal phosphides. All cases are listed in Table 1. The trendanalysis is represented in Figure 1.

DISTRIBUTION OF SYMPTOMS

Seven victims presented nausea and 4 vomiting, which makes gastro-intestinal symptoms being the majority of the symptoms (66.6%). Six (33.3%) victims presented respiratory symptoms and 7 (38.8%) victims presented neurological symptoms.

Gastro-intestinal symptoms included nausea, vomiting and abdominal pain. Respiratory symptoms included respiratory tract irritation, cough and bronchospasm. Neurological symptoms included mostly headache. Ten victims presented other symptoms such as mucosa irritation, dry mouth, myalgia, sleepiness, fever. One patient presented a kind of allergic reaction with Quincke oedema, but that patient was exposed to phosphine in a hold with rice containing mycotoxins which could have contributed to the symptoms.

DISCUSSION

Phosphine is a colourless, flammable gas with a smell of garlic or rotten fish. The threshold of olfactory detection in humans varies according to individuals but seems to appear above 0.3 ppm [21].

The main route of systemic absorption is through the lungs. Phosphides can also be absorbed through damaged skin [21]. For workers, the major risk is mainly during acute exposure. Phosphine interferes with the electron transport chain in mitochondria and mainly in myocardial and hepatic cells. For myocardial cells, an alteration of the transmembrane potentials causing arrhythmia and hypotension was described. Cardiac arrest, vascular collapse and pulmonary oedema may occur [22]. Pulmonary involvement with oedema and chemical pneumonia would result from the cytotoxicity of the gas on the lung cells. In lethal cases, hepatic centrilobular necrosis was diagnosed [22]. The majority of deaths occur within 12 to 24 hours of exposure and are related to cardiac effects. Cardiovascular toxicity is reversible. The risk of death arises with exposure greater than 400 ppm of phosphine and after 30 minutes. Health problems could also occur with a concentration lower than 50 ppm [23]. Phosphine depresses the central nervous system and also the peripheral nervous system. The clinical signs described during acute intoxication are directly due to gas toxicity. The first symptoms are pulmonary and gastrointestinal. With exposure with high concentration neurological and muscular signs

Table 1. List of cases from the Belgian Poison Centre

Incidents reported to the Belgian Poison Centre						
No. incident No. case	**Date Place**	**Number of victims**	**Route of exposure Symptoms**	**PSS**	**I**	**Narrative**
1 Case no. 1	2000 Port of Antwerp	1	Inhalation Vomiting Agitation	PSS 1	I_2	A dock worker who was unloading a container ship in the port of Antwerp when he was standing in the docks, some meters from a container but he has inhaled phosphine gas. A priori it seemed to be a very short and limited exposure but despite he got ill. He presented with vomiting and was very agitated. He has been admitted to the emergency department of an Antwerp hospital and was hospitalised for symptomatic treatment, normobaric oxygen and observation. The BPC was contacted by the emergency physician.
2 Case no. 2	2007 Port of Zeebrugge?	1	Inhalation cutaneous No symptoms	PSS 0	I_i	In a non-specified port (Zeebrugge?), during the unloading of a container from India, a dock worker has been covered with aluminium phosphide powder. There was no smell in the container. He presented no symptoms. He contacted the BPC 10 min after the exposure because he was very concerned and it was advised to do a good decontamination (removing clothes, shower) and in case of symptoms to present himself at the emergency department of a hospital.
3 Case no. 3	2008 Port of Antwerp	1	Inhalation cutaneous Ocular Bronchospasm Ocular irritation Cutaneous irritation erythema Angioneurotic oedema (Quincke)	PSS 2	I_1	In the port of Antwerp, a dock worker was unloading a container with rice, contaminated with mycotoxins and whilst unloading he got a bag on his head and powder of aluminium phosphide on his skin which he also inhaled. Immediately, he presented with bronchospasm and angioneurotic oedema. His eyes were irritated and on his skin he got local irritation. The symptoms could also be linked to the mycotoxins. It is unknown if the worker was asthmatic. The BPC was contacted by the occupational doctor of Medimar but it has been advised to hospitalise the patient via the emergency department for symptomatic treatment and medical observation.
4 Case no. 4	2010 Port of Zeebrugge	1	Inhalation No symptoms	PSS 0	I_i	In the port of Zeebrugge, a customs officer was very concerned since the day before, he had opened a container with a warning label for hydrogen phosphide/phosphine. He had no complaints but was very concerned about his health and so anxious that he presented the next to the emergency department of the hospital of Brugge. The BPC was contacted by the emergency physician.
5 Case no. 5	2010 Port of Antwerp	1	Inhalation Nausea Fever	PSS 1	I_1	On Christmas day a seafarer staying in the port of Antwerp presented himself with fever (hyperthermia) and nausea at the emergency department. Apparently his colleague died (no documentation) some days before, after an exposure to phosphine gas. He had been exposed too, but it was not really clear when. The seafarer has been hospitalised. The BPC was contacted by the emergency physician.
6 Case no. 6	2011 Port of Antwerp	1	Inhalation No symptoms	PSS 0	I_i	In the port of Antwerp a dock worker was very briefly exposed to phosphine gas whilst unloading a container ship. He presented no symptoms. The patient has been hospitalised in the emergency department in an Antwerp hospital and the BPC was contacted by the emergency physician. He has been hospitalised for medical observation.
7 Case no. 7	2012 Port of Antwerp	1	Inhalation No symptoms	PSS 0	I_i	In the port of Antwerp, a dock worker unloading grain from a ship came into contact with phosphine gas during 30 min. He presented no symptoms. He has been hospitalised in the emergency department of an Antwerp hospital for medical observation. The BPC was contacted by the emergency physician
8 Case no. 8	2013 Port of Antwerp	1	Inhalation Throat pain	PSS 1	I_1	A dock worker in the port of Antwerp contacts the BPC because 4 days earlier he has been exposed to phosphine. Since than he has throat irritation/throat pain but at the same time his kids have a white angina. It has been advised to consult a general practitioner to make a differential diagnosis.

→

Table 1 cont. List of cases from the Belgian Poison Centre

Incidents reported to the Belgian Poison Centre						
No. incident No. case	**Date Place**	**Number of victims**	**Route of exposure Symptoms**	**PSS**	**I**	**Narrative**
9 Case no. 9	2014 Port of Antwerp	1	Inhalation Nausea Headache Vertigo Myalgia	PSS 1	I_4	A dock worker in the port of Antwerp has been exposed during 2 min to phosphine gas during the unloading of a cargo ship. He has been admitted to the emergency department of an Antwerp hospital since he presented nausea, headache, vertigo and myalgia. He has been hospitalised in the emergency department for symptomatic treatment and medical observation. The BPC has been contacted by the emergency physician.
10 Case no. 10	2015 Port of Antwerp	1	Inhalation Dry mouth Pasty mouth Nausea Abdominal pain	PSS 2	I_1	A seafarer presented himself to the emergency department of an Antwerp hospital. Eight days before he has been exposed to phosphine and he still has symptoms: dry mouth, pasty mouth, nausea, abdominal pain. The ship also carried arsine but it seemed clear the exposure had clearly been to phosphine and not at all to arsine. He has been hospitalised for a paraclinical and clinical assessment. The BPC has been contacted by the emergency physician.
11 Case no. 11	2015 Port of Antwerp	1	Inhalation Nausea Sleepiness	PSS 1	I_4	A dock worker was involved in an incident in the port of Antwerp where a barrel of phosphine was leaking. He has been exposed to phosphine gas 2 ppm during 5 min. He presented nausea and sleepiness. He has been hospitalised in the emergency department for symptomatic treatment and medical observation. The BPC has been contacted by the emergency physician.
12 Case no. 12	2016 Port of Antwerp	1	Inhalation No symptoms	PSS 0	I_i	A worker in the port of Antwerp consulted the occupational nurse because he was very concerned. The day before he had been unloading a ship where the measurements of phosphine seemed to be positive. He didn't have any symptoms but felt very anxious about the situation. The occupational nurse contacted the BPC and it has been advised that the worker got a medical assessment in the emergency department.
13 Case no. 13	2017 Goes, Zeeland	1	Inhalation Dyspnoea Malaise Pallor Paresis Asthenia	PSS 2	I_3	A dock worker had been exposed to phosphine 4 days ago whilst opening a container in Zeeland Seaport. He complained about dyspnoea and malaise and he got hospitalised in the emergency department of the hospital in Goes and afterwards he became symptom free. Now he presents again in the emergency department of an Antwerp complaining of dyspnoea, pallor, paresis and fatigue. The BPC has been contacted by the emergency physician. He stayed hospitalised for a medical assessment.
14 Case no. 14	2017 Port of Antwerp	1	Inhalation Respiratory tract irritation	PSS 1	I_4	A dock worker in the port of Antwerp was exposed to phosphine whilst opening a container. The measurements showed phosphine 1.14–0.7 ppm. There was a correct ventilation of the container. Since the patient presented a respiratory tract irritation he has been hospitalised in the emergency department of an Antwerp hospital. The BPC has been contacted by the emergency physician.
15 Case no. 15 Case no. 16 Case no. 17	2018 Port of Antwerp	3	Inhalation Nausea Vomiting Cough Headache Vertigo	PSS 1	I_4	In the port Antwerp 3 dock workers have been exposed to phosphine whilst opening a container without knowing about it being fumigated with phosphine. The exposure time was maximum 5 min. The measurement after the exposition was 0 ppm. Although they immediately presented nausea, vomiting, cough, headache and vertigo. The have been hospitalised in the emergency department of an Antwerp hospital for symptomatic treatment and medical observation. The BPC has been contacted by the emergency physician.
16 Case no. 18	2018 Port of Antwerp	1	Inhalation Vertigo	PSS 1	I_2	A dock worker in the port of Antwerp has been exposed to phosphine and presented vertigo. He had consulted a general practitioner who contacted the BPC for advice. Since it was a doctor on call a follow-up was not possible.

BPC — Belgian Poison Centre; PPS — Poisoning Severity Score

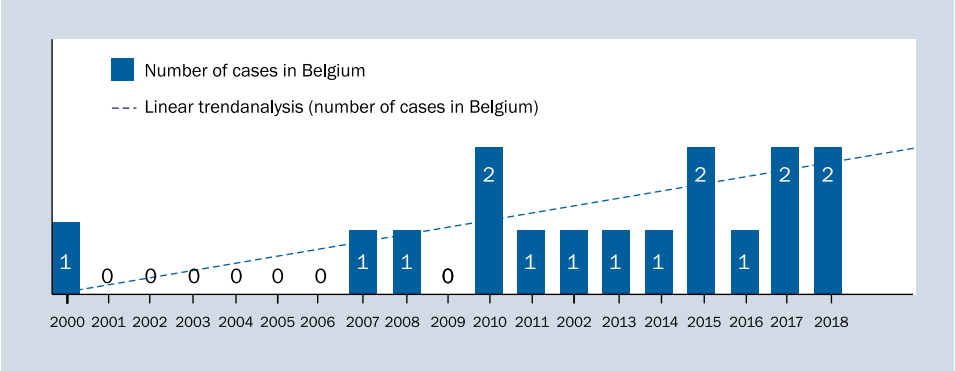

Figure 1. Number of cases in the Belgian Poison Centre

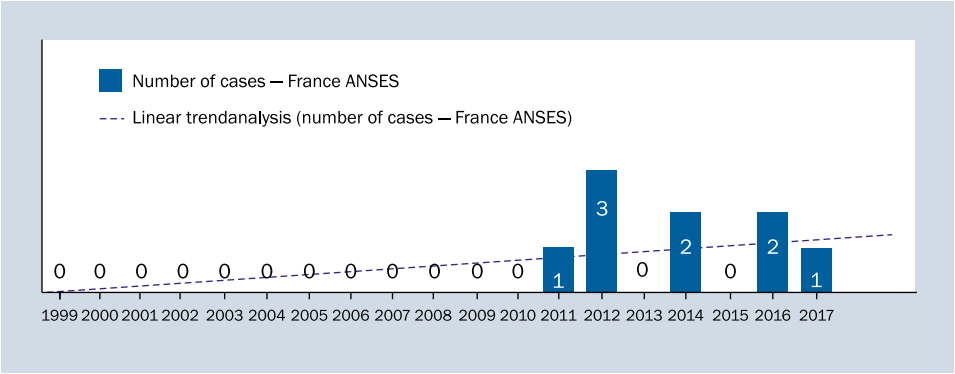

Figure 2. Number of cases in France ANSES (Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail)

appear [24]. Hepatic disorder usually appear only 48 to 72 hours later with elevated blood transaminases and bilirubin. Haematuria, proteinuria and renal failure could also occur. Signs of respiratory and metabolic acidosis may be revealed in blood gases. Similarly, increased levels of magnesaemia and kalaemia due to massive myocardial cytolysis have been described [22]. The long-term follow-up of intoxicated patients did not show the persistence of these disorders. But, respiratory diseases such as reactive airways dysfunction syndrome could occur after subacute exposure at moderate dose [24]. Anaemia, gastrointestinal, ophthalmological, motor and aphasia disorder have been described after chronic exposure to very low dose. These disorders were especially noted in children [22]. Phosphine is not classified as carcinogenic or reprotoxic by the International Agency for Research on Cancer and the European Protection Agency [25].

In the retrospective study published by the ANSES, 9 incidents and 12 symptomatic victims were retrieved (Fig. 2) [19]. Of the 12 victims, 1 was exposed as a lorry driver and 5 victims were exposed in land whilst opening/working in containers. Like for Belgian Poison Centre there seems to be an increase in cases over the last years in Belgium: comparing the period 2000–2009 (0.002% of all calls) versus the period 2010–2018 (0.01%) and in France: 1 case in 2011, 3 cases in 2012, 4 cases in 2014, 2 cases in 2016 and 2 cases in 2017. This could be linked to the phasing out of methyl bromide in the Montreal Protocol or better knowledge and information on this risk in workers' population. Exposure at work in harbours and in logistic platform was the most frequently described in the two studies. Port workers, seafarers and logistic workers during unloading/loading containers and bulk carriers have higher risk levels of acute exposure to phosphine. This problem of exposure along the transport chain has been reported by different authors [26, 27].

Not surprisingly with high ratio of male in these occupations, in the French and Belgian studies all cases were male. The findings of the French study, even if not exclusively maritime, are very similar to the above described cases from the Belgian Poison Centre. The basic difference is that in the Belgian series of cases are included asymptomatic victims whilst in the French study only symptomatic victims were included.

All cases were exposed to phosphine mostly by inhalation of phosphine gas (respectively 58% and 89% in France and Belgium). Most symptoms were irritative (pulmonary and ocular first). Non-specific symptoms were also described in both studies. Like we discussed in a study on 125 French dockers, neurologic symptoms were frequently

noticed by workers but they are unspecific of exposure to fumigants (dizziness, headaches, sleep disorders) and link to occupational exposure is difficult to prove. Some questionnaires like the Fumex questionnaire developed by the European Society of Occupational and Environmental Medicine and another one by the French Society of Maritime Medicine [28]. We hope that they could be helpful to clinicians. In Belgian cases, more gastrointestinal symptoms were described. This may be explained by higher levels of exposure and more frequently pulmonary exposure in maritime transport.

Neither in the French nor in the Belgian study, any severe symptoms occurred. In the French study 9 of the 12 cases had a PSS 1 and 3 had a PSS 2. Indeed, the Dutch Poison Centre did a study between February 2011 and January 2013 about the registration of occupational exposure to gases whilst opening sea containers [29]. They registered the calls for information concerning occupational exposure to gases from sea containers. In that period, they were consulted for 14 incidents with 33 victims. In 8 incidents which concerned 24 workers, they could do a follow-up. Three incidents concerned an exposure exclusively to phosphine. The findings in the Dutch study were that all cases of exposures to gases coming from containers had minor symptoms. This corresponds to the findings of Preisser et al. [30, 31] and Verschoor et al. [32]. In all cases of acute exposure included, a medical consultation was made and hospitalisation respectively for 9/12 cases in France and 16/18 in Belgium. There are two explanations for that: the risk of delayed symptoms was known by workers or supervisors and they were addressed to emergency services systematically or more workers were anxious about this occupational exposure and wanted explanations on medical assessment.

Like described in the study by Pedersen et al. [28], workers and supervisors have a limited knowledge about the type of chemicals in containers' atmosphere and their health impact, the second hypothesis seems more realistic.

In the Dutch study, workers declared being anxious about the impact of the acute exposure to fumigants. That anxiety often seems to be caused by a lack of information concerning the risk they have been exposed.

In line with the findings of Preisser et al. [30, 31] and Verschoor et al. [32] the Belgian Poison Centre has as well been contacted concerning longer lasting symptoms. Considering this fact and the findings of the above-mentioned publications, the impact of longer lasting symptoms after an acute exposure to phosphine should not been underestimated. As mentioned earlier in this paper, the EU-OHSA report 2018 points out some problems on the work floor [16]. The report is about all fumigants but gives a line for the situation with phosphine, since phosphine is mainly used for in-transit fumigation. EU-OHSA states that often exposure to fumigants is higher than the OELs, that containers are rarely labelled, that there are few protocols for controlling containers and that reporting of accidents is often not done.

Meanwhile, it is very important that harbours and workplaces implement the recommendations EU-OSHA has given into their report, such as a good risk assessment before opening containers or unloading cargo ships, standardised off-gassing procedures, reinforcement of the legislation concerning labelling of containers and good information towards the workers concerning the possible risks [16].

LIMITATIONS OF THE STUDY

Our study also has some limitations. Observational routinely collected health data from the Belgian Poison Centre were used and reported according to the RECORD Statement. Those data are not always complete due to substantial reporting deficits depending on the type of records (e.g. used codes and terms and their uniformity) [17]. Only occupational exposures and exposures in the maritime shipping industry have been included. However, it has not been possible to know all details of the exposure, products or to know the outcome of an exposure. Only in some recent cases a follow-up has been done.

In the Belgian registration there are probably quite some cases where phosphine has been released by aluminium phosphide due to the opening of the containers under given meteorological conditions and where phosphine has been mentioned as the toxin but probably coming from aluminium phosphide tablets or sachets [5, 16]. Conclusions are drawn based on the analysis of the pattern and the incidence of the accidents exploring the accidental aetiology, clinical presentation and medical care. Since the poison centres are not always contacted for those incidents, it is an underestimation of the reality. We have also been limited in the data collection. It was also difficult to have relevant information from port instances and hospitals around the ports.

Seen the above-mentioned limitations, the results of the study from the Belgian Poison Centre should be interpreted carefully. Because of non-specific symptoms, lack of workers' and medical doctors' experience of this occupational exposure, most of the incidents are probably never reported.

CONCLUSIONS

For occupational exposure to phosphine, the findings of the Belgian Poison Centre and the French Poison Centres are showing a tendency of increased numbers of incidents. In Belgium, all victims were male dockers. Most of the symptoms are non-specific. To facilitate safe handling of

fumigated containers at sea and in port/on land, joint effort from both organisations is needed. Strict precautions are needed when using phosphine in fumigation processes on ships. Different actors in the fumigation process should work together in a transparent way and should be well informed. From ship-owner to crew, captain, harbour instances, dockers and primary health care givers.

The lack of knowledge of stakeholders, workers and physicians needs an answer. We are convinced that, information by means of scientific literature but also by social media or the International Maritime Health Association has to be done. For measures of prevention, like writing in the EU-OSHA report, local or national or international guidelines for safely handling containers and stuffs in maritime industry have to be developed. A European study including most poison centres' databases should be relevant to increase the knowledge on this occupational intoxication.

REFERENCES

1. Ec.europa.eu. Data – Eurostat maritime transport. https://ec.europa.eu/eurostat/web/transport/data (Accessed 2 December 2019).
2. The United Nations Conference on Trade and DevelopmentUnctad.org. UNCTAD | Statistics. https://unctad.org/en/Pages/Statistics.aspx (Accessed 2 December 2019).
3. International Chamber of Shipping ICS. Shipping Facts. http://www.ics-shipping.org/shipping-facts/shipping-facts (Accessed 2 December 2019).
4. Food and Agriculture Organization. Manual of fumigation for insect control-Space fumigation at atmospheric pressure. http://www.fao.org/3/x5042e/x5042E0L.HTM#Fumigation%20of%20bagged%20goods%20in %20ships%20and%20barges (Accessed 2 December 2019).
5. Lucas D, Mauguen G, Lesné P, et al. Exposure to phosphine in maritime transport: a real and important occupational risk: a report of three cases. Int Marit Health. 2018; 69(3): 181–183, doi: 10.5603/imh.2018.0029.
6. International Maritime Organisation IMO. Recommendations on the Safe use of Pesticides in Ships applicable to the fumigation of cargo transport units. http://www.imo.org/blast/blastDataHelper.asp?data_id=22227&filename=1265.pdf (Accessed 2 December 2019).
7. Low A, Hüsing UP, Preisser A, et al. Regulations and control of in-transit fumigated containers as well as of fumigated cargo ships. Int Marit Health. 2003; 54(1-4): 77–85, indexed in Pubmed: 14974780.
8. Knol-de Vos T. Measuring the amount of gas in import containers — Report 609021025/2003 Bilthoven. Dutch National Institute for Public Health and the Environment. 2002. https://www.rivm.nl/bibliotheek/rapporten/609021024.pdf (Accessed 2 December 2019).
9. Baur X, Poschadel B, Budnik LT. High frequency of fumigants and other toxic gases in imported freight containers — an underestimated occupational and community health risk. Occup Environ Med. 2010; 67(3): 207–212, doi: 10.1136/oem.2008.043893, indexed in Pubmed: 19858536.
10. Spijkerboer H, Vries Ide, Meulenbelt J. Use of fumigants in sea containers can lead to serious human poisonings. Toxicol Lett. 2008; 180: S139–S140, doi: 10.1016/j.toxlet.2008.06.784.
11. Scholtens EJ, De Vr, Meulenbelt J. International transport of fumigated containers, a risk for dock workers. Clin Toxicol. 2009; 47/5(494): 1556–3650.
12. Preisser AM, Heblich F, Budnik LT, et al. Health disorders due to fumigants: Occupational health aspects and long-term findings. Zentralblatt für Arbeitsmedizin, Arbeitsschutz und Ergonomie. 2009; 59: 180–184.
13. Baur X, Budnik LT, Preisser AM. [Health risks of residual fumigants in international transport containers]. Dtsch Med Wochenschr. 2010; 135(11): 516–521, doi: 10.1055/s-0030-1249198, indexed in Pubmed: 20221968.
14. Baur X, Poschadel B, Budnik LT. High frequency of fumigants and other toxic gases in imported freight containers–an underestimated occupational and community health risk. Occup Environ Med. 2010; 67(3): 207–212, doi: 10.1136/oem.2008.043893, indexed in Pubmed: 19858536.
15. Svedberg U, Johanson G. Work inside ocean freight containers–personal exposure to off-gassing chemicals. Ann Occup Hyg. 2013; 57(9): 1128–1137, doi: 10.1093/annhyg/met033, indexed in Pubmed: 23825354.
16. European Union- Occupational and Safety Health Agency. Handling fumigated containers in ports — health risks and prevention practices - Safety and health at work – EU-OSHA. https://osha.europa.eu/en/tools-and-publications/publications/health-risks-and-prevention- practices-during-handling-fumigated/view (cited 2 Dec 2019).
17. Nicholls SG, Quach P, von Elm E, et al. The REporting of Studies Conducted Using Observational Routinely-Collected Health Data (RECORD) Statement: Methods for Arriving at Consensus and Developing Reporting Guidelines. PLoS One. 2015; 10(5): e0125620, doi: 10.1371/journal.pone.0125620, indexed in Pubmed: 25965407.
18. World Health Organisation. Poison Severity Score. https://www.who.int/ipcs/poisons/pss.pdf (Accessed 19 December 2019).
19. Agence Nationale de Sécurité Sanitaire de l'alimentation, de l'environnement et du travail ANSES. Expositions à des préparations contenant des phosphures dans le cadre d'une activité portuaire ou maritime, ou lors de l'ouverture d'un conteneur. Étude rétrospective des observations enregistrées par les Centres antipoison et de toxicovigilance français (1999-2017). ANSES Sept 2018. https://www.anses.fr/fr/system/files/Toxicovigilance2018SA0290Ra.pdf (Accessed 5 December 2019).
20. World Health Organisation WHO. The French imputability method. https://www.who.int/medicines/areas/quality_safety/safety_efficacy/trainingcourses/2imputabilitefr.pdf (Accessed 19 May 2019).
21. Phosphine (FT 179). Généralités-Fiche toxicologique-INRS. http://www.inrs.fr/publications/bdd/fichetox/fiche.html?refINRS=FICHETOX_179 (Accessed 5 December 2019).
22. Hoffman RS, Howland MA, Lewin MA, Nelson LS. Goldfrank's Toxicologic Emergencies, 10th edition. McGraw-Hill Education, Europe 2015: 1381–1383.
23. International Labour Organisation. ICSC 0694 - PHOSPHINE . https://www.ilo.org/dyn/icsc/showcard.display?p_version=2&p_card_id=0694 (Accessed 19 March 2019).
24. The Emergency Response Safety and Health Database: Lung Damaging Agent: PHOSPHINE-NIOSH. https://www.cdc.gov/niosh/ershdb/emergencyresponsecard_29750035.html (Accessed 19 March 2019).
25. Occupational Cancer – Carcinogen List – NIOSH Safety and Health Topic . https://www.cdc.gov/niosh/topics/cancer/npotocca.html (Accessed 19 March 2019).
26. Baur X, Budnik LT, Zhao Z, et al. Health risks in international container and bulk cargo transport due to volatile toxic compounds. J Occup Med Toxicol. 2015; 10: 19, doi: 10.1186/s12995-015-0059-4, indexed in Pubmed: 26075009.
27. Lucas D, Loddé B, Jegaden D, et al. Phosphine exposure in maritime foodstuff transportation: a recent case along logistic chain. Proceedings of the 2nd International DiMoPEx conference. Journal of Health and Pollution. 2018; 8(17): S1–S77.

28. Pedersen R, Jepsen J, Ádám B. Regulation and practice of workers' protection from chemical exposures during container handling. J Occupat Med Toxicol. 2014; 9(1), doi: 10.1186/s12995-014-0033-6.
29. Rapport 10/2014 Omvang, aard en ernst van incidenten met blootstelling van werknemers aan schadelijke gassen uit (gegaste) containers. NVIC. Umcutrecht.nl. 2014. https://www.umcutrecht.nl/getmedia/1b18d8b2-ed36-4238-a472-34fa113179a1/Incidenten-met-blootstelling-aan-containergassen.pdf.aspx?ext=.pdf (Accessed 19 March 2019).
30. Preisser AM, Budnik LT, Baur X. Health effects due to fumigated freight containers and goods: how to detect, how to act. Int Marit Health. 2012; 63(3): 133–139, indexed in Pubmed: 23129094.
31. Preisser AM, Budnik LT, Hampel E, et al. Surprises perilous: toxic health hazards for employees unloading fumigated shipping containers. Sci Total Environ. 2011; 409(17): 3106–3113, doi: 10.1016/j.scitotenv.2011.04.053, indexed in Pubmed: 21636109.
32. Verschoor A, Leeuwen Hv, Verschoor L. Health problems in handling gassed containers. Zentralblatt für Arbeitsmedizin, Arbeitsschutz und Ergonomie. 2014; 60(7): 246–247, doi: 10.1007/bf03344291.

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Seasickness and its impact on researchers' work on board French oceanographic vessels

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ABSTRACT

Background: *Seasickness (SS) is an often hidden pathology, but one that can significantly disrupt work on board. The aim of the study is to evaluate the influence of SS on the workability of workers on board vessels.*

Materials and methods: *We performed a cross-sectional questionnaire study conducted on 250 oceanographers in 2015 during 3 months. Based on the "Bos seasickness susceptibility questionnaire", we created a specific questionnaire with 49 questions.*

Results: *151 men and 72 women responded to the survey. 188 of them (91.7% of women and 80.8% of men) report being seasick, either occasionally (69%) or at each boarding where there is female predominance (23.6% vs. 11.3% for men). The major symptoms are nausea (82%) and vomiting (56%). 60% of the workers think that SS has an influence on the success of their mission, by first affecting their mood (50%), relationship (23%), and increased risk of accidents such as falls, accidents on machines or in laboratories (40%). Antinaupathic treatments also produce deleterious effects on their workstation. Women have higher risk of developing SS (odds ratio [OR] 2.6; 95% confidence interval [CI] 1.03–6.6; p = 0.04), more frequently taking medicines when ill (OR 4.1; 95% CI 1.27–13.2; p = 0.004) and coming with her own tablets (OR 2.3; 95% CI 1.3–4.1; p = 0.04).*

Conclusions: *Gender is a trending factor of SS. Information on SS clinical signs, impact and therapeutics could be prone to prevent sickness and impact of it on workability.*

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Key words: maritime medicine, seasickness, onboard conditions

INTRODUCTION

On board a ship, in addition to its own movement related to its propulsion and like for all nonstable natural environment, the sea could induce various movements back and forth (pitch) and from right to left (roll). This complex and random system of very low frequency vibratory type, due to changing weather conditions, is variable in time, frequency and intensity. The main result is a vertical translational movement directly related to waves' height. The frequency of these vibrations is between 0.01 Hz in very calm condition and 1.5 Hz in bad weather and accelerations range from 0.01 to 0.8 g, sometimes even 1 g. At these frequencies, the body behaves like a single mass and the vibrations are fully transmitted in amplitude and acceleration (whole body vibrations) [1].

O'Hanlon and McCauley [2] have shown that, more than roll and pitch, which would ultimately play a secondary role, the primary cause of seasickness (SS) is above all the acceleration of the vertical component of the movements. An abacus drawn from the theory of these authors was modelled by Bos and Bles [1]. They compiled the frequency of the movement (in Hertz [Hz]), the acceleration (in m/s^2) and the motion sickness incidence (MSI = percentage of subjects presenting a vomiting within 2 h) [1]. Thus, the maximum MSI would be reached for a movement frequency of 0.16 Hz and an acceleration of 5.4 m/s^2. Lawther and Griffin [3] and after Davis and Hollowey [4] confirmed that the MSI was directly dependent on waves' height and proportional to the movements' vertical acceleration.

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Seasickness is a consequence of a body positioning information disorder, involving simultaneously three components: the vestibular system; the visual system, in particular tracking; and the proprioceptive and somatosensory system, in particular feet and nape of neck. The information produced by these three systems, transmitted to the brain centres, is compared with each other, but also compared with the information previously stored, to evaluate their coherence, which involves an adequate motor reaction of equilibration when they are coherent. In the case of SS, this information is conflicting and results in the appearance of clinical signs (sensory rearrangement theory of Reason and Brand [5]).

The chronology, number and intensity of the symptoms could be different in a very marked way according to the individual susceptibility of the individuals, the size of the ship, the nature, duration and importance of the movement and the environmental conditions (odours, heat, onboard places, position of the body and psychological conditions). We classically distinguish three phases: the beginning phase (anxiety, pallor, cold sweats, yawning, salivation, and drowsiness), the state phase (nausea, vomiting and prostration) and evolution (in general resolution of signs within a few hours). In rare cases, the process can lead to acute dehydration, imbalance of a preexisting health disorder such as diabetes, or disruption of treatment (not taking medication or rejection by vomiting).

Most studies and articles published in the field of motion sickness talked about road and air transport. Some also discussed about the mal du debarquement syndrome but SS in seafarers' population is rarely discuss. Few studies have been published on the influence of SS and time to get used to life at sea on the workability of workers on board vessels.

The objectives of this study were to test certain epidemiological data found in the SS literature (prevalence, differences in relation to sex, study of clinical signs) and above all to assess the medical, economic and relational impact of this pathology on the implementation of professional tasks on board, highlighting the possible differences between men and women.

We studied these questions in a population of oceanographic researchers from a French research centre.

MATERIALS AND METHODS

SURVEY METHODOLOGY

This is cross-sectional questionnaire study was conducted on 250 oceanographers in 2015 during 3 months. Based on the "Bos seasickness susceptibility questionnaire" [6], we created a specific questionnaire with 49 questions. Before the survey and during an onboard mission, it was tested in a smaller population. A health unit with an occupational nurse and a physician was located in the research centre. According to the health policies of the occupational health service, all workers who had onboard worktimes had been referred to the health unit for annual medical examinations. In 2014, during examinations, employees of the health unit inform workers about the survey. In 2015, the questionnaires were sent individually by email. Workers had to send it back to the occupational health. They gave it in hand to hand to the nurse and confirm their consent. The inclusion criteria were: volunteer, being a researcher or a technician from the French research institute, regular onboard mission, fit at work and for navigation [7]. The onboard periods were either coastal or longer ocean-going missions.

STATISTICAL ANALYSIS

Statistical analysis was done by using Statistica software (TIBCO data sciences, Palo Alto California, USA). The quantitative variables were described using the usual position and standard deviations. Categorical variables were presented as numbers (percentage). When conditions applied, the t-test was used. When needed, the Shapiro-Wilk test was used to test for normal distribution of data. Where variables were not normally distributed, non-parametric test (Mann-Withney U test) were used, otherwise. Crude odds ratio (OR) including 95% confidence interval (CI) were calculated by binary regression. The alpha risk was set at 5% for all analyses.

RESULTS

DATA COLLECTION

The source population included 250 workers: oceanographers are researchers from different specialties (biologists, geologists, oceanographers, climatologists, physicists, chemists) who are interested in all aspects of the marine environment. We collected 223 questionnaire (151 men and 72 women), for a satisfactory response rate of 89.2%.

The population and missions characteristics are summarised in Table 1.

Frequency, characteristics of SS and environmental factors effects are listed in Table 2.

Table 1. Characteristics of population and onboard missions

	Number	Per cent
Men	151	67.7
Women	72	32.3
Coastal and offshore	136	61
Offshore	58	26
Coastal	29	13
1 to 2 missions	133	59.6
> 2 missions	90	40.9
Total	223	

Table 2. Frequency, characteristics and environmental factors effects on seasickness

		Number	Per cent
Seasickness	Yes	188	84.3
	Never	35	15.7
Frequency	Sometimes	154	81.9
	Every time	34	18.1
With sea conditions	Yes	166	89.2
	No	20	10.8
	Total	186	
Vertical movements of the ship	Yes	145	78.4
	No	36	19.5
	Total	185	
Roll movements of the ship	Yes	92	50
	No	74	40.2
When first symptoms begin	After some hours	167	88.8
	Immediately after embarkment	20	10.6
Do you need time for getting used to the sea	Yes	165	88.2
	No	22	11.8
When symptoms disappeared	2/3 days	81	44
	1 day	43	23.4
	Few hours	34	18.5
	Never	26	14.1
Symptoms are increased by	Smell of gasoil	136	88.9
	Smell of cooking	83	54.2
	Smell of tobacco	80	53.2
	Poor ventilation	54	35.2
Influence of menstruation period	Don't know	45	62.5
	No	20	27.8
	Yes	7	9.7

Vomiting is the highest stage of SS and allows patients to be counted on a common basis (MSI). The Tables 3 and 4 demonstrates respectively the SS symptoms, the impact of SS on workability and missions declared by workers.

When comparing two groups by gender, we find significant differences for SS (OR 2.6; 95% CI 1.03–6.6; p = 0.04), increased frequency in women for taking medicines when ill and coming with her own tablets (respectively OR 4.1; 95% CI 1.27–13.2; p = 0.004 and OR 2.3; 95% CI 1.3–4.1; p = 0.04) (Table 5).

Average boarding times were much lower for coastal missions (7.8 days) compared to offshore missions (25.7 days, p = 0.05).

FREQUENCY OF SEASICKNESS

The occurrence of SS was not related to the number of days on board (18 days for agents prone to SS and 21 days for the others, p = 0.1), age (p = 0.7) nor to the type of navigation (83.5% for offshore, 89.7% in coastal, p = 0.86).

Table 3. Declared symptoms of seasickness in percentage

Nausea	81.9%
Vomiting	55.9%
Pallor	43.1%
Yawning	42.6%
Cold sweats	40.4%
Drowsiness	38.3%
Fatigue	35.6%
Work disinterest	35.1%
Listlessness	17%
Withdrawal	16.5%
Headaches	16.5%
Dizziness	12.8%
Balance impairment	6.9%
Sopite syndrome	2.6%

Table 4. Impact of seasickness (SS) on workability

		Number	Per cent
Are you afraid of SS before embarkment	No	164	85.4
	Yes	28	14.6
Due to SS, have you refused a mission	No	183	95.8
	Yes	8	4.2
Does SS have an impact on your mission?	Yes	118	62.1
	No	72	37.9
What kind?	My own mood	86	75.4
	Economical	43	37.7
	Relationship with colleagues	33	28.9
	Hard relationship with head of mission	5	4.4
In case of SS what do you do?	Go on deck	106	56.4
	Stay in my cabin	99	52.7
	Take medicines	79	42
	Nothing special	25	13.3
Type of medication	Nothing	85	45.9
	Mercalm	53	28.6
	Scopolamine patches	40	21.6
	Other: homeopathy, food and beverages	18	9.7
	Stugeron	3	1.6
Do you feel embarrassed by SS	No	119	64
	Yes	67	36
What is the most embarrassing?	Less reactive and active at work	61	88.4
	To be sick in professional place	29	42
	My colleagues could see me vomiting	18	26.1
Is SS have an impact on your time at workplace	Yes	95	50.8
	No	92	49.2

Table 5. Comparison by gender

	Man	Woman	Odds ratio	P
Seasickness* (yes)	122 (80.8%)	66 (91.7%)	2.6 [1.03–6.6]	0.004
Coastal missions	19 (12.6%)	10 (13.9%)	2.2 [0.86–5.4]	0.09
Coastal and offshore	105 (69.5%)	31 (43.1%)	0.56 [0.23–1.33]	0.18
Symptoms				
Stop after few hours	17 (14.3%)	17 (26.2%)	2.3 [0.9–5.88]	0.08
Stop after 2 days	58 (45.7%)	23 (35.4%)	0.91 [0.4–2]	0.8
Never stop	14 (11.8%)	12 (18.5%)	1.97 [0.72–5.42]	0.18
Afraid before mission (yes)	14 (11.3%)	14 (20.6%)	2.03 [0.9–4.57]	0.08
Take medicines* (yes)	44 (35.8%)	35 (53.8%)	4.1 [1.27–13.2]	0.001
Come with my own medicines (yes)*	52 (36.4%)	41 (53.9%)	2.3 [1.3–4.1]	0.004
No embarkation because of SS (yes)	4 (3.2%)	4 (6%)	0.52 [0.12–2.1]	0.37
Does SS have an impact on your mission? (no)	45 (36.6%)	27 (40.3%)	1.17 [0.63–2.15]	0.61
Concentration at work (no)	65 (52.8%)	30 (46.9%)	1.27 [0.69–2.32]	0.4
Do you feel embarrassed by SS	41 (33.3%)	26 (41.3%)	1.4 [0.75–2.62]	0.28

*$p < 0.05$

Table 6. Medicines

	Man	Woman	Total
Dimenhydrinate	18.5%	34.7%	23.8%
Cinnarizine	2%	0%	1.4%
Scopolamine's patch	13.3%	27.8%	17.9%
Other (acupuncture, homeopathy)	7.3%	9.7%	8.1%
Are medicines efficient yes	75%	84%	79%

TAKING ANTI-SICKNESS TREATMENT

Table 6 summarises the behaviours implemented during the occurrence of a naupathy. The most widely used conventional treatments were dimenhydrinate and cinnarizine (only 1% for the latter molecule because it is not marketed in France, despite its recognized effectiveness) for treatments in tablets and scopolamine per patch [6, 7].

DISCUSSION

The high level in response rate allows us to discuss our results.

We found, consistently to literature on the subject, gender susceptibility for SS and mostly gastrointestinal disorders. Due to SS, women are also more anxious before mission and taken medicines, but they less declared than men impact on work (concentration at work, psychological disorders).

Due to extreme variability of its occurrence' conditions it is hard to collect quantitative data on the incidence and prevalence of this pathology. Indeed, the weather, sea conditions and number of patients during each mission are various. The estimated prevalence ranged from 25% to 30% of American and British white populations in calm sea, increasing between 50% and 90% in heavy sea [8]. A recent publication on sailors from the French Merchant Navy gives a figure of 55% of sailors who would not be affected by SS at all [9]. In our study we found respectively a prevalence of 84% and 69% for "occasionally or systematically" and "occasionally" SS suffering. Lower frequency and duration of onboard mission in researchers could explain it. Consistent with our results, gastrointestinal symptoms were more frequently declared with nausea (61%) and vomiting (48%) followed by yawning and drowsiness (30%) in the study involved by Turner and Griffin [10] or incidence of vomiting of 40% in 4915 passengers during 17 trips [8, 10]. Various percentages for apathy, fatigue and cold sweats are described [10]. But data in literature is based either on a calculation of the MSI in specific conditions [10]. In 1976, Graybiel and Knepton [11] isolated a particular type of motion sickness, sopite syndrome, associating drowsiness, yawning, disinterest in work, mood disorders, sleep disorders, but without digestive signs. We can classify in this syndrome only 5 people (2 men and 3 women).

Confirmed by our study, it is generally accepted that women are more often affected by SS than men [12, 13]. Our results shed particular light on this point by showing significant differences with an OR at 2.6. Moreover, some studies show a relationship between menstrual period and SS [14]. In our results, only 10.6% of women expressed greater sensitivity to SS during menstruation, 30% reported none. According to Cuomo-Granston and Drummond [15] female sex hormones may, at least in part, predispose individuals susceptible to motion sickness and migraine.

In addition, adaptation to maritime conditions plays a role here. Sailors regularly on board are generally less prone to SS than passengers, since they incorporate movement patterns conforming to the theory of Reason and Brand [5]. Like described by Bos and Bles [1] the effect of gender on SS susceptibility decreased inversely with age and no differences after 35 years were noted.

Seasickness first poses a problem of self-esteem and relationships with others. In popular imagination, a seafarer is not (or should not be) prone to SS and, therefore, is prone to easily mock passengers affected by SS. The sick person therefore feels in a situation of psychological inferiority vis-à-vis those who are not or who do not want to admit it. In our population, 17% find it humiliating to be forced to vomit in front of work colleagues and 20% declared having their relationship disrupted. It could also explain why women significantly come with their own medicines against SS and taken it more frequently than men who have to be "stronger" against SS.

Seasickness and susceptibility to SS have a direct and indirect impact on workability. When they were ill, onboard workers went on deck or stayed in their cabin and daily time at work decrease. Indeed, most of workers declared that SS have an impact on their work tasks, concentration at work and own mood. Pisula et al. [16] have showed that vertical accelerations can cause cognitive impairment. Matsangas and McCauley [17] believe that the stress caused by SS and sopite syndrome is, in part, responsible for the deterioration of cognitive performance. Valk mentions the fatigue and sleep disturbances caused by SS in the decline in performance rather than the movements of the ship itself [18]. The causes of SS accidents are in the risk of falling

(especially overboard while vomiting). But, whether in falls or in accidents at work such as accidents on machine tools or launching devices, or even jets of chemicals, it is mainly the movements of the ship, by bad time, which carry the risk, more than SS. In his thesis on 61 Finnish sailors, Spätgens [19] notes that 10% of them had SS at some point which prevented them from carrying out their usual tasks on board, 11% could only do light work, 38% had moderate discomfort in their work station and 42% were able to fully perform their tasks.

Side effects of drugs taken for SS could impact work capacities. Gordon [20] has shown that dimenhydrinate disrupts reaction and memorisation tests like digit span, which is not the case with cinnarizine and scopolamine. Also drowsiness and blurred vision have been noticed with such medicines.

To prevent impact of SS on work non-drug treatments such as optokinetic rehabilitation could be discussed. It gives good lasting results over time, and which can be proposed for subjects with uncontrollable SS [20, 21]. This treatment requires 20 sessions over a period of 3 months in a specialised environment. According to the authors, 71% of reeducated subjects are improved, compared to 12.5% of subjects subjected to placebo treatment [22]. It allows you to be less prone to SS and not taking medication during the mission. This therapy could also benefit to workers who declared higher susceptibility to SS.

Our study is a self-declared study by questionnaire. A healthy worker effect is a possible bias with a population of selected oceanographers who regularly embarked. Indeed, in popular imagination, a seafarer is not (or should not be) prone to SS and, therefore, is prone to easily mock passengers affected by SS. The sick person therefore feels in a situation of psychological inferiority and do not declared it.

CONCLUSIONS

Seasickness is an often hidden pathology, but one that can significantly disrupt work on board. Gender is a trending factor of SS. Information on SS clinical signs, impact and therapeutics could be prone to prevent sickness, other diseases linked to or imbalanced by SS and impact of it on workability.

REFERENCES

1. Bos JE, Bles W. Modelling motion sickness and subjective vertical mismatch detailed for vertical motions. Brain Res Bull. 1998; 47(5): 537–542, doi: 10.1016/s0361-9230(98)00088-4, indexed in Pubmed: 10052585.
2. O'Hanlon JF, McCauley ME. Motion sickness incidence as a function of the frequency and acceleration of vertical sinusoidal motion. Aerosp Med. 1974; 45(4): 366–369, indexed in Pubmed: 4821729.
3. Lawther A, Griffin MA. survey of the occurrence of motionsickness amongst passengers at sea. Aviat Space Environ Med. 1988; 59: 399–406.
4. Davis MR, Holloway DS. The influence of hull form on the motions of high speed vessels in head seas. Ocean Eng. 2003; 30(16): 2091–2115, doi: 10.1016/s0029-8018(03)00045-3.
5. Reason JT, Brand JJ. Motion sickness. Academic Press, Oxford, England 1975.
6. Bos JE, Damala D, Lewis C, et al. Susceptibility to seasickness. Ergonomics. 2007; 50(6): 890–901, doi: 10.1080/00140130701245512, indexed in Pubmed: 17457748.
7. Jégaden D, Dewitte JD, Loddé B. L'aptitude à la navigation maritime: une véritable évaluation des risques de maladie. Arch Mal Prof Environnement. 2005; 66(4): 318–325, doi: 10.1016/s1775-8785(05)79100-1.
8. Chan G, Moochhala C, Zhao B, et al. A comparison of motion sickness prevalence between seafarers and non-seafarers onboard naval platforms. Int Marit Health. 2006; 57(1-4): 56–65.
9. Grovel A, Stevanovic J, Maruani M. Travailler à bord des navires de la marine marchande. Etude sociologique des risques et des violences physiques, psychologiques ou a caractere sexuel; 2017 [Document IRES].
10. Turner M, Griffin MJ. Motion sickness incidence during a round-the--world yacht race. Aviat Space Environ Med. 1995; 66(9): 849–856, indexed in Pubmed: 7487823.
11. Graybiel A, Knepton J. Sopite syndrome: a sometimes sole manifestation of motion sickness. Aviat Space Environ Med. 1976; 47(8): 873–882, indexed in Pubmed: 949309.
12. Lawther A, Griffin MJ. The motion of a ship at sea and the consequent motion sickness amongst passengers. Ergonomics. 1986; 29(4): 535–552, doi: 10.1080/00140138608968289, indexed in Pubmed: 3709507.
13. Reschke MF, Cohen HS, Cerisano JM, et al. Effects of sex and gender on adaptation to space: neurosensory systems. J Womens Health (Larchmt). 2014; 23(11): 959–962, doi: 10.1089/jwh.2014.4908, indexed in Pubmed: 25401941.
14. Matchock RL, Levine ME, Gianaros PJ, et al. Susceptibility to nausea and motion sickness as a function of the menstrual cycle. Womens Health Issues. 2008; 18(4): 328–335, doi: 10.1016/j.whi.2008.01.006, indexed in Pubmed: 18485739.
15. Cuomo-Granston A, Drummond PD. Migraine and motion sickness: what is the link? Prog Neurobiol. 2010; 91(4): 300–312, doi: 10.1016/j.pneurobio.2010.04.001, indexed in Pubmed: 20416353.
16. Pisula PJ, Lewis CH, Bridger RS. Vessel motion thresholds for maintaining physical and cognitive performance: a study of naval personnel at sea. Ergonomics. 2012; 55(6): 636–649, doi: 10.1080/00140139.2012.657249, indexed in Pubmed: 22455510.
17. Matsangas P, McCauley ME, Becker W. The effect of mild motion sickness and sopite syndrome on multitasking cognitive performance. Hum Factors. 2014; 56(6): 1124–1135, doi: 10.1177/0018720814522484, indexed in Pubmed: 25277021.
18. Valk P, Grech M, Bos JA. multi-factorial analysis of human performance during a 9-day sea trial. International Conference on Human Performance at Sea, Glasgow. 2010.
19. Spatgens P. Seasickness amongst less experienced seafarers. Finlande: University of Turku, Finland; 2016 [Thesis].
20. Gordon CR, Gonen A, Nachum Z, et al. The effects of dimenhydrinate, cinnarizine and transdermal scopolamine on performance. J Psychopharmacol. 2001; 15(3): 167–172, doi: 10.1177/026988110101500311, indexed in Pubmed: 11565623.
21. Trendel D, Haus-Cheymol R, Erauso T, et al. Optokinetic stimulation rehabilitation in preventing seasickness. Eur Ann Otorhinolaryngol Head Neck Dis. 2010; 127(4): 125–129, doi: 10.1016/j.anorl.2010.07.006, indexed in Pubmed: 20860921.
22. Ressiot E, Dolz M, Bonne L, et al. Prospective study on the efficacy of optokinetic training in the treatment of seasickness. Eur Ann Otorhinolaryngol Head Neck Dis. 2013; 130(5): 263–268, doi: 10.1016/j.anorl.2012.03.009, indexed in Pubmed: 23562228.

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Sexually transmitted infections in seafarers: 2020's perspectives based on a literature review from 2000–2020

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ABSTRACT

Background: *Seafarers are a special population. The issue of sexually transmitted diseases among seafarers is as old as navigation itself, and is a public health issue and a matter of concern for seafarers themselves. The purpose of this article is to review the literature on sexually transmitted infections (STIs) in professional seafarers in the 21st century, with a view to guiding maritime physicians in their practice.*

Materials and methods: *This is a Medline® and Scopus® literature review covering publications between 01/01/2000 and 31/12/2019. Out of the 224 articles, 26 were selected.*

Results: *This review showed that at the beginning of the 21st century, attention has been focused mainly on human immunodeficiency virus (HIV). Few seroprevalence data were available. Between 10% and 91% of seafarers had been tested for STIs. Several risk behaviours were identified: out of 4022 seafarers surveyed, 34.3% said they had several sexual partners; out of 3722 seafarers surveyed, 19.5% engaged with sex workers; out of 3493 seafarers surveyed, 63.3% did not always use condoms, while 58.0% were aware of the relevance of this protection. There was a lot of misunderstanding about STIs: 28.3% of seafarers believed that a healthy-looking person could not be HIV-positive.*

Conclusions: *The main pathology studied was HIV. Many seafarers had no specific training and only learned about STIs and HIV through media such as television. Maritime doctors could use new technologies to disseminate the right information on STI prevention.*

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Key words: sexually transmitted diseases, seafarer, HIV-positive

INTRODUCTION

Seafarers are a special population. Depending on their activities, they may travel long distances or even circumnavigate the globe. They may stay at sea for several weeks, or make stopovers in many ports. On some ships, there are seafarers from many different countries. Seafarers cross borders and geopolitical boundaries. They can be both vectors of pathologies and victims of infectious diseases [1, 2].

The issue of sexually transmitted diseases among seafarers is as old as navigation itself, and is a public health issue and a matter of concern for seafarers themselves [3]. Data on sexual behaviour have shown, among other things, that being away from home for more than 1 month increases

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the prevalence of sexual relations with several partners [4]. The issue of sexually transmitted infection (STIs) among seafarers can be approached from several points of view, including the prevention of infections contracted in ports of call and arresting the spread of infection after returning home [5]. Shipowners and navies have set up prevention campaigns [6]. The French Navy, for example, has a strong public health policy. On-board doctors train seamen on microbiological risks before each port of call, so that they will take all the necessary measures to avoid infections. The training is comprehensive (prevention of food-borne infections, infections related to wildlife, etc.) and covers STIs. Recently, there has been an increase in STIs among French military seafarers, due to a drop in vigilance after returning from missions [7]. In Croatia, between 1985 and 2009, 9% of human immunodeficiency virus (HIV)-positive patients were seafarers [8].

Seafarers are therefore at risk of STIs [9]. This is a centuries-old health problem that affects the entire world [10]. In some countries, the HIV rate among fishermen is 10 times higher than that of the general population [11]. The purpose of this article is to review the literature on STIs in professional seafarers in the 21st century, with a view to guiding maritime physicians in their practice: which infections and which microorganisms should they focus on? These data may help for the 2020s.

MATERIALS AND METHODS

This is a Medline® and Scopus® literature review covering publications between 01/01/2000 and 31/12/2019. Keywords used were: "Sexually Transmitted Diseases" [Mesh] (also included were: Sexually Transmitted Diseases, Bacterial, Chancroid, Chlamydia Infections +, Gonorrhea, Granuloma Inguinale, Syphilis, Sexually Transmitted Diseases, Viral, Condylomata Acuminata +, Herpes Genitalis, HIV Infections +, Herpes Genitalis) "Hepatitis B" [Mesh], "Hepatitis C" [Mesh], "Chlamydiaceae Infections" Mesh], "Vaginosis, Bacterial" [Mesh], "mariner", mariners", "seafarer", seafarers", "seaman", "seamen", "fisherman", "fisherman", "sailor", "seafarers", "fisher", "fishers", and "migrant health". For Scopus®, the French key words were: maladies sexuellement transmissibles, infections sexuellement transmissibles, pêcheurs et marins.

Criteria for inclusion were the following: English, French or Spanish articles were selected. The pertinence of results was analysed according to titles and abstracts available on Medline® and Scopus®.

Only articles studying STIs in professional, civilian seafarers were included. Excluded were articles studying other types of infections or infections in other populations (military seafarers, recreational seafarers, port officials, etc.) or articles in which it was not possible to distinguish seafarers from other populations that were studied. Also excluded were anthropological articles on discourse analysis as such, or articles on pre-exposure treatments [12]. Very specific articles on Lake Victoria fishermen were excluded because this was not a marine fishery and there is a "sex-for-fish" economy specific to this location [13].

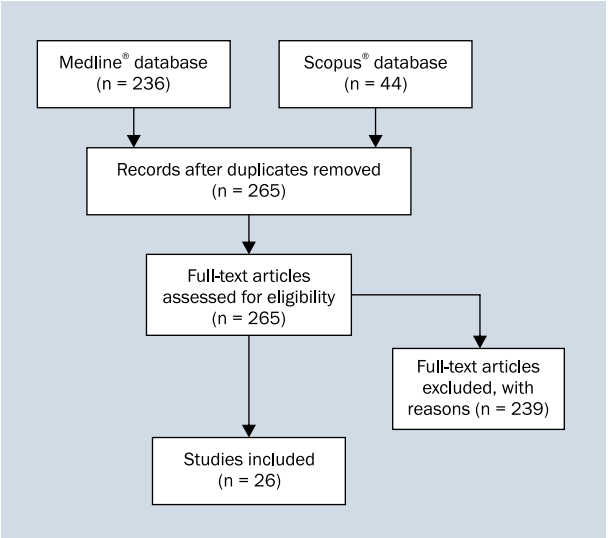

Figure 1. Flow chart

Out of the 265 articles, 26 were selected (Fig. 1).

Data on seafarers' risk behaviour and knowledge were collected by theme. If the articles dealt with comparable data (e.g. multiple sexual partners), prevalence rates in the virtual population were calculated by adding the numerators (mariners with the same response) and the denominators (mariners who responded).

RESULTS

The results are organised according to the theme studied: microbial ecology, prevention, risky behaviour and company policies [4, 14–38].

MICROBIAL ECOLOGY

There were few seroprevalence studies. Only 9 papers studied the prevalences of STIs, and mainly HIV. The rate of seafarers having had an HIV test varied from 10% in a study in Morocco and a study in Turkey to 91% in a study in the Philippines [14–16].

In Europe. In Croatia, seafarers were the population most affected by HIV, with a prevalence rate of 246.67 per 100,000 seafarers, which is 14 times that of the general population, between 1985 and 2009 [8]. A Croatian HIV study described the non-B HIV-1 subtype dissemination [17]. Of the 145 Croatian seafarers at risk, there were 25 seafarers and 13 seafarers' wives. The study showed

that heterosexual intercourse and travel in Europe promoted the spread of this subtype. For another Croatian study, 9.9% (43/435) seafarers ever had one STI [38].

In Africa, Asia and Oceania. Nguyen et al. [18] studied the prevalence of HIV and hepatitis B seropositivity among at-risk populations in Hai Phong, Vietnam. Among the 94 seafarers in the study, none had HIV, while 54% were hepatitis B carriers (HBs antigen and HBs antibody were positive) [18, 19].

In the majority of cases, the studies were carried out with the fishing community. Their results therefore corresponded to the lifestyle of small communities. In Cambodia, 3% (9/262) of fishermen had at least one HIV test [4]. In a systematic serology study among 446 Cambodian fishermen, 16.1% were HIV positive [20]. In 2000, 818 fishermen (582 Thai, 137 Burmese, 99 Khemer) had a serology. And 15.5% fisherman were HIV-1 positive [33]. In Myanmar, out of 2798 men receiving treatment for HIV between 2004 and 2014, 41.2% (1172) were fishermen, 22.8% of whom were also infected with hepatitis C virus (HCV) [21]. In Malaysia, 12.4% were HIV positive and 48.6% had HCV infection. But HCV infection was correlated with drug use rather than with sexual behaviour [22]. In Uganda, Katusiime et al. [24] conducted clinical assessments and serological tests on 16 fishermen. Among these fishermen, 38% (6/16) had an STI: 3 syphilis, 1 hepatitis B virus (HBV), 1 genital herpes and 1 gonorrhoea (nongonoccocal urethritis).

In the America. In Mexico, the central blood bank of Veracruz studied prevalence and risk factors of positive serology for several biological agents: HIV, syphilis, Treponema pallidum. Fishermen had a higher risk of being positive for syphilis than the general population: odds ratio (OR): 1.92; 95% confidence interval (CI): 1.13–3.25 [23].

PREVENTION AND TESTING

A study conducted in 30 countries (including India, Indonesia, Myanmar, Philippines, Turkey, Ukraine — and major beneficial ownership countries such as Germany, Italy, Norway, and South Korea) showed that 3/4 of seafarers' unions in these countries considered STIs to be a major public health problem, particularly HIV [25].

Testing. The rate of seafarers who were tested for HIV varied from study to study. It was generally around 10%. But it could sometimes be very high: 91% in a study in the Philippines; 60% of seafarer officers and 66% of crew members in a Croatian study [14–16, 38].

Training and knowledge. There were many false beliefs about STIs, especially HIV (Table 1). For example, some seafarers believed that only homosexuals could be infected with HIV (9/186) [25]. Or, many seafarers believed that HIV could be transmitted through mosquito bites (Table 1).

In Turkey, the nursing university studied seafarers' knowledge of STIs through a knowledge and perception self-questionnaire [15]. Of the 660 seafarers, 53% had inadequate knowledge about STIs and their prevention. This was particularly the case for HIV: only 44% of seafarers had adequate knowledge of protective measures. Their knowledge came mainly from the media, for 68% of them. Although the majority considered themselves at risk, only 10% had been tested.

A study of 27 Italian shipowners, involving 197 seafarers of several nationalities (Italian, Indian, Filipino, Ukrainian, Romanian, Bulgarian and others) showed that 93% of Filipino, 92% of Indian, 73% of Eastern European and 53% of Italian seafarers had received training on STIs by health professionals [26].

RISK BEHAVIOURS

Many seafarers had multiple sexual partners or engaged with professional sex workers (Table 2). Several risk factors for risky behaviours were identified.

A study of 502 seafarers in the Philippines showed that certain factors were correlated with higher rates of unprotected sex and sex with multiple partners: alcohol consumption ($p = 0.027$), being single ($p = 0.007$) and being under 35 years of age ($p = 0.05$) [27]. Similarly, Robate et al. [28] showed several risk factors for having multiple partners and unprotected sex: being aged 15 to 34 years (51.4% vs. 33.3%, $p < 0.001$), and being unmarried (60% vs. 39%, $p < 0.05$). Ford and Chamrathrithirong [29] studied STI risk behaviours among Thai workers. Seafarers engaged with sex workers more often than workers in other occupations did: OR: 6.22, 95% CI: 3.67–10. 54 [29]. The same was true in Malawi [30]. For Zafar et al. [31], lower education and higher income were significantly associated (OR: 2.25, 95% CI: 1.11–4.55; OR: 3.04, 95% CI 1.03–9.02, $p = 0.04$) with negative attitude and un-safe practices towards HIV/AIDS, respectively [31].

COMPANY POLICIES

For cruise ships, a study reported several possible prevention policies by means of a questionnaire on behalf of 24 companies with a total of 155 ships. All 8 companies with a medical department had a written HIV policy. Thirteen companies required pre-sea HIV testing, 12 had a written HIV policy regarding HIV testing and prevention, and 18 had free condoms for the crew [32]. A positive HIV test would result in revocation of the employment offer from 5 companies, and another 6 companies established HIV as a pre-existing condition. Eight companies required HIV-positive seafarers to demonstrate stability at regular intervals as a condition for sailing.

For transport seafarers, the International Transport Workers' Federation (ITF) launched the ITF's Global HIV/AIDS

Table 1. Misconceptions and knowledge about sexually transmitted infections (STIs) and human immunodeficiency virus (HIV) among seafarers

Type of knowledge	Altaf Chowdhury [25]	Laraqui [14]	Saniel [27]	Robate [28]	Robate [28]	Zafar [31]	Sopheab [4]	Grappasonni [26]	Faye [37]	Total prevalence
Type of maritime activities (fishing or other activity)	Seafarers	Seafarers and fishermen	Seafarers	Seafarers and fishermen	Seafarers and fishermen	Fishermen	Fishermen	Seafarers	Seafarers and fishermen	–
Country of origin of the population	International	Morocco	Filipino	Kiribati	Kiribati	Pakistan	Pakistan	International	Senegal	–
Years of study	2010–2011	2014	2008	2005	2008	2012	2005	2011	2010	
Misconceptions										
A healthy-looking person is not contagious	6% (11/186)	–	19% (96/502)	–	–	61.6% (183/297)	24% (63/262)	–	–	28.3% (353/1247)
AIDS is treatable	8% (15/186)	–	–	–	–	85.9% (255/297)	–	–		55.9% (270/483)
Transmission of HIV by certain vectors	Food and drink 8% (15/186)	Mosquitos 59.3%	Mosquitos 47.9% (240/502) Eating with an HIV patient 62.3% (312/502)	–	–	–	–	Insects 15% (/197) Glasses 6.6% Breathing closely 2.5%	Food 34% (55/400)	–
Correct knowledge										
Systematic condom use protects against STIs/HIV	39% (73/186)	–	76.1% (381/502)	36% (100/275)	80% (128/160)	50.2% (150/297)	–	–	56% (224/400)	58.0% (1056/1820)
HIV transmission through unprotected sexual relations	52% (96/186)	–	–	62% (170/275)	73% (113/160)	–	–	88.3% (174/197)	–	67.6% (553/818)
HIV transmission through blood (needle, razor, etc.)	–	91.2% (1255/1376)	–	62% (170/275)	73% (113/160)	44.4% (132/297)	32% (84/262)	79.2% (156/197)	–	74.4% (1910/2567)

Abbreviations — see text

Table 2. Risk behaviours in seafarers and fishermen

Type of behaviour	Altaf Chowdhury [25]	Grappasonni [26]	Saniel [27]	Guevara [16]	Stulhofer [38]	Prevalence for seafarers	Bailey [36]	Setiawan [35]	Entz [33, 34]	Zafar [31]	Sopheab [4]	Prevalence for fishermen	Robate [28]	Robate [28]	Laraqui [14]	Total prevalence
Type of maritime activities (fishing or other activity)	Seafarers	Seafarers	Seafarers	Seafarers	Seafarers	–	Fishermen	Fishermen	Fishermen	Fishermen	Fishermen	–	Seafarers and fishermen			–
Country of origin of the population	International	International	Filipino	Filipino	International		India	Indonesia	Thailand	Pakistan	Pakistan		Kiribati	Kiribati	Morocco	
Years of study	2010–2011	2011	2008	2009	2003		2005	2005	2000	2012	2005		2005	2008	2014	
Several partners	14% (26/186)	56% (110/197)	20% (100/502)	59% (59/100)	37.7% (164/435)	32.3% (459/1420)	13.4% (33/247)	–	–	90.2% (268/297)	4% (10/262)	38.6% (311/806)	37% (102/273)	47% (69/147)	32% (437/1376)	34.3% (1378/4022)
Engaging with sex workers	–	–	15% (75/502)	–	2.1% (9/435)	9.0% (84/937)	–	66% (19/29)	16% (131/818)		4% (10/262)	14.4% (160/1109)	34% (63/184)	47% (59/125)	26.3% (360/1367)	19.5% (726/3722)
Inconsistency in protected sexual relations	55% (103/186)	47.6% (94/197)	25% (125/502)	–	20.1% (91/435)	31.3% (413/1320)	86% (212/247)	–	–	74.4% (221/297)	78% (205/262)	79.2% (638/806)	–	–	84.9% (1161/1367)	63.3% (2212/3493)
Condoms	18% (34/186) didn't like	–	4.5% (23/502) not available	–	–	–	–	–	–	–	90% (236/262) not available	–	–	–	10.5% (101/1367) too expansive or not available 38% (365/959) didn't like	–

Programme in 2006, including ITF seafarer's affiliates [25]. Twenty eight unions said HIV prevention, 19 the prevention of other STIs, and 16 stigma and discrimination linked to HIV. For a second survey, 615 seafarers replied to a questionnaire. Their knowledge and behaviours were assessed to help better target prevention (Table 1).

DISCUSSION

This review of the literature on STIs in seafarers and fishermen at sea has shown that at the beginning of the 21st century, attention has been focused mainly on HIV. Few seroprevalence data were available. Between 10% and 91% of seafarers had been tested for STIs. Several risk behaviours were identified: out of 4022 seafarers surveyed, 34.3% said they had several sexual partners; out of 3722 seafarers surveyed, 19.5% engaged with sex workers; out of 3493 seafarers surveyed, 63.3% did not always use condoms, while 58.0% were aware of the relevance of this protection. There was a lot of misunderstanding about STIs: 28.3% of seafarers believed that a healthy-looking person could not be HIV-positive.

This review was limited by several factors. The notion of sea worker includes different populations that are not comparable. Commercial seafarers and offshore fishermen do not have the same constraints as coastal fishermen, especially those from the poorest countries. Some studies have shown in particular the specific vulnerability of fishermen in certain countries. The cultural environment may encourage engaging with sex workers, or value sexual philandering, or devalue the use of condoms [39]. Some coastal fishermen may belong to groups with particular cultural representations or economic situations, making the data not generalizable. These articles were therefore removed from the review [40]. Commercial seafarers, on the other hand, have access to port areas where brothel density or access to alcohol and drugs may vary from country to country. This type of article is also limited due to publication bias. Not all data on seafarers' STIs are available in medical databases. Each reader should review the data from his or her own health authorities for an assessment of the prevalence in his or her country. However, this review provides a global view of the problem. This global and worldwide vision is relevant, since some seafarers are required to travel to several countries around the world. Doctors providing medical follow-up for this population could therefore draw information from it; risk behaviours were sometimes quantified, which could help guide prevention campaigns.

There were few studies on the prevalence of STIs in seafarers. Several explanations are possible. The difficulty of studies with examinations and the disparity of tests could hinder this type of study. Moreover, there could be a psychological barrier: seafarers in some parts of the world might not want to be tested, whereas in other regions testing was systematic. Some teams have suggested better screening of seafarers using personal screening kits. Seafarers could then act as a relay to their peers [41]. Without better assessing the prevalence of certain STIs, this could help seafarers begin to undertake treatment.

The issue of STI care must be integrated into comprehensive health care [42]. Certain behaviours can interfere with medical follow-up or with proper compliance with treatment [43]. Other socio-economic factors such as age, income and education could influence adherence to treatment or to prevention rules [44].

Prevention policies must also take into account cultural differences, especially around condom use. In some countries and in some communities, gender hierarchies and cultural representations hinder consistent condom use [45]. This review has also highlighted the wide disparity in condom availability [46]. Seafarers' doctors could take decisive action on this issue. For example, they could inform the health authorities to help them target information and condom distribution campaigns. Or they could encourage shipowners to make condoms available. Prevention policies are possible. Altaf Chowdhury et al. [25] have shown that unions can help raise awareness and take action. Interaction between the different social partners and the states could help [47]. Prevention campaigns must take into account language proficiency. A study of immigrant workers (including seafarers) showed the correlation between mastery of the local language and the level of knowledge of preventive measures [48]. Seafarers are often migrant worker [49]. STI screening is all the more important as seafarers are often migrant workers, likely to be carriers of mild symptoms [50]. They can therefore ignore their state of health.

CONCLUSIONS

Sexually transmitted infections among seafarers were a major health issue at the beginning of the 21st century. The main pathology studied was HIV. There was a wide variety of situations. Nearly half of the seafarers interviewed in different studies did not consistently use condoms, and nearly a third of seafarers had sex with multiple partners or even sex workers. Information was not always available. Many seafarers had no specific training and only learned about STIs and HIV through media such as television. Maritime doctors could use new technologies to disseminate the right information on STI prevention, especially HIV prevention. For example, internet training or smartphone campaigns have not been reported in the literature. A better understanding of the risks could encourage the use of testing and could also help to better integrate HIV-positive people socially.

REFERENCES

1. Koren ES. [The health of sailors–at sea and in port towns]. Tidsskr Nor Laegeforen. 2007; 127(24): 3259–3263, indexed in Pubmed: 18084384.
2. Mant M. For those in peril on and off the sea: Merchant marine bodies in nineteenth-century St. John's, Newfoundland. Int J Marit Hist. 2020; 32(1): 23–44, doi: 10.1177/0843871420904188.
3. Ramos Gregorio E. The Filipino seafarers' lived experiences aboard international shipping vessels: A basis for health promotion intervention. Acta Medica Philippina. 2012; 46(3): 69–74.
4. Sopheab H, Fylkesnes K, Vun MC, et al. HIV-related risk behaviors in Cambodia and effects of mobility. J Acquir Immune Defic Syndr. 2006; 41(1): 81–86, doi: 10.1097/01.qai.0000174654.25535.f7, indexed in Pubmed: 16340478.
5. Schofield CB. Veneral disease imported by mariners. Br J Vener Dis. 1965; 41: 51–59.
6. Korzeniewski K, Konior M, Lass A, et al. Occurrence of Chlamydia trachomatis in military environment on the example of professional soldiers in the Polish Armed Forces. Int Marit Health. 2014; 65(3): 137–141, doi: 10.5603/IMH.2014.0028, indexed in Pubmed: 25471163.
7. Pougnet L, Pougnet R, Drouillard I. Commentary to the article by Korzeniewski et al. Int Marit Health. 2014; 65(4): 235, doi: 10.5603/IMH.2014.0044, indexed in Pubmed: 25522709.
8. Mulić R, Vidan P, Polak NK. HIV infection among seafarers in Croatia. Int Marit Health. 2010; 62(4): 209–214, indexed in Pubmed: 21348014.
9. den Hoed W. Morbidity among international seafarers examined at the Port Health Centre in Rotterdam in the years 1999 and 2000. Int Marit Health. 2002; 53(1-4): 167–171.
10. Nikolić N. AIDS prophylaxis–achievements due to appropriate strategies. Int Marit Health. 2011; 62(3): 176–182.
11. Michalopoulos LM, Jiwatram-Negrón T, Choo MKK, et al. The association between psychosocial and structural-level stressors and HIV injection drug risk behavior among Malaysian fishermen: A cross-sectional study. BMC Public Health. 2016; 16: 464, doi: 10.1186/s12889-016-3125-7, indexed in Pubmed: 27250497.
12. Mack N, Odhiambo J, Wong CM, et al. Barriers and facilitators to pre-exposure prophylaxis (PrEP) eligibility screening and ongoing HIV testing among target populations in Bondo and Rarieda, Kenya: results of a consultation with community stakeholders. BMC Health Serv Res. 2014; 14: 231, doi: 10.1186/1472-6963-14-231, indexed in Pubmed: 24886646.
13. Camlin CS, Kwena ZA, Dworkin SL. Jaboya vs. jakambi: Status, negotiation, and HIV risks among female migrants in the "sex for fish" economy in Nyanza Province, Kenya. AIDS Educ Prev. 2013; 25(3): 216–231, doi: 10.1521/aeap.2013.25.3.216, indexed in Pubmed: 23631716.
14. Laraqui S, Laraqui O, Manar N, et al. The assessment of seafarers' knowledge, attitudes and practices related to STI/HIV/AIDS in northern Morocco. Int Marit Health. 2017; 68(1): 26–30, doi: 10.5603/IMH.2017.0005, indexed in Pubmed: 28357833.
15. Acaroglu R. Knowledge and attitudes of mariners about AIDS in Turkey. J Assoc Nurses AIDS Care. 2007; 18(1): 48–55, doi: 10.1016/j.jana.2006.11.007, indexed in Pubmed: 17338985.
16. Guevara N, Pineda M, Dorotan M, et al. Cross-sectional survey on the knowledge, attitude and practice of male Filipino seafarers on sexual health. Int Marit Health. 2010; 62(4): 224–232, indexed in Pubmed: 21348016.
17. Ramirez-Piedad MK, Lepej SZ, Yerly S, et al. High prevalence of non-B HIV-1 subtypes in seamen and their sexual partners in Croatia. J Med Virol. 2009; 81(4): 573–577, doi: 10.1002/jmv.21433, indexed in Pubmed: 19235840.
18. Nguyen CH, Ishizaki A, Chung PT, et al. Prevalence of HBV infection among different HIV-risk groups in Hai Phong, Vietnam. J Med Virol. 2011; 83(3): 399–404, doi: 10.1002/jmv.21978, indexed in Pubmed: 21264859.
19. Ishizaki A, Cuong NH, Thuc PV, et al. Profile of HIV type 1 infection and genotypic resistance mutations to antiretroviral drugs in treatment-naive HIV type 1-infected individuals in Hai Phong, Viet Nam. AIDS Res Hum Retroviruses. 2009; 25(2): 175–182, doi: 10.1089/aid.2008.0193, indexed in Pubmed: 19239356.
20. Samnang Po, Leng HB, Kim A, et al. HIV prevalence and risk factors among fishermen in Sihanouk Ville, Cambodia. Int J STD AIDS. 2004; 15(7): 479–483, doi: 10.1258/0956462041211315, indexed in Pubmed: 15228734.
21. Ousley J, Nesbitt R, Kyaw NT, et al. Increased hepatitis C virus co-infection and injection drug use in HIV-infected fishermen in Myanmar. BMC Infect Dis. 2018; 18(1): 657, doi: 10.1186/s12879-018-3558-y, indexed in Pubmed: 30547747.
22. Choo MKK, El-Bassel N, Adam PCG, et al. Prevalence and correlates of HIV and hepatitis C virus infections and risk behaviors among Malaysian fishermen. PLoS One. 2015; 10(8): e0118422, doi: 10.1371/journal.pone.0118422, indexed in Pubmed: 26244844.
23. López-Balderas N, Hernández-Romano J, Cámara-Contreras M, et al. Trends in prevalence of HIV and syphilis in a central blood bank of Veracruz, Mexico. Transfus Apher Sci. 2019; 58(1): 94–99, doi: 10.1016/j.transci.2018.12.001, indexed in Pubmed: 30554960.
24. Katusiime C, Schlech WF, Parkes-Ratanshi R, et al. Characteristics of Sexually Transmitted Infections among High-Risk HIV-Positive Patients Attending an Urban Clinic in Uganda. J Int Assoc Provid AIDS Care. 2016; 15(1): 36–41, doi: 10.1177/2325957413506493, indexed in Pubmed: 24144639.
25. Altaf Chowdhury SA, Smith J, Trowsdale S, et al. HIV/AIDS, health and wellbeing study among International Transport Workers' Federation (ITF) seafarer affiliates. Int Marit Health. 2016; 67(1): 42–50, doi: 10.5603/IMH.2016.0009, indexed in Pubmed: 27029929.
26. Grappasonni I, Paci P, Mazzucchi F, et al. Survey on HIV risk perception and sexual behaviours among seafarers. Int Marit Health. 2011; 62(2): 131–137, indexed in Pubmed: 21910117.
27. Saniel OP, De los Reyes SJ. Prevalence of risky behaviours and determinants of multiple sex partnerships among male Filipino seafarers. Int Marit Health. 2010; 62(4): 215–223, indexed in Pubmed: 21348015.
28. Robate M, Toatu T, Kirition R, et al. Sexual behaviour of Kiribati seafarers: second generation surveillance in 2005 and 2008. Int Marit Health. 2010; 62(4): 195–200, indexed in Pubmed: 21348012.
29. Ford K, Chamrathrithirong A. Sexual partners and condom use of migrant workers in Thailand. AIDS Behav. 2007; 11(6): 905–914, doi: 10.1007/s10461-007-9207-x, indexed in Pubmed: 17323124.
30. Soldan VA, deGraft-Johnson JE, Bisika T, et al. Social, economic and demographic determinants of sexual risk behaviors among men in rural Malawi: A district-level study. Afr J Reprod Health. 2007; 11(2): 33–46, indexed in Pubmed: 20690286.
31. Zafar M, Nisar N, Kadir M, et al. Knowledge, attitude and practices regarding HIV/AIDS among adult fishermen in coastal areas of Karachi. BMC Public Health. 2014; 14: 437, doi: 10.1186/1471-2458-14-437, indexed in Pubmed: 24886122.
32. Dahl E. HIV (human immunodeficiency virus) testing and prevention in the cruise industry. Int Marit Health. 2011; 62(1): 3–7, indexed in Pubmed: 21534219.

33. Entz AT, Ruffolo VP, Chinveschakitvanich V, et al. HIV-1 prevalence, HIV-1 subtypes and risk factors among fishermen in the Gulf of Thailand and the Andaman Sea. AIDS. 2000; 14(8): 1027–1034, doi: 10.1097/00002030-200005260-00015, indexed in Pubmed: 10853985.
34. Entz A, Prachuabmoh V, van Griensven F, et al. STD history, self treatment, and healthcare behaviours among fishermen in the Gulf of Thailand and the Andaman Sea. Sex Transm Infect. 2001; 77(6): 436–440, doi: 10.1136/sti.77.6.436, indexed in Pubmed: 11714943.
35. Setiawan IM, Patten JH. The organization of STI/HIV risk-taking among long-line fishermen in Bali, Indonesia. Int Marit Health. 2010; 62(4): 201–208, indexed in Pubmed: 21348013.
36. Bailey A. Left at sea: HIV vulnerability among migrant fishermen in Goa, India. Int Marit Health. 2011; 62(2): 116–122, indexed in Pubmed: 21910115.
37. Faye A, Faye MD, Leye MM, et al. Knowledge and attitudes of Senegalese seafarers about HIV/AIDS. Int Marit Health. 2013; 64(3): 148–153.
38. Stulhofer A, Brouillard P, Nikolić N, et al. HIV/AIDS and Croatian migrant workers. Coll Antropol. 2006; 30 (Suppl 2): 105–114, indexed in Pubmed: 17508483.
39. Seeley JA, Allison EH. HIV/AIDS in fishing communities: challenges to delivering antiretroviral therapy to vulnerable groups. AIDS Care. 2005; 17(6): 688–697, doi: 10.1080/09540120412331336698, indexed in Pubmed: 16036255.
40. Ombere SO, Nyambedha EO, Bukachi SA. Wimbo: implications for risk of HIV infection among circumcised fishermen in Western Kenya. Cult Health Sex. 2015; 17(9): 1147–1154, doi: 10.1080/13691058.2015.1018949, indexed in Pubmed: 25774858.
41. Choko AT, Nanfuka M, Birungi J, et al. A pilot trial of the peer-based distribution of HIV self-test kits among fishermen in Bulisa, Uganda. PLoS One. 2018; 13(11): e0208191, doi: 10.1371/journal.pone.0208191, indexed in Pubmed: 30496260.
42. Kiene SM, Sileo KM, Dove M, et al. Hazardous alcohol consumption and alcohol-related problems are associated with unknown and HIV-positive status in fishing communities in Uganda. AIDS Care. 2019; 31(4): 451–459, doi: 10.1080/09540121.2018.1497135, indexed in Pubmed: 30022681.
43. Sileo KM, Kizito W, Wanyenze RK, et al. A qualitative study on alcohol consumption and HIV treatment adherence among men living with HIV in Ugandan fishing communities. AIDS Care. 2019; 31(1): 35–40, doi: 10.1080/09540121.2018.1524564, indexed in Pubmed: 30241440.
44. Sileo KM, Wanyenze RK, Kizito W, et al. Multi-level Determinants of Clinic Attendance and Antiretroviral Treatment Adherence Among Fishermen Living with HIV/AIDS in Communities on Lake Victoria, Uganda. AIDS Behav. 2019; 23(2): 406–417, doi: 10.1007/s10461-018-2207-1, indexed in Pubmed: 29959718.
45. MacPherson EE, Sadalaki J, Njoloma M, et al. Transactional sex and HIV: understanding the gendered structural drivers of HIV in fishing communities in Southern Malawi. J Int AIDS Soc. 2012; 15 (Suppl 1): 1–9, doi: 10.7448/IAS.15.3.17364, indexed in Pubmed: 22713352.
46. Mullany LC, Maung C, Beyrer C. HIV/AIDS knowledge, attitudes, and practices among Burmese migrant factory workers in Tak Province, Thailand. AIDS Care. 2003; 15(1): 63–70, doi: 10.1080/0954012021000039761, indexed in Pubmed: 12655834.
47. Vignier N. Profils de santé des migrants en France [The faces of migrant health in France]. Rev Prat 2019;69(5. 2019; 69(5): 555–560.
48. Fuller TD, Chamratrithirong A. Knowledge of HIV risk factors among immigrants in Thailand. J Immigr Minor Health. 2009; 11(2): 83–91, doi: 10.1007/s10903-008-9163-1, indexed in Pubmed: 18604584.
49. Ford K, Chamratrithirong A, Apipornchaisakul K, et al. Social integration, AIDS knowledge and factors related to HIV prevention among migrant workers in Thailand. AIDS Behav. 2014; 18(2): 390–397, doi: 10.1007/s10461-013-0410-7, indexed in Pubmed: 23325377.
50. Wagner KS, Lawrence J, Anderson L, et al. Migrant health and infectious diseases in the UK: findings from the last 10 years of surveillance. J Public Health (Oxf). 2014; 36(1): 28–35, doi: 10.1093/pubmed/fdt021, indexed in Pubmed: 23520266.

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Training seafarers to deal with multicultural crew members and stress on board

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ABSTRACT

Background: *The present study describes the intercultural differences in the perception of stress and the preparation of seafarers.*

Materials and methods: *Three hundred twenty-three seafarers (156 [48.3%] Europeans and 167 [51.7%] Southeast Asians) were interviewed about their subjective stress on board.*

Results: *According to the interviews with ship's officers, mostly represented by Europeans, mental stress was most often due to high responsibilities (82.0%), extensive administrative tasks (81.1%) and lack of qualification of seafarers (64.8%). Subjectively, the Europeans questioned were significantly more likely to experience mental stress on board than the Southeast Asians (74.2% vs. 56.3%), whereas the latter were more prone to being physically stressed. 43.1% of the Southeast Asian seafarers often felt lonely on board compared with 26.2% of the Europeans. Preparation for maritime-specific stress in the form of specific training units is only provided in 1 of the 5 universities surveyed. The most important reason for this is a lack of time. Intercultural leadership training was also only offered at one university.*

Conclusions: *In view of the many psychophysical stressors in daily life on a ship and the lacking respective education, it is recommended to integrate stress management and diversity training in intercultural communication in the higher education of future superiors on board.*

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Key words: cultural differences, maritime, stress, training, seafarer

INTRODUCTION

According to Salomon (2019) [1], mental stress is defined as mental excitement caused by mental demands. In the maritime context, this means, for example, high attention during watch keeping, high responsibility in the management of the ship. On the other hand, physical stress is associated with physical exertion and being active beyond capacity [2] (in seafaring, for instance, through hard physical work, lashing, or ship movements). A high level of chronic physical stress can lead to severe physical exhaustion and complaints regarding the musculoskeletal system [1, 2].

For Forsell et al. [3], psychosocial stress is the most frequent problem in the workplace on merchant vessels, apart from noise, vibration and the risk of accidents. This is also confirmed in the study by Nielsen et al. [4], who observed that physical and psychosocial work factors are important reasons for job dissatisfaction and fluctuation. In connection with mental stress and mental health of seafarers, Iversen [5] found an increased rate of depression and suicide among seafarers.

Occupational stress factors, such as a lack of separation between work and leisure, are practically an essential feature of the seafaring profession. Seafarers normally spend longer periods of time on board, leisure activities take place in the same environment and the crews are subject to continuous physical stress impacts through vibration, noise and ship movements [6]. For this reason the crew members' everyday life is still subject to high levels of mental and psychosocial stress [7–9]. This also reduces the recreational value for seafarers during their leisure time.

Within the past decades, stress situations, such as long, irregular working hours and, in particular, isolation and con-

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flicts between crew members have increased in seafaring [10]. Furthermore, growing rationalisation measures [11] often complicate the everyday work on board. These developments require a tailor-made preparation of prospective ship's officers in nautical training. Shipping companies and in particular maritime stakeholders are responsible for the appropriate training of shipping crews. Jeżewska et al. [12] and Carotenuto et al. [7] also recommend the development of shipboard "strategies for coping with inevitable stress conditions".

The appropriate preparation of the superiors in their maritime training is enshrined in the International Safety Management (ISM) Code of the International Maritime Organisation (IMO) [13]. One objective of the ISM Code is to protect people from harm to life and limb. In addition, the IMO has an International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW, 1995) [14], which define internationally comparable standards in the training of seafarers. The Convention also includes medical-psychological training procedures for ship's personnel and is internationally binding. Thus, the nautical students should already receive basic medical-psychological training during their university education. In addition, the future leaders on board should be briefed on how to provide first-aid during a potential medical emergency on the high seas far from professional support.

Nowadays, merchant ships are multinationally manned with a high proportion of Southeast Asian crew members [15]. The linguistic or cultural differences among the employees on board can lead to significant understanding problems. Particularly Asian crew members with their strong family ties and their intense needs for contact often feel mentally stressed due to the lack of social relations on the high seas [16, 17]. In addition, especially Southeast Asians, who are usually deployed as ratings, are often exposed to high levels of physical stress in daily life on board (e.g. during loading) [18]. Overall, seafarers' cultural background should be taken into account when assessing their psychophysical stress by examining their working situation. Consequently, further requirements also arise for prospective ship's officers to lead crew members with different cultural backgrounds [19].

The present study addresses the issue of psychological stress for crew members, possible cultural differences in the experience of stress, and the particular stress and strain experienced by ship's officers. A further question that arises from this is the extent to which prospective ship's officers are prepared in their training for mental stress and the management of multicultural crews with their particular work situation. For example, Youssuf [20] postulated measures to combat stress in maritime shipping as seafarers are exposed to particular psychological stressors such as family separation, loneliness, limited recreational opportunities or lack of sleep.

Furthermore, as a higher proportion of East Asian crew members, mainly Filipinos, experiences the work situation and the social relations on board as stressful — compared to European seafarers [16, 17] — the training of nautical officers should also encompass the responsibility and the need of qualification for the ship's officers in the leadership of multicultural crew members. The motivation of crew members mentioned in the ISM Code as well as possible communication problems due to linguistic and cultural differences also seem to require training of the superiors on board in intercultural communication and leadership.

In Germany, nautical education is provided at 5 Universities of Applied Sciences in Flensburg, Elsfleth, Bremen, Leer and Wismar over 6 semesters and includes navigation, cargo technology, telecommunications, emergency management and law. However, no data is available on the training of prospective ship's officers in stress management and on intercultural communication and leadership training. Therefore, this study presents and discusses the intercultural differences in the subjective perception of stress and the preparation of seafarers, in particular of superiors, for ship-specific stressors and intercultural leadership in higher education.

MATERIALS AND METHODS

An own recent literature review has shown that standardised maritime methods are not available for stress analysis that covers the special working and living conditions in seafaring (data not published). Leszczyńska et al. (2008) [21] also stated that such suitable and standardised methods are lacking in seafaring. For this reason, the interview method was selected in this study as a qualitative research method. The interview was developed on the basis of the most important shipboard stressors (according to a previous maritime specific stress survey of seafarers [9]), as well as on the results of several previous qualitative interviews with seafarers, officers and ratings.

The interview questions were related to the specific working conditions for officers and ratings in ship operation and allowed a bivariate response behaviour (stressful or not). The questionnaire used for the officers consisted of five questions about their specific workload with regard to high responsibility, extensive administrative work, lack of qualification of seafarers, conflicts between security and economy and frequent difficulties with staff on land during port handling. To assess the subjective stress, the following items were asked in the whole study population: mental or physical stress, irregular working times, loneliness, vibration, noise, ship's movements, acclimatising to a new ship, relationships with superiors and understanding of problems.

The standardised interview guide was tested and optimised in pilot studies both on board a container ship and within a sample of 200 seafarers. The interviewer on board had maritime and scientific qualifications and interview experience (see quality aspects). The survey by an interviewer usually enables an immediate completeness check and the elimination of ambiguities as a quality criterion [22].

The interview procedure was examined according to the quality aspects of an interview [23, 24]. Quality aspects are conceptual quality, structural quality, process quality and result quality. The conceptual quality is determined by a meaningful, unambiguous question and an appropriate context such as the consideration of the interviewees' language skills. The present study is based on a clear question. The developed guideline interview was checked in a pre-test with seafarers with regard to linguistic and content-related comprehensibility, relevance to the specific professional conditions of ocean shipping and an acceptable survey time in a four-eye interview procedure. The structural quality refers to the qualification of the investigators to carry out an interview competently, as well as the organisational framework such as rooms for individual interviews. In the present study, the interviewer was an educational scientist with a maritime profession and practical interview experience. A single cabin was available on each examination ship for a four-eye interview. Process quality is about the concrete implementation of the interview, such as minimum participation of the interviewees through informed consent, compliance with ethical standards, data protection and appropriate feedback. The quality of results refers to the relevance of the results for the solution of the respective practical problem. The interview results of the present study are the basis for further processing of the question. They serve as a possible justification for the necessary psychological preparation or training of prospective ship's officers for the specific personnel and stressful situation of ship operation.

The investigation was conducted during 22 sea voyages (aboard 16 small container ships in the exclusive coastal voyage and 6 large container ships with worldwide shipping routes). In this study, a total of 323 seafarers were interviewed about their psychophysical stress on board (participation rate 88.5%). All seafarers were male. 234 participants were married (72.4%) and 217 (67.2%) had children. The study sample consisted of 156 Middle and East Europeans (48.3%) and 167 Southeast Asians (51.7%; mostly Philippines). In addition the participants were grouped in 122 (37.8%) officers and 201 (62.2%) ratings. The average age of crew was 38.2 ± 11.8 years with no differences in age between the two cultural groups or the ranks.

Participation in the study was completely voluntary and the data collected was pseudonymised. All participants gave their written informed consent before taking part in this study. The study was approved by the Ethics Committee of the (blinded) Hamburg Medical Association (no. PV4395).

Furthermore, a psychologist and a physician conducted interviews at all 5 German universities with maritime training courses and evaluated their curricula. The interviews in the universities dealt with the question of whether the students, as future ship's officers, would be prepared for dealing and coping with mental stress situations in ship operation and the leadership of multi-ethnic seafarers. It was important to find out the reasons and attitudes if such preparation and training did not take place and whether a corresponding training concept is planned for the future. Interview partners were twice the Deans of the Faculties, once the President of the University and 4 times the Professors for Nautics or Ship Operation Engineering.

All interviews were also based on an interview guideline in a semi-standardised process. During the development of the interview guideline, a flexible set of questions was compiled. The evaluation was qualitatively based on the coding procedure of Kvale and Brinkmann [25]; through coding, a text passage or records could be transformed to an interview code, i.e. keywords or terms. In a synopsis, the results of the interviews were compiled separately by the two scientists and finally supplemented and compared with each other. The two interviewers had an overall agreement of more than 95%. In cases of discrepancies, an agreement was found after discussion.

STATISTICAL ANALYSIS

Data analysis was performed with SPSS for Windows (version 25.0, SPSS GmbH Software, Munich, Germany). Continuous variables were presented as mean ± standard deviation (SD). The Pearson χ^2 test was applied to compare frequencies between groups. All indicated p-values were two-sided, and a p-value of < 0.05 was regarded as statistically significant.

RESULTS

PSYCHOPHYSICAL STRESS OF SEAFARERS

In the context of ship management, psychophysical stress among officers was most often caused by high responsibility (82.0%) and extensive administrative work (81.1%). Other relevant stress factors for officers were, in decreasing order, the lack of qualification of subordinate crew members irrespective of their nationality (64.8%), conflicts between security and economy (59.8%) and frequent

Table 1. Subjective stress of officers during job performance

	All officers (122)	< 40 years (59)	≥ 40 years (63)	P (χ^2-test)
High responsibility	100 (82.0%)	48 (81.4%)	52 (82.5%)	0.865
Extensive administrative work	99 (81.1%)	48 (81.4%)	51 (81.0%)	0.955
Lack of qualification of seafarers	79 (64.8%)	35 (59.3%)	44 (69.8%)	0.224
Conflicts between security and economy	73 (59.8%)	32 (54.2%)	41 (65.1%)	0.222
Difficulties with staff on land during port handling	71 (58.2%)	33 (55.9%)	38 (60.3%)	0.624

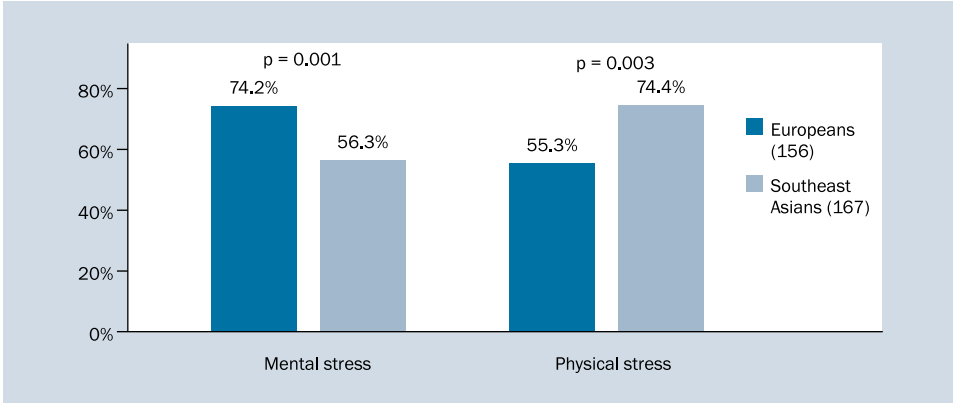

Figure 1. Cultural differences in seafarers' stress (χ^2-test)

difficulties with staff on land during port handling (58.2%). Considering the age of the officers, there were no significant differences in the frequency of subjective stress concerning the mentioned management duties (Table 1).

For the ratings, physical strain (72.4%) was in the foreground. Europeans were significantly more likely to experience mental stress on board than Southeast Asians (74.2% vs. 56.3%). The latter, on the other hand, experienced physical demands significantly more frequently in their daily routine on board (74.4% vs. 55.3% of Europeans, Fig. 1). After adjusting for age, the described associations remained significant.

In particular, the irregular working hours were more often stressful for European crew members compared to Southeast Asian seafarers (87.2% vs. 71.8%, p = 0.02). 43.1% of the Southeast Asian participants often felt lonely on board compared with 26.2% of Europeans (p = 0.002). One in four Southeast Asian crew members (24.0%) more often stated being "sad and depressed" on board (Europeans 10.3%; p = 0.001). No differences were observed between the ethnic groups regarding subjective mental stress due to vibration, noise and the ship's movements.

More than half of the Southeast Asian seafarers (53.9%) and 44.2% of the Europeans had difficulties acclimatising to a new ship. In terms of their relationship with the supervisor on board, 37.1% of the Southeast Asians and 23.7% of the Europeans believed that the supervisors usually did not understand the problems of their subordinate crew members (p = 0.033).

INTERVIEWS WITH THE UNIVERSITIES CONCERNING TRAINING IN STRESS MANAGEMENT

According to the interviews with the university representatives, preparation for maritime-specific stress in the form of specific training units is only provided in 1 of the 5 universities surveyed. Although appropriate training was considered useful by all university representatives, 4 of them had not thought about the possibilities of including special training to prepare the students for occupational stress on board. The most important reason for this is a lack of time. For most of them, the compulsory portion of the STCW is "so large and so packed" that training to reduce stress (for example, anti-fatigue training), even within compulsory or optional subjects, is not possible. According to the statement of one interview partner, a university was not suitable for such a training concept due to its traditional tuition style in seminars, according to which the training of maritime students consists of three stages: board practice, study at the university and initial experience as a ship's officer under guidance. Thus, university education only covers one third of the training for ship's officers. According to 4 representatives, such training in stress management is rather the responsibility of shipping companies.

INTERVIEWS WITH THE UNIVERSITIES CONCERNING TRAINING IN INTERCULTURAL COMMUNICATION AND LEADERSHIP

In respect of intercultural leadership training, the interview results in the universities show that this training is only treated more comprehensively in a maritime psychology and personnel management module in one university. In one other university, these training contents are superficially integrated into other subjects such as health care or ship simulation exercises. For three universities, such training is not feasible for time reasons. Nevertheless, one of these three universities is thinking of introducing intercultural communication training. Furthermore, the other two universities without such training see the necessity to teach intercultural leadership competence to the students. However, this content should then be binding in the compulsory curriculum according to STCW.

DISCUSSION

Considering that in a socio-centred culture, such as that from which the East Asian crew members come, close social ties, group orientation, community affiliation, and collective identities are meaningful, particularly strong psychosocial stress is suspected within the Southeast Asian crew members on board [26–28]. This could also explain why Southeast Asian crew members more often subjectively felt "lonely" or "sad and depressed" on board. The predominance of these findings among South-Asian seafarers is also likely due to their long-lasting time spent away from family, which is usually considerably longer than among European seafarers.

In the recent and relatively comprehensive study about "Seafarers' mental health and wellbeing" by Sampson and Ellis [29], seafarers more often reported isolation and loneliness at sea. Every fifth seaman (20%) described themselves to be always or very often alone. The authors found evidence of emotional exhaustion, burnout and an evidence of an "increase in anxiety and depression among serving seafarers". The latter often feel down by discrimination, having a "bossy captain", conflicts with superiors and other crew members. The authors evaluated the results of the study as need to improve the psychological conditions for the seafarers on board.

More than a third of the Southeast Asian crew believed that the supervisors did not understand the problems of their subordinate crew members. The socio-centric orientation of seafarers from East Asian cultures also has an influence on their understanding of leadership. These crew members expect respect and understanding for their personal problems and situations in return for their personal commitment, their loyalty to their supervisor and compliance with their orders.

The high level of psychosocial stress in the multicultural context on board, the critical attitude of several crew members towards the superiors' behaviour as well as the requirements of the ISM Code necessitate a corresponding qualification of the ship's officers in intercultural communication and personnel management. Seafaring-related diversity training is a suitable method for imparting these competences. Diversity training programmes are not only conducted traditionally in the business world, but also in other occupational groups such as health and care [30, 31]. According to Theotokas et al. [32], cultural diversity in maritime shipping requires appropriate training and further education for more effective communication between seafarers and managers. In particular, maritime diversity training should include attitudinal and behavioural content and should be action-oriented. Moreover, this training should take into account the different professional experience and the ethnicity of workers [33]. Training in cultural diversity enables the identification of psychosocial needs of multi-ethnic seafarers and can improve well-being. According to the findings of Smith et al. [34], social support and recognition by superiors can improve communication and relationships in the psychosocial working environment of multi-ethnic working groups.

In light of the abundance of ship-specific stressors, training in stress management (especially short-term relaxation methods such as breathing techniques and power napping) for seafarers seems very useful. The meta-analysis of Kröll et al. [35] distinguishes between three forms of stress management training: cognitive-behavioural skills training, relaxation techniques, and multiple stress management training. These different kinds of stress management training can improve employees' psychological health [36].

A "Multimodal Stress Management Training" programme combines a cognitive management component with a change of attitudes and the evaluation of stress situations, on the one hand, and a palliative-regenerative part with the reduction and control of psychophysical stress reactions on the other hand [37]. In addition to a change in attitude and assessment in cognitive stress management, palliative-regenerative stress management is particularly suitable for short-term relaxation, which, given the specific conditions of a ship's operation with its long and irregular working hours, is very helpful for regeneration [38]. Umanodan et al. [39] also suggest a multi-component stress management programme. According to their results, it is effective in improving knowledge and the professional effectiveness of worksite stress management [36].

The maritime education at the respective universities in Germany and thus also possible stress management training are aligned with the needs of German and, at most, other Central European students. According to the inter-

views performed, it can be concluded that the hypothesis of the studies was confirmed, i.e. that training concerning stress management and intercultural communication and leadership is not sufficiently dealt with in current education. Particularly cognitive stress management as part of multimodal stress training requires self-awareness and self-reflection. This raises the question as to what extent such training corresponds to the cultural norms and values of East Asian seafarers [40]. An important feature of this population is, besides a stronger group orientation, the need to control emotions and save face in the communication process [41]. In this context, training or instruction for short-term relaxation, such as power napping, would therefore be preferred, especially by the Asian crew members. Since the training of East Asian or East European seafarers takes place in their home countries, it is the responsibility of the crewing agencies or the maritime training centres there and — as a limitation of the present survey — cannot be evaluated in this study.

In view of the often described fatigue problem among seafarers due to the high mental and psychophysical stress on board [11, 42], special anti-fatigue training for nautical officers is recommended. This is already an integral part of compulsory training for pilots in Germany. The contents of such training should be: causes and symptoms of fatigue, sleep hygiene, principles of sleep and regulations for adherence of necessary rest and sleeping times. Furthermore, the high stress level of officers in the context of ship command highlights the need to develop and carry out "Multimodal Stress Management Training".

CONCLUSIONS

The present study clearly demonstrates the high stress level for ship's officers during the ship's operation, irrespective of their age. Cultural differences were found in the assessment of the general working and social life situation on board. Here, significantly more Asian crew members rated their work and social life situation as stressful compared to European seafarers. Also in light of the currently insufficient education in human resources management, it seems necessary to prepare the prospective ship's officers in maritime training centres for the special stress situations of ship operation. They should also enable them to recognise and take into account cultural differences in the stress perception and needs of subordinate crew members. "Multimodal Stress Management Training" and maritime "Diversity Training" are proposed for this purpose.

Especially for the East Asian, family-oriented crew members with a longer stay on board, the communication with the family is helpful against feelings of isolation and depressive moods. Visiting welfare facilities such as the Seamen's Mission can also have positive effects on feelings of isolation and depression. It enables a change from the narrow, one-sided professional role on board to a different social environment in which no demands are made, uncomplicated contact is possible and the seaman finds understanding.

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INFORMED CONSENT

Taking part in this study was voluntarily. All participants gave their informed consent before taking part in this study.

CONFLICT OF INTEREST

There are no conflicts of interest.

REFERENCES

1. Salomon K. Mental stress. Encyclopedia of Behavioral Medicine. https://doi.org/10.1007/978-1-4419-1005-9_261 (Last accessed on March).
2. Vincent V. Physical strain in the workplace. Labor Employment. 2011.
3. Forsell K, Eriksson H, Järvholm B, et al. Work environment and safety climate in the Swedish merchant fleet. Int Arch Occup Environ Health. 2017; 90(2): 161–168, doi: 10.1007/s00420-016-1180-0, indexed in Pubmed: 27815725.
4. Nielsen MB, Bergheim K, Eid J. Relationships between work environment factors and workers' well-being in the maritime industry. Int Marit Health. 2013; 64(2): 80–88, indexed in Pubmed: 23788224.
5. Iversen RTB. The mental health of seafarers. Int Marit Health. 2012; 63(2): 78–89, indexed in Pubmed: 22972547.
6. Hystad SW, Eid J. Sleep and fatigue among seafarers: the role of environmental stressors, duration at sea and psychological capital. Saf Health Work. 2016; 7(4): 363–371, doi: 10.1016/j.shaw.2016.05.006, indexed in Pubmed: 27924241.
7. Carotenuto A, Molino I, Fasanaro AM, et al. Psychological stress in seafarers: a review. Int Marit Health. 2012; 63(4): 188–194, indexed in Pubmed: 24595974.
8. Oldenburg M, Baur X, Schlaich C. Occupational risks and challenges of seafaring. J Occup Health. 2010; 52(5): 249–256, doi: 10.1539/joh.k10004, indexed in Pubmed: 20661002.
9. Oldenburg M, Jensen HJ, Wegner R. Burnout syndrome in seafarers in the merchant marine service. Int Arch Occup Environ Health. 2013; 86(4): 407–416, doi: 10.1007/s00420-012-0771-7, indexed in Pubmed: 22526089.
10. Rengamani J, Murugan MSA. study on the factors influencing the seafarers' stress. AMET Intern J Manag. 2012: 44.
11. Lundh M, Rydstedt LW. A static organization in a dynamic context: A qualitative study of changes in working conditions for Swedish

engine officers. Appl Ergon. 2016; 55: 1–7, doi: 10.1016/j.apergo.2016.01.006, indexed in Pubmed: 26995030.
12. Jeżewska M, Leszczyńska I, Jaremin B. Work-related stress at sea self estimation by maritime students and officers. Int Marit Health. 2006; 57(1-4): 66–75, indexed in Pubmed: 17312695.
13. ISM. ISM Code (International Safety Management Code) of the International Maritime Organization, IMO 2018. http://www.imo.org/en/OurWork/HumanElement/TrainingCertification/Pages/Default.aspx (Last accessed on March).
14. STCW. International Convention on Standards of Training, Certification and Watchkeeping for Seafarers. 1995. http://www.imo.org/en/OurWork/humanelement/trainingcertification/pages/stcw-convention.aspx (Last accessed on March).
15. Progoulaki M, Roe M. Dealing with multicultural human resources in a socially responsible manner: a focus on the maritime industry. WMU J Marit Affairs. 2011; 10(1): 7–23, doi: 10.1007/s13437-011-0003-0.
16. Sampson H, Thomas M. The social isolation of seafarers: causes, effects, and remedies. Int Marit Health. 2003; 54(1-4): 58–67, indexed in Pubmed: 14974778.
17. Lu CS, Lai Kh, Lun YH, et al. Effects of national culture on human failures in container shipping: the moderating role of Confucian dynamism. Accid Anal Prev. 2012; 49: 457–469, doi: 10.1016/j.aap.2012.03.018, indexed in Pubmed: 22578904.
18. Jensen OC, Sørensen JFL, Thomas M, et al. Working conditions in international seafaring. Occup Med (Lond). 2006; 56(6): 393–397, doi: 10.1093/occmed/kql038, indexed in Pubmed: 16804089.
19. Lu CS, Hsu CN, Lee CH. The Impact of Seafarers' Perceptions of National Culture and Leadership on Safety Attitude and Safety Behavior in Dry Bulk Shipping. Int J e-Navigation Marit Econ. 2016; 4: 75–87, doi: 10.1016/j.enavi.2016.06.007.
20. Youssuf S. The rationale of the workplace issues of a stress management event; an approach to address this issue in organisations and on-board. Int J Business and General Management. 2015; 4(4).
21. Leszczyńska I, Jeżewska M, Jaremin B. Work-related stress at sea. Possibilities of research and measures of stress. Int Marit Health. 2008; 59(1-4): 93–102, indexed in Pubmed: 19227742.
22. Adhabi E, Anozie C. Literature review for the type of interview in qualitative research. Int J Edu. 2017; 9(3): 86, doi: 10.5296/ije.v9i3.11483.
23. Grath CM, Palmgren PJ, Liljedahl M. Interview: a research instrument for social science researchers. Int J Social Sciences, Humanities and Education 2017. https://www.tandfonline.com/doi/full/10.1080/0142159X.2018.1497149 (Last accessed on March).
24. Oltmann SM. Qualitative interviews: a methodological discussion of the interviewer and respondent contexts forum. Qualitative Social Res. 2016; 17(2): 15.
25. Kvale S, Brinkmann S. InterViews: learning the craft of qualitative research interviewing. Sage Publications Ltd., Los Angeles, London 2008.
26. McKay S. Filipino Sea Men: Constructing Masculinities in an Ethnic Labour Niche. J Ethnic Migration Studies. 2007; 33(4): 617–633, doi: 10.1080/13691830701265461.
27. Hinton DE, Lewis-Fernández R. Idioms of distress among trauma survivors: subtypes and clinical utility. Cult Med Psychiatry. 2010; 34(2): 209–218, doi: 10.1007/s11013-010-9175-x, indexed in Pubmed: 20407812.
28. Jensen HJ. Interkulturelle Verhaltensmuster und schifffahrtsspezifische Belastungen. Maritime Medizin. Ottomann C, Seidenstücker KH. Springer-Verlag, Berlin Heidelberg 2015: 127–132.
29. Sampson H, Ellis N. Seafarers' mental health and wellbeing. Seafarers International Research Centre 2019, Cardiff.
30. Appannah A, Meyer C, Ogrin R, et al. Diversity training for the community aged care workers: A conceptual framework for evaluation. Eval Program Plann. 2017; 63: 74–81, doi: 10.1016/j.evalprogplan.2017.03.007, indexed in Pubmed: 28431301.
31. Phillips BN, Deiches J, Morrison B, et al. Disability diversity training in the workplace: systematic review and future directions. J Occup Rehabil. 2016; 26(3): 264–275, doi: 10.1007/s10926-015-9612-3, indexed in Pubmed: 26519035.
32. Theotokas I, Progoulaki M, Iakovaki H. Management of cultural diversity: identifying the training needs of seafarers and shore-based personnel in the European maritime shipping industry. Intern Assoc Marit Econ. Annul conference at Marseille 2013, France.
33. Daly A, Carey RN, Darcey E, et al. Using three cross-sectional surveys to compare workplace psychosocial stressors and associated mental health status in six migrant groups working in Australia compared with Australian-born workers. Int J Environ Res Public Health. 2019; 16(5): 735, doi: 10.3390/ijerph16050735, indexed in Pubmed: 30823505.
34. Smith LH, Hviid K, Frydendall KB, et al. Improving the psychosocial work environment at multi-ethnic workplaces: a multi-component intervention strategy in the cleaning industry. Int J Environ Res Public Health. 2013; 10(10): 4996–5010, doi: 10.3390/ijerph10104996, indexed in Pubmed: 24129115.
35. Kröll C, Doebler P, Nüesch S. Meta-analytic evidence of the effectiveness of stress management at work. Eur J Work Organizational Psychology. 2017; 26(5): 677–693, doi: 10.1080/1359432x.2017.1347157.
36. Boysen E, Schiller B, Mörtl K, et al. Preliminary analyses showed short-term mental health improvements after a single-day manager training. Int J Environ Res Public Health. 2018; 15(1): 108, doi: 10.3390/ijerph15010108, indexed in Pubmed: 29320444.
37. Palmer S. Multimodal relaxation method applied to counselling, psychotherapy and coaching. Euro J Couns Theory, Res Practice. 2017; 1: 5.
38. Lehrer PM, Woolfolk RL, Wesley Sime E. (eds.). Principles and practice of stress management. Guilford Publications 2007.
39. Umanodan R, Kobayashi Y, Nakamura M, et al. Effects of a worksite stress management training program with six short-hour sessions: a controlled trial among Japanese employees. J Occup Health. 2009; 51(4): 294–302, doi: 10.1539/joh.l8055, indexed in Pubmed: 19483369.
40. Carter T, Jepsen JR. Exposures and health effects at sea: report on the NIVA course: maritime occupational medicine, exposures and health effects at Sea Elsinore, Denmark, May 2014. Int Marit Health. 2014; 65(3): 114–121, doi: 10.5603/IMH.2014.0024, indexed in Pubmed: 25471159.
41. Wang YQ, Gu P. Reducing intercultural communication barriers between seafarers with different cultural backgrounds. International Association of Maritime Universities 2014. http://iamu-edu.org/wp-content/uploads/2014/2007/ s2013-wang.pdf (Last accessed on March).
42. Raby M, Lee JD. Fatigue and workload in the maritime industry. Stress, workload and fatigue. Hancock PA, Desmond PA. Lawrence, Mahwah New Jersey 2001: 566–578.

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Cardiovascular risk factors among 3712 Greek seafarers

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ABSTRACT

Background: *Global concern on seafarers' health and its potential cost is widely evident across the shipping industry. Seafarers are at increased cardiovascular risk since it is common to have risk factors associated with that risk such as hyperlipidaemia, obesity and smoking. The aim of this study is to assess the prevalence of the main risk factors for cardiovascular disease (CVD), i.e. hyperlipidaemia, smoking and obesity, in Greek seafarers.*

Materials and methods: *During pre-embarkation medical examination, seafarers undergo an interview with a physician, physical examination and laboratory tests. The parameters studied included hyperlipidaemia, identified as low density lipoprotein > 150 mg/dL, tobacco use or severe obesity, as defined by body mass index > 35 kg/m^2.*

Results: *A total of 3712 seafarers have been examined. Seafarers had overall rates of 3% hyperlipidaemia, 4% tobacco use and 0.2% severe obesity, with similar distributions in all age groups. Our study shows that Greek seafarers have lower risk for CVD, as low rates of obesity, tobacco use, and hyperlipidaemia are observed. The related literature is discussed. Unhealthy eating patterns are the rule and contribute to CVD. Shipping management could improve diet on board; however, smoking falls rather under individual control.*

Conclusions: *We conclude that, despite the low rates of hyperlipidaemia, smoking and obesity among Greek seafarers compared to other nations, campaigns for promoting awareness of the phenomenon and on the potential health impact of these conditions should be promoted.*

(Int Marit Health 2020; 71, 3: 181–183)

Key words: seafarers, Greek, cardiovascular risk, obesity, hyperlipidaemia, smoking

INTRODUCTION

It is estimated that 90% of global commerce relies on water transportation. There are approximately 1.5 million seafarers worldwide (oceangoing). They can be considered labour migrants, moving from port to port and contract to contract. Seafarers are mostly from developing nations and are an aging workforce. They are an isolated workforce with unique health risks and limited access to medical care. Maritime regulators, ship owners, trade unions and P&I clubs are all alert to the fact that seafarers face multiple challenges, therefore their health and wellness should be at its top tier.

All seafarers are obliged to undergo biennial pre-embarkation medical examination to ensure their fitness for duty. For many seafarers, this examination, represents the only contact with a physician [1], and, therefore, the only chance for underlying disease to be detected and treated. Seafarers with common diseases such as hyperlipidaemia, obesity and smoking may have reduced performance, which could lead to environmental damage, ill-health and reduced lifespan among highly skilled seafarers, who are in increasingly short supply. Seafarers are at increased risk of myocardial infarction; and cardiovascular disease

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Table 1. Overall and age group analysis of the prevalence of hyperlipidaemia, tobacco use and obesity in Greek seafarers, expressed in terms of absolute (n) and relative (%) frequencies

Age group	Total subjects	Hyperlipidaemia	Smoking	Obesity
Overall	3712	105 (3%)	140 (4%)	7 (0.2%)
20–30 years	1626	26 (2%)	72 (4%)	2 (0.1%)
30–40 years	1051	38 (4%)	43 (4%)	3 (0.3%)
40–50 years	476	26 (5%)	21 (5%)	0 (0%)
50–60 years	211	15 (7%)	4 (2%)	2 (1%)

(CVD) accounts for more than 18% of all naval disability causes [2].

Although there is literature regarding cardiovascular risk factors among European sailors [3], Greek seafarers have not been studied. The aim of this study is to assess the prevalence of the main risk factors for CVD [3], i.e. hyperlipidaemia, smoking and obesity, in Greek seafarers.

MATERIALS AND METHODS

MEASUREMENTS PARAMETERS

A computer-based prospective database was developed, where Fleet Medical Advisor records all medical information. During pre-embarkation medical examination, seafarers undergo an interview with the doctors, physical examination and laboratory tests. All results are recorded in the database. The parameters studied included hyperlipidaemia, identified as low density lipoprotein (LDL) > 150 mg/dL, tobacco use or severe obesity, as defined by body mass index (BMI) > 35 kg/m^2. The data of nationality, age, weight, height, blood glucose and blood pressure values obtained from 3712 seafarers in a 4-year period were analysed. Body mass index values were calculated.

STATISTICAL ANALYSIS

Data normality was determined with histograms, Q-Q plots and the Shapiro test. Continuous data with a normal distribution is presented in mean-deviation form. Non-normal distributed variables are presented with medians and ranges. Data analyses were performed using SPSS version 17.0.

RESULTS

A total of 3712 seafarers have been seen. All seafarers examined were males, aged between 21 and 60 years (median 31 years). Seafarers had overall rates of 3% hyperlipidaemia, 4% tobacco use and 0.2% severe obesity. In the age group 20–30, 2% of the seafarers had hyperlipidaemia, 4% used tobacco and 0.1% were severely obese. In the age group 30–40, 4% of the seafarers presented with hyperlipidaemia, 4% used tobacco and 0.3% suffered from severe obesity. In the age group 40–50, 5% had hyperlipidaemia, 5% were smokers but no obese seafarers were observed. Seafarers between 50 and 60 years of age demonstrated higher prevalence of hyperlipidaemia and lower smoking rates than the other groups (7% and 2%, respectively), the difference not being statistically significant. All data presented is summarised in Table 1.

DISCUSSION

Our study showed that Greek seafarers are not at increased risk of CVD, as low rates of obesity, tobacco use and hyperlipidaemia were observed.

Smoking is a well-defined risk factor for chronic heart disease among seafarers. High smoking prevalence among seafarers is attributed to work-related stress and lack of leisure time facilities [4]. Our study demonstrates a low prevalence of smoking among Greek seafarers, compared to seafarers sailing under other flags. In a literature review smoking prevalence among mariners varied between 37.3% and 72.3% [3]. Slišković et al. [5] report 42% of 507 Croatian seafarers being smokers.

One possible explanation for the low number of smokers among Greek seafarers, given the high prevalence of smoking in the general population, could be that smoking habits are more common on board and our seafarers were interviewed during pre-embarkation. Seafarers that work for months on tankers, followed by vacations after disembarkation, which can last up to several months. Such seafarers are more possible to experience different-life-styles [6] with smoking sessions on board followed by non-smoking periods and are the majority of our sample. Higher smoking levels on board (18%) than at home (12.5%) have indeed been observed in case of heavy smokers, i.e. more than 20 cigarettes per day [5]. Our finding is in line with the general decrease in smoking rates observed in the subpopulation of seafarers during the last decades, e.g. 2000s compared to 1990s [3].

We also found 4% overall obesity rate, significantly lower to the rates reported. The next lower obesity rate is reported for Italian seafarers (10%), but rates > 30% are common in the literature. However, the difference might be explained from the fact that the threshold defining obesity

differs between the studies. Some authors consider obesity BMI > 30 kg/m^2 [6–8], others (e.g. the current work) study severe obesity setting the threshold at BMI > 35 kg/m^2, whereas others group together overweight and obese seafarers, i.e. BMI > 25 kg/m^2 [1]. Older age is associated with increase in obesity [6]. Turkish male seafarers begin to gain excessive weight from the age of 28, reaching the highest BMI value at their 50s [8], while Italian male seafarers gain excessive weight between 39 and 45 years and reach the highest BMI in the group of 55–66 years of age [9].

An overall of 3% of our sample demonstrated hyperlipidaemia, defined as high LDL cholesterol levels. This is a low percentage compared to the existing studies. Oldenburg et al. [4] report high LDL cholesterol levels in 18% of German seafarers. According to a literature review for mariners, 25–42% of the populations studied, suffered from hypercholesterolaemia [3].

Unhealthy eating patterns are the rule and contribute to CVD. It is known for example that overeating as well as consuming sweets, cake and sugared sodas are more frequent on board than at home [7]. About 80% of the mariners are not satisfied with the quality of food available on board. Twenty per cent of them consume dietary supplements to overcome dietary gaps [9]. Several other barriers to a healthy diet have been described, including easily accessed duty-free tobacco and sugared products available on-board, not adequately trained cooks [6], financial difficulties together with stress- and boredom-related factors [7]. Shipping management could improve diet on board; however, smoking falls rather under individual control [5]. Our low rates might, thus, be explained as the result of interventions implemented to improve seafarers' health the last 2 years (diet centralisation, introduction of low-fat diets, prevention of overeating, cooking classes with experts for the ship cooks' etc.).

Physical activity during leisure time is also very important with variations among individuals. Danish seafarers claimed to do fitness training 3 times a week or more; more often on board than at home (32% vs. only 24%) [7]. However, only 30% were classified as having high physical fitness during testing, with one-third demonstrating low physical fitness [7]. Twenty per cent of the seafarers are completely inactive, the main reasons being lack of motivation due to poor weather conditions at sea or lack of time [7].

Our study has several limitations. Firstly, the job duration has not been recorded. Secondly, other dependent and independent chronic heart disease risk factors (e.g. hypertension, diabetes, positive family history, alcohol) have not been studied, which may underestimate the cardiovascular risk. Thirdly, seafarers are a working population and it is possible that our outcomes reflect a healthy worker effect. Fourthly, the analysis was based on seafarers' data from a 4-year period. A larger database could deliver more reliable results [8].

CONCLUSIONS

We conclude that, despite the low rates of hyperlipidaemia, smoking and obesity among Greek seafarers compared to other nations, campaigns for promoting awareness of the phenomenon and on the potential health impact of these conditions should be promoted.

REFERENCES

1. Romero-Paredes Md, Reinoso-Barbero L, González-Gómez MF, et al. Improving cardiovascular health in Spanish seafarers. Int Marit Health. 2016; 67(1): 3–8, doi: 10.5603/IMH.2016.0002, indexed in Pubmed: 27029922.
2. Oldenburg M, Jensen HJ, Latza U, et al. Coronary risks among seafarers aboard German-flagged ships. Int Arch Occup Environ Health. 2008; 81(6): 735–741, doi: 10.1007/s00420-007-0261-5, indexed in Pubmed: 17909838.
3. Pougnet R, Pougnet L, Loddé BL, et al. Cardiovascular risk factors in seamen and fishermen: review of literature. Int Marit Health. 2013; 64(3): 107–113, indexed in Pubmed: 24072535.
4. Oldenburg M, Jensen HJ, Latza U, et al. The risk of coronary heart disease of seafarers on vessels sailing under a German flag. Int Marit Health. 2010; 62: 123–128.
5. Slišković A, Penezić Z. Lifestyle factors in Croatian seafarers as relating to health and stress on board. Work. 2017; 56(3): 371–380, doi: 10.3233/WOR-172501, indexed in Pubmed: 28339415.
6. Baygi F, Jensen OC, Qorbani M, et al. Prevalence and associated factors of cardio-metabolic risk factors in Iranian seafarers. Int Marit Health. 2016; 67(2): 59–65, doi: 10.5603/IMH.2016.0013, indexed in Pubmed: 27364169.
7. Hjarnoe L, Leppin A. A risky occupation? (Un)healthy lifestyle behaviors among Danish seafarers. Health Promot Int. 2014; 29(4): 720–729, doi: 10.1093/heapro/dat024, indexed in Pubmed: 23630132.
8. Nas S, Fışkın R. A research on obesity among Turkish seafarers. Int Marit Health. 2014; 65(4): 187–191, doi: 10.5603/IMH.2014.0036, indexed in Pubmed: 25522701.
9. Nittari G, Tomassoni D, Di Canio M, et al. Overweight among seafarers working on board merchant ships. BMC Public Health. 2019; 19(1): 45, doi: 10.1186/s12889-018-6377-6, indexed in Pubmed: 30626365.

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Wellbeing of a selection of seafarers in Eastern Adriatic Sea during the COVID-19 pandemic 2020

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ABSTRACT

Background: *Work-related stress among seafarers is well known but a suspected excess of work-related stress due to the COVID-19 so far has not been published. The aim of the study was to evaluate the well--being of the seafarers during the outbreak of COVID-19 pandemic and their evaluation of the precautions taken by the shipping companies.*

Materials and methods: *Seventy-two seafarers completed the General Health Questionnaire (GHQ12) with three extra questions on how the COVID-19 precautions were taken on board.*

Results: *The mean Likert score was 13.9 for the whole sample, corresponding to "no problems" while a subgroup of 40% had mean Likert sum scores of 16.1 (level 15–23) corresponding to "starting problems." In response to the extra items, 50% of the seafarers did not feel safe doing their job in relation to the epidemic and 60% did not think everything has been done to ensure their health at work in relation to the epidemic. Thirty per cent suffered of insomnia to the extent of becoming concerned and 26% had been unhappy and depressed during the latest tours of duty.*

Conclusions: *The hypothesis that excess work-related stress has been put on the seafarers in this specific situation was confirmed and calls for prevention. A combination of person-focused and organisation-focused prevention approaches has been advocated as the most promising for alleviation of job stress in the workplaces at sea.*

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Key words: seafarers, wellbeing, pandemic, work related stress

INTRODUCTION

Many people worldwide and especially in the countries of southern Europe (e.g. Italy and Spain) have been severely affected by the COVID-19 pandemic. The situation is causing many risks and problems even for workers who have to continue working during the epidemic, such as seafarers.

Seafarers often experience stress connected with their specific work conditions, job responsibility and psychosocial factors, which generate health and psychological problems [1–3]. As the problem mainly affects the population on land, seafarers are expected to feel very safe in ships, but the preliminary results of this study seem to pose instead for a considerable sense of concern for their health in the group of seafarers. During the latest months there has been high attention to the COVID-19 from International Maritime Organisation/International Labour Organisation (IMO/ILO) but there is so far no scientific studies published.

The objective was to investigate in time the impact of the pandemic on the physical and mental well-being of seafarers, considering the situation as a risk factor due to excess work-related stress due to the pandemic. We also want to investigate the level of satisfaction of workers regarding the measures implemented in ships and ports and their

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subjective perception of risk and safety in this moment. The hypothesis is that that excess work-related stress has been put on the seafarers in this specific situation. Our study is part of a context where the difficulty of detecting and measuring psychological problems that can be exacerbated by related stress on work is ascertained.

MATERIALS AND METHODS

A cross-sectional study design by the use of a standard questionnaire with a random sampling method of the seafarers and the type of ships was used. All seafarers passing through the terminal from the ships were asked to complete the questionnaire on a Tablet/iPhone or answer the interviewer who entered the data in the Tablet. The container ships involved in the study make weekly calls in the Port of Trieste. One of the authors delivered the questionnaire to the seafarers in a hit and returned the completed document to the next hit in Trieste.

The questionnaires were administered on a voluntary basis to all ranks of seafarers from a sample of the container ships of all sizes (5 ships with different flags) arriving to Trieste Container Terminal in the 4 months period from January to April 2020.

The variables include personal data, ship type, position on board, workplace and the 12-item General Health Questionnaire and three more questions on the correct handling of the prevention in COVID-19 by the company.

The study size was based on a decision to stop the data collection when 50 questionnaires have returned; however, due to unexpected quick completing there was time to extend 72 participants. The analysis was done in SPSS v.26. Each of the Goldberg's General Health Questionnaire (GHQ12) items has four answer options: 1) more than usual, 2) as usual, 3) less than usual, and 4) much less than usual describing mood states. Using the Likert code method 0-1-2-3 gives a total score range of 0–36.

The Likert sum scores were classified as 0–14 (no problems), 15–19 (starting problems) and 19–36 (serious problems). Analyses of the Likert scores were divided in two groups: group 1: Likert score 0–14 no problems, (no action needed) and group 2: Likert score 15–19 starting problems (included 2 with Likert score 20–36: serious problem).

Stratification was done of the variables: age < 40 and > 40 years of age, officer/non-officer, workplace: bridge, kitchen, deck and engine and nationality in four groups and on Likert sum scores, no problems (0–14) and problems (15–19). Cross-tab analysis was done for the question: "Do you think everything has been done to ensure your health at work in relation to the COVID-19 pandemic?" and the responders with Likert score 15–19 "Less than usual". See Table 1 for the complete questionnaire.

RESULTS

STUDY POPULATION

A total 72 consecutive seafarers, all men, entered the study. All invited seafarers were willing to participate and there were no missing values in the completion of the questionnaires. The age distribution was as follows: 15–39 years, n = 32 (44%), 40–60 years, n = 40 (56%). Mean age 39 ± 11.2 years, range 11–60, median 41. Non-officers, n = 41 (57%). Officers, n = 31 (43%). Working department on ship: bridge, n = 4 (6%), galley, n = 8 (11%), deck, n = 36 (50%), engine, n = 24 (33%). Nationality of seafarers was as follows: Asian countries, n = 39 (54%). European countries, n = 12 (17%). Russian and former Soviet Union (USSR) countries, n = 20 (28%) and other countries, n = 1 (1.3%).

LIKERT SCORE DISTRIBUTIONS

Frequency distribution of GHQ12 scores for the total sample (Table 2). Distribution of the Likert sum scores: 0–14 (no problems; n = 43; 59.7%), 15–19 (starting problems; n = 28; 38.9%) and 19–36 (serious problems; n = 2; 1.3%). The mean Likert score was 13.9 (sum = 1004/72). Distribution of the Likert scores level 15–19: "Less than usual" were as follows: officers n = 31 (45.2%) and non-officers, n = 41 (36.6%). In relation to the workplace on board the engine room personnel with n = 24 (50%) ranged highest and the Russian and the Asian seafarers with scores on 45% and 38.5%, respectively ranged highest among the nationalities (Table 3).

LIKERT SCORE 2–3 TO THE SPECIFIC ITEMS

Figure 1 describes the personal prevalences of the two levels Likert score 0–1 = "same as usual" and 2–3 = "less than usual or worse" to each of the 12 items. The highest prevalence for 47% of the participants marked Likert score 2–3 means that 47% of all felt "less than usual happy emotionally" and 40% marked Likert score 2–3 "less than usual been able to carve out free time for yourself and enjoy it".

THE EXTRA QUESTIONS ADDED TO THE GHQ12

Sixty-three per cent of the non-officers and 55% of the officers did not think "that everything has been done to ensure their health at work in relation to the COVID-19 pandemic" (Fig. 2).

Fifty-four per cent of the non-officers and 52% of the officers did not feel safe doing their job in relation to the epidemic. And 73% of the non-officers and 74% of the officers did think "that the international situation has relatively changed the responses of this test compared to before the crisis".

Table 1. All questions of questionnaire

Psycho-physical wellbeing and risk of work related stress in SEAFARERS in a situation of international emergency situation due to COVID-I9 epidemic in 2020. A brief investigation using the GENERAL HEALTH QUESTIONNAIRE (GHQ12)

Age of Seafarer:.....

Nationality of Seafarer:
- ☐ European Countries (all)
- ☐ Russian and ex URSS Countries
- ☐ Asian Countries
- ☐ North-African, Middle East and Arabic Countries
- ☐ African Countries
- ☐ Others Countries

Please ask to all the following questions sincerely (GHQ12 questionnaire)

In the last 2 weeks you have:	More than usual	Same as always	Less than usual	Much worse than usual
1. Been able to concentrate on what one is doing? Eg. Can follow the point of a discussion. can concentrate while reading, etc.	0	1	2	3
2. Suffered insomnia to extent of becoming concerned?	3	2	1	0
3. Been productive (doing lots of things) in most of the activities undertaken?	0	1	2	3
4. Been able to make decisions in moat cases?	0	1	2	3
5. Been constantly under pressure?	3	2	1	0
6. Not he able to overcome difficulties?	3	2	1	0
7. Been able to carve out free time for yourself and enjoy it?	0	1	2	3
8. Been able to resolve your problems?	0	1	2	3
9. Been unhappy and depressed?	3	2	1	0
10. Felt as if you have lost faith in yourself?	3	2	1	0
11. Felt as if you have less self-esteem?	0	1	2	3
12. In general felt a happy emotional state of mind?	0	1	2	3

Do you think that the international situation has relatively changed the responses of this test compared to before the crisis?
☐ Yes ☐ No

Do you think everything has been done to ensure your health at work in relation to the COVID epidemic?
☐ Yes ☐ No

Do you feel safe doing your in relation to the epidemic?
☐ Yes ☐ No

Your rank:
- ☐ No officer (crew)
- ☐ Officer

Your job:
- ☐ Deck
- ☐ Engine-Engineer
- ☐ Steward
- ☐ Other job

Thank you for your kind collaboration! We want to improve the health and life of seafarers. The questionnaire is anonymous and will be treated in compliance with the privacy legislation (GDPR).

The data is used for research purposes. Thank you for your kind collaboration.

Giuliano Pesel, MD, Occupational Medicine. Ord. Med. N. 3988 Trieste

Corso de Especialista en medicina del trabajo maritimo. Course for specialist in occupational maritime medicine — Fundación Universidad Empresa de la provincia de Cádiz, Spain.

DISCUSSION

This is to our knowledge the first study to investigate the impact of the COVID-19 pandemic on seafarers' mental and physical risk factors during their stay and work on board. Seventy-two seafarers from container ships of different sizes and from different countries completed the GHQ12 and three extra questions on how the COVID-19 precautions were taken on board by the companies. The mean Likert score was 13.9 for all, which corresponds to the cut-off limit for "no problems". However, by stratification of the Likert

score levels, then 40% of the sample was in the range of 15–19 Likert score indicating "starting problems". Further, in the response of the three extra items, 50% of the sample did not feel safe doing their job in relation to the epidemic and 60% did not think everything has been done to ensure their health at work in relation to the epidemic (Fig. 2).

The hypothesis that excess work-related stress has been put on the seafarers in this specific situation was confirmed with a need to take specific preventive precautions for all of them.

A combination of elevated Likert score on the level of "starting problems" and that more than 50% of all did not feel safe about the precautions done by the shipping company in the actual situation indicates an urgent need to establish a care-taking programme for the seafarers on the personal level and the organisational level in the companies. A combination of person-focused and organisation-focused approaches has been advocated as the most promising for alleviation of job stress in the workplaces at sea [4, 5]. That 60% of the whole sample had Likert sum scores 0–14 (cut-off level "no problems") does not mean, that this group is free of any problems, but that they probably has higher personal resilience and so the need for organisational preventive programme is as important for them as for those with the highest Likert scores. For comparison, a study with 350 seafarers in international shipping, higher levels of resilience, longer seafaring experience and greater work support were significantly associated with lower levels of self-reported stress at sea [6].

Table 2. Frequency distribution of Likert GHQ12 scores for all (n = 72)

Score	Number	Per cent
10	1	1.3%
11	10	14%
12	15	21%
13	7	10%
14	10	14%
15	11	15%
16	12	17%
17	3	4%
18	2	2.6%
23	1	1.3%
Total	72	100%

METHODS

The most popular questionnaire for measuring general well-being and the risk of mental illness is probably Goldberg's General Health Questionnaire. This tool assesses well-being by detecting the possible presence of symptoms that could be the result of a stress condition, and offers a rapidly variable measure over time, such as to be valid in periodic monitoring of the state of health. In alternative to the classic version with 60 items, we used the shorter version with 12 items, the GHQ12, expecting this to give a better response rate than using the longer version. About 80% of the questionnaires were administered face-to-face, the rest were filled in by the seafarers on board and subsequently delivered. With regard to the questions in the questionnaire, a shorter and easier to understand version was chosen that best suits our purpose than the Goldberg format.

Table 3. Distribution of Likert score 15–21: "Less than usual" in the demographic groups (n = 28/72)*

	Likert score 15–21	Whole sample	Per cent	95% CI
Rank				
Officers	13	31	45.2	28–62
Non-officers	15	41	36.6	23–52
Work place on board		72		
Deck	14	36	38.9	24–55
Engine	12	24	50.0	31-69
Galley	1	8	12.5	1–48
Bridge	1	4	25.0	1–76
Nationality				
Asian countries	15	39	38.5	24–54
Russian and ex USSR countries	9	20	45.0	25–67
European countries	4	12	33.3	12–62
Other countries	0	1	0.0	0–0

*Likert scores divided in the three groups: group 1: Likert score 0–14 (no problems) and group 2: Likert score 15–19 (starting problems) and Likert score 19–36 (serious problem); CI — confidence interval

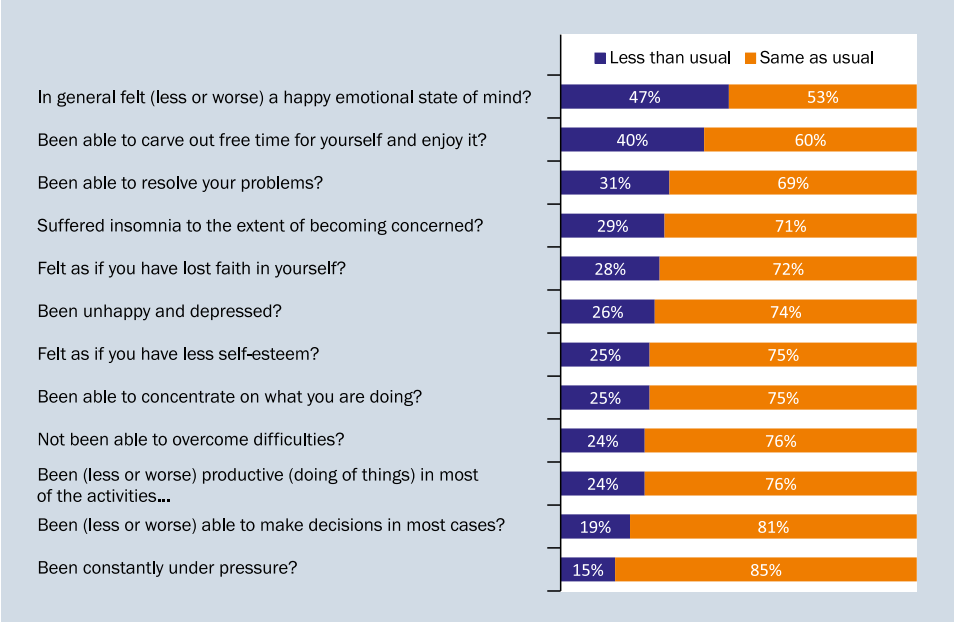

Figure 1. Distribution of prevalence of Likert score 0–1 = "same as usual" and 2–3 = "less than usual or worse" to each of the 12 items the GHQ12 (n = 72). Explanation: as an example, in the upper row 47% marked blue with a Likert score 2–3 means that 47% of all felt "less than usual happy emotionally" and 53% marked orange had Likert score 0–1 felt "same as usual"

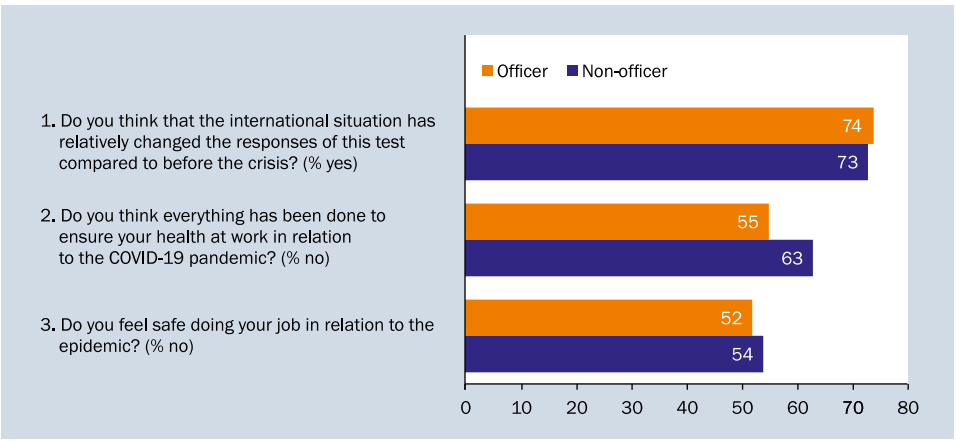

Figure 2. Percentages of officers (n = 31) and non-officers (n = 41) who answered "Yes" to question 1 and "No" to question 2–3

GHQ12 LIKERT SCORES

The overall distribution of Likert sum scores were: 0–14 (no problems, n = 43; 59.7%), score 15–19 (starting problems, n = 28; 38.9%) and 19–36 (serious problems, n = 2; 2.3%). The sum of Likert scores among the 72 participants = 1004 corresponding to a mean of 13.9 Likert scores corresponding to a cut-off limit for "starting problems", n = 28; 38.9%. In comparison with the studies by Sampson et al. [7] these levels are somewhat similar to the presence of a 'psychiatric disorder' of 37% in 2016 that had risen substantially from 28% in 2011 (p = 0.000), Martin et al. [8] found by comparison with other scoring methods that the GHQ12 is a reliable screening instrument for psychological distress in clinical groups. Lundin et al. [9] found sufficient sensitivity and specificity by the use of the GHQ12 for separating those with or without a depressive disorder was reached at ≥ 12 Likert scored points. Winefield et al., 2003 [10] found GHQ12 Likert score mean values of 11.6–14.00 among university staff. The academics scored generally higher than general staff and teaching and research staff scored highest. All questions related to the GHQ test were weighed according to Likert. The results of the final questions on the subjective perception of stress were calculated separately.

STRENGTH AND WEAKNESS OF THE STUDY

The instructions of the questionnaire invite the subjects to choose the answer that "seems more correct", that is, to subjectively estimate their degree of agreement about the question asked. This tool offers a rapid and focused measure of a person's general well-being, both physically and psychologically. The problem of evaluation by means of questionnaires is always linked to the subjectivity of the answers provided by the interviewees. The small study size (n = 72) is prone to wider statistical confidence intervals from which no firm conclusions can be drawn and does not allow for age-group, job-function/work area. Further, when 73% of the non-officers and 74% of the officers did think "that the international situation has relatively changed the responses of this test compared to before the crisis", then the results are probably influenced in a direction with worse results than before the crisis. A further limitation of the study could be related to the fact that some questionnaires were not completed face-to-face, as explained in the methods. Stratification results below n = 10 require a critical note and in general conclusions should be drawn with reserve. It is possible that there was some misunderstanding or boycott of the questionnaire by some interviewees. A barrier to the analysis of seafarers' depression and other psychological problems caused or aggravated by work related stress comes from the lack of information on the characteristics of the seafaring population. The Global Seafarer noted that in the 1980s there was a dramatic change in recruitment strategies for seafarers with an increasing proportion of seafarers being hired from developing countries and East Asia, particularly the Philippines, and this represents a selection bias [11].

FUTURE STUDIES

The bio-markers such as the salivary alpha-amylase measurements have emerged as valid and reliable objective marker of work related stress [12]. A biological marker could be the solution for an objective evaluation, considering the difficulties and uncertainty, found in the literature, in evaluating the level of work-related stress of seafarers.

However, such objective measurements cannot replace the GHQ12 questionnaire instrument to measure the specific daily problems, such as sleeping problems, but the biomarkers may be used as supplement to the questionnaire measures to be further developed. While the primary objective was to evaluate the well-being of the seafarers during the outbreak of COVID-19 pandemic, the intention is also to create the basis for a permanent monitoring of the seafarer's health and well-being in an international perspective. These studies will serve as the scientific evidence base to assess the effect of the implementation of the ILO-based International Conventions, the Maritime Labour Convention 2006 for seafarers. And due to the continuing appearance of new health risks a permanent surveillance of the maritime health and safety is needed.

CONCLUSIONS

A combination of elevated Likert score to the level of "starting problems" for 15–47% of the sample and more than 50% of all did not feel safe about the precautions done by the shipping company indicates an urgent need to establish a care-taking programme for the seafarers. A combination of person-focused and organisation-focused approaches has been proposed to be the most promising way for prevention. On the personal level, guidelines of prevention for the crew on board and the crew exchange with test of infection before embarkation of new crew is recommended. Extensive communication to all seafarers during the situation with information of the possibility to disembark and the flights home and the economic situation for them; access to unlimited internet for tele-communication to home, access to Radio-Television and to Radio-Medical and the possibility of getting test on board before they disembark (incubation time) are some of the important requirements besides masks and disinfection remedies available. In some cases, individual crisis consultations with the company psychologist and occupational doctor may be useful, but for the population at large there is no good evidence that programs with individual consultations has any effect on the longer perspective [13]. Some studies available in the literature provide us with indications about the importance of psychological problems (such as depression and suicidal risk), and also show us the difficulty of studying and measuring the problem [11]. In this context, it is very important to carefully evaluate the risk of work-related stress. Our results also show a certain difficulty and uncertainty in framing this kind of problem in the population of seafarers, even in the pandemic period. In light of our results, we could say that seafarers' resistance to stress appears to be remarkable, even in a pandemic period. We can therefore state that further studies on this topic would be necessary also with the aid, as anticipated, of more objective stress measurement systems, such as biological indicators.

On the organisational level, there are detailed guidelines from the IMO/ILO and the National Maritime Authorities on how the companies should be prepared and ready to act adequately.

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REFERENCES

1. Jeżewska M, Leszczyńska I, Jaremin B. Work related stress in seamen. Int Marit Health. 2006; 57(1-4): 66–75.
2. Oldenburg M, Jensen HJ, Latza U, et al. Seafaring stressors aboard merchant and passenger ships. Int J Public Health. 2009; 54(2): 96–105, doi: 10.1007/s00038-009-7067-z, indexed in Pubmed: 19288290.
3. Agterberg G, Passchier J. Stress among seamen. Psychol Rep. 1998; 83(2): 708–710, doi: 10.2466/pr0.1998.83.2.708, indexed in Pubmed: 9819944.
4. Semmer NK. Job stress interventions and the organization of work. Scand J Work Environ Health. 2006; 32(6): 515–527, doi: 10.5271/sjweh.1056, indexed in Pubmed: 17173207.
5. Lamontagne AD, Keegel T, Louie AM, et al. A systematic review of the job-stress intervention evaluation literature, 1990-2005. Int J Occup Environ Health. 2007; 13(3): 268–280, doi: 10.1179/oeh.2007.13.3.268, indexed in Pubmed: 17915541.
6. Doyle N, MacLachlan M, Fraser A, et al. Resilience and well-being amongst seafarers: cross-sectional study of crew across 51 ships. Int Arch Occup Environ Health. 2016; 89(2): 199–209, doi: 10.1007/s00420-015-1063-9, indexed in Pubmed: 26062930.
7. Sampson H, Ellis N, Acejo I, et al. Changes in seafarers' health 2011 16: A summary report. SIRC. 2017; 22.
8. Martin C, Newell R. Is the 12-item General Health Questionnaire (GHQ-12) confounded by scoring method in individuals with facial disfigurement? Psychology Health. 2005; 20(5): 651–659, doi: 10.1080/14768320500060061.
9. Lundin A, Hallgren M, Theobald H, et al. Validity of the 12-item version of the General Health Questionnaire in detecting depression in the general population. Public Health. 2016; 136: 66–74, doi: 10.1016/j.puhe.2016.03.005, indexed in Pubmed: 27040911.
10. Winefield A, Gillespie N, Stough C, et al. Occupational stress in Australian university staff: Results from a national survey. Int J Stress Manag. 2003; 10(1): 51–63, doi: 10.1037/1072-5245.10.1.51.
11. Mellbye A, Carter T. Seafarer's depression and suicide. Int Marit Health. 2017; 68(2): 108–114.
12. Ali N, Nater UM. Salivary alpha-amylase as a biomarker of stress in behavioral medicine. Int J Behav Med. 2020; 27(3): 337–342, doi: 10.1007/s12529-019-09843-x, indexed in Pubmed: 31900867.
13. Jensen O, Charalambous G, Flores A, et al. Strategies for prevention of non-communicable diseases in seafarers and fishermen: lessons learned. Int J Community Family Med. 2018; 3(2), doi: 10.15344/2456-3498/2018/142.

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Coronavirus variant COVID-19 pandemic: a report to seafarers

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ABSTRACT

We report the current situation regarding the COVID-19 pandemic with particular regard to seafarers and with the indications drawn up by the Centro Internazionale Radio Medico (C.I.R.M.) in this regard.

(Int Marit Health 2020; 71, 3: 191–194)

Key words: coronavirus, COVID-19, maritime medicine, acute distress respiratory syndrome, occupational health

INTRODUCTION

Coronaviruses are a large family of viruses, which include 4 genera: α and β infect mammals while γ and δ infect birds. In humans, several coronaviruses are known to cause respiratory infections ranging from the common cold to more severe diseases, such as severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) [1]. The most recently discovered coronavirus is SARS-CoV-2 which causes the coronavirus disease named COVID-19. This new virus and resulting disease were unknown before the outbreak that began in Wuhan, China, in November–December 2019. SARS-CoV-2 and SARS-CoV share approximately 80% of genomic material.

This report takes stock of the situation approximately 3 months after it was declared a pandemic by the World Health Organization (WHO; March 11, 2020) [2], and reports the position of the *Centro Internazionale Radio Medico* (C.I.R.M., International Radio Medical Centre, the Italian Telemedical Advice Service) with regard to this topic. The C.I.R.M. was established in 1935 to provide medical care via telecommunication systems to seafarers of all nationalities, sailing across the seas, aboard vessels without a doctor on board.

The ongoing COVID-19 outbreak probably started in November–December 2019. Wuhan is the capital of the Hubei Province, located at the confluence of the Changjiang River and the Hanshui River. Today Wuhan is considered the political, economic, financial, commercial, cultural and educational centre of central China. It is a major transportation hub, with dozens of railways, roads and expressways passing through the city and connecting to other major cities. Wuhan Tianhe International Airport, which opened in April 1995 in order to replace the previous Hankou Wangjiadun and Nanhu airports, thus becoming Wuhan's major airport, is one of the busiest airports in central China. Wuhan is also a major hub for maritime transport in central China. The port of Wuhan hosts services for the local population and for shipping enterprises.

The John Hopkins University database, in the situation report of June 28, 2020, stated that there are 9,953,083 confirmed cases with 498,217 deaths [2]. There are 240,136 confirmed cases in Italy with 34,716 deaths, with a lethality rate of approximately 14% [3].

The signs and symptoms of 2019-nCoV include fever, cough, respiratory problems and pneumonia. Human-to-human transmission may occur during the incubation period (before symptoms appear), and the average time from infection until the onset of the disease is approximately 7 days, with a maximum incubation period of approximately 14 days. WHO has defined suspect, probable and confirmed cases, as well as contacts, as indicated below [4].

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SUSPECT CASE

— A patient with acute respiratory illness (fever and at least one sign/symptom of respiratory disease, e.g., cough, shortness of breath), AND a history of travel to or residence in a location reporting community transmission of COVID-19 disease during the 14 days prior to symptom onset; OR
— A patient with any acute respiratory illness AND having been in contact with a confirmed or probable COVID-19 case (see definition of contact) in the last 14 days prior to symptom onset; OR
— A patient with severe acute respiratory illness (fever and at least one sign/symptom of respiratory disease, e.g., cough, shortness of breath; AND requiring hospitalisation) AND in the absence of an alternative diagnosis that fully explains the clinical presentation.

PROBABLE CASE

— A suspect case for whom testing for the COVID-19 virus is inconclusive; OR
— A suspect case for whom testing could not be performed for any reason.

CONFIRMED CASE

A person with laboratory confirmation of COVID-19 infection, irrespective of clinical signs and symptoms. See laboratory guidance for details: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/laboratory-guidance.

CONTACT

A contact is a person who experienced any one of the following exposures during the 2 days before and the 14 days after the onset of symptoms of a probable or confirmed case:
— face-to-face contact with a probable or confirmed case within 1 m and for more than 15 min;
— direct physical contact with a probable or confirmed case;
— direct care for a patient with probable or confirmed COVID-19 disease without using proper personal protective equipment;
— other situations as indicated by local risk assessments.

Note: For confirmed asymptomatic cases, the period of contact is measured as the 2 days before through the 14 days after the date on which the sample was taken which led to confirmation.

A recent review of 22 studies by Krampf et al. [5], on SARS, MERS and HcoV (alphacoronavirus) syndromes, all variants of coronavirus, has highlighted the persistence of these viruses on inanimate surfaces for up to 9 days, and that the use of ethanol, sodium hypochlorite and hydrogen peroxide inactivates the viruses within one minute. In the recent history of public hygiene we have seen the dangerousness of the coronavirus family variants, namely the SARS and MERS viruses. The main mode of transmission of these pathologies was also airborne, with COVID-19 having similar animal reservoirs as SARS [1]; while the main animal reservoir for MERS seems to have been the camel [1]. In 2003 the fatality rate of SARS, which also originated in China, was approximately 10%, while in 2012 the fatality rate of MERS was an average of approximately 35% (WHO data). The initial clinical information on COVID-19 is summarised in Table 1, which reports the data of two initial patient cohorts from two hospitals in Wuhan [6, 7] and subsequently one cohort.

The initial data showed that almost all patients had a fever (98% of cases) and radiographically visible pneumonia (100% of cases). A cough was present in 60–76% of cases and dyspnoea in 30–55% of cases. The median time between the onset of symptoms and hospitalisation was 7 days for both of the patient cohorts reported in Table 1. If acute respiratory distress syndrome developed, the median time to onset was 8–9 days from the start of symptoms. This data has been substantially confirmed

Table 1. Patient data from two hospitals in Wuhan (two initial patient cohorts)

	Huang C et al. [6] (Jin Yintan Hospital, Wuhan): 41 patients (January 2–24, 2020)	**Wang D et al. [7] (Zhongnan Hospital, Wuhan): 138 patients (January 1–28, 2020)**
Men	73%	54.3%
Mean age	49 years	56 years
Main symptoms	Fever (98%), cough (76%), dyspnoea (55%), lymphopenia (63%)	Fever (98.6%), dry cough (59.4%), dyspnoea (31.2%), lymphopenia (70.3%)
Pneumonia	100%	100%
Comorbidities	32%	46.4%
Intensive Care Unit	32%	26.1%
Lethality	15%	4.3%

with a meta-analysis by Li et al. [8] with 1994 patients originating from 10 scientific works selected. The lethality of this meta-analysis was 7%. The largest cause for the transmission and the wide spread of COVID-19 within the province of Hubei was local transportation, while the spread to other countries was through airplanes. Maritime transport could have, or has, played a role in the spreading of COVID-19, but given the slower speed and the confined spaces used, COVID-19 spreads less effectively than with air transport.

The first American case of COVID-19 was reported on March 5, 2020, and in addition to the symptoms summarised in Table 1, the case also presented with abdominal pain and loose stools, testing positive for COVID-19 [9]. On June 28, 2020 the confirmed cases of SARS-CoV-2 in United States are 2,510,092 with 125,539 deaths [3].

The term quarantine, or forced confinement, is well-known in the maritime sector and actually originates from the word "forty" in Italian, which refers to the forty day period during which the Venetian government in the 16th century forbade any ships from approaching the port of Venice in order to avoid contaminating the city with the black plague. Sikorska [10] highlights that the lack of an effective treatment or a vaccine renders quarantine as the only effective protection.

In the maritime sector there are two types of shipping that must be underline. Cruise ships carry a large number of people, travelling to multiple destinations and providing a high number of available services (including healthcare ones). Cargo ships, instead, transport any type of goods (hydrocarbons, metals, various chemicals, etc.) and the crew does not exceed 30 members, without any medical services and with an average 3–6 months period of stay on board. In order to be able to continue supplying raw materials (hydrocarbons, chemical substances, etc.) even in endemic areas, this type of commercial maritime transport must continue, with the foresight that the personnel on board cannot disembark and no personnel can be replaced. Reducing all contact between the ship and external personnel to a minimum is essential, and with these dealings a safe distance must be kept, and protective gloves and masks must be used as specified by the guidelines issued by the United States Centre for Disease Control and Prevention [11]. According to these guidelines, the safety distance on board should be approximately 6 feet (approx. 1.8 m).

The use of N95 filtering face masks is only recommended for those who are directly assisting suspect/probable or confirmed cases, and this assistance should always be provided by the same people, who will also wear disposable goggles as protection and medical gloves. For individuals experiencing fever, cough or dyspnoea, only the use of a surgical mask is recommended.

The frequent washing of hands for at least 20 s, with water and soap or a 60–95% alcohol solution, is prescribed to everyone.

In general, the medical devices on these ships are limited to only a sphygmomanometer and a thermometer, thus lacking the ability of evaluating fundamental vital signs such as blood oxygen saturation or performing an electrocardiogram test.

In this respect, the C.I.R.M. has always insisted on diffusing telemedicine stations on merchant ships, which would render it possible to quickly assess the conditions of seafarers on board, even remotely.

The issues encountered aboard these types of ships during this COVID-19 epidemic are:

— discerning between a common flu and a form of COVID-19;
— on-board isolation methods;
— any method of evacuation (MEDical EVACuation).

In the event of a suspect/probable case of COVID-19, knowing the history, movements and origin of the index case(s) is absolutely necessary. With this information and with the epidemiological data that is being collected, the case can be categorised in the appropriate risk range. It is essential to follow the clinical progress of the patient(s) who, if suspected to have contracted COVID-19, should be isolated in the infirmary, which should be equipped with one or two hospital beds and medical oxygen, and where the use of the toilet is reserved to the patient(s) and can be easily cleaned with a sodium hypochlorite solution.

If the fever (≥ 38°C) and respiratory symptoms resolve within a few days and the risk of having been infected is low, clearly, chances are the person did not contract COVID-19. Nevertheless, the lingering issue is that COVID-19 can also manifest itself in milder forms, similar to the flu, and diagnostic tests for COVID-19 cannot be conducted in all the ports. In the event of a suspected COVID-19 infection, the staff must obviously undergo quarantine and therefore cannot leave the ship that has docked at the port, to load and unload goods.

In ports of entry, the ship with suspect cases should be moored and the parties should disembark and undergo diagnostic tests in local equipped healthcare facilities, if possible. If such tests are not available, the index case will still have to undergo radiological diagnostics in order to check if viral pneumonia is present. If the diagnostic tests for the index case are not available, the personnel on board should remain in isolation for 14 days, starting from when the symptoms of the index case began. Frequent hand washing is a requirement for all quarantined personnel. As of today, potential COVID-19 vaccines are still in the testing phase, and with time being of the essence, many companies

have announced that they have been developing potential vaccines to curb further spread of the virus.

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REFERENCES

1. Perlman S, McIntosh K. Coronaviruses, including Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS). In: Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. Elsevier, Philadelphia 2020.
2. https://www.epicentro.iss.it/en/coronavirus/sars-cov-2-international-outbreak (June 28, 2020).
3. https://coronavirus.jhu.edu/map.html (June 28, 2020).
4. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/surveillance-and-case-definitions..
5. Kampf G, Todt D, Pfaender S, et al. Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. J Hosp Infect. 2020; 104(3): 246–251, doi: 10.1016/j.jhin.2020.01.022, indexed in Pubmed: 32035997.
6. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020; 395(10223): 497–506, doi: 10.1016/S0140-6736(20)30183-5, indexed in Pubmed: 31986264.
7. Wang D, Hu Bo, Hu C, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA. 2020 [Epub ahead of print], doi: 10.1001/jama.2020.1585, indexed in Pubmed: 32031570.
8. Li LQ, Huang T, Wang YQ, et al. COVID-19 patients' clinical characteristics, discharge rate, and fatality rate of meta-analysis. J Med Virol. 2020; 92(6): 577–583, doi: 10.1002/jmv.25757, indexed in Pubmed: 32162702.
9. Holshue ML, DeBolt C, Lindquist S, et al. Washington State 2019-nCoV Case Investigation Team. First Case of 2019 Novel Coronavirus in the United States. N Engl J Med. 2020; 382(10): 929–936, doi: 10.1056/NEJMoa2001191, indexed in Pubmed: 32004427.
10. Sikorska K. Coronavirus Disease 2019 as a challenge for maritime medicine. Int Marit Health. 2020; 71(1): 4, doi: 10.5603/IMH.2020.0002, indexed in Pubmed: 32212138.
11. https://www.cdc.gov/quarantine/maritime/recommendations-for-ships.html (June 28, 2020).

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Eustachian tube function test as a predictor of middle ear barotrauma

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ABSTRACT

Background: *Most cases of middle ear barotraumas in divers are due to impassability of the Eustachian tube, and typically occur during diving or during compression and decompression in a hyperbaric chamber. The aim of our study is to compare the results of tympanometry and Valsalva part of Eustachian tube function test (ETF-test) with the ability of divers to compensate for the change in ambient pressure in a hyperbaric chamber and to evaluate the tests as predictors of middle ear barotraumas.*

Materials and methods: *The study included 35 professional divers undergoing annual medical examination. Using tympanometer we measured the intratympanic pressure at rest, and after the manoeuvre of Valsalva. Then all subjects underwent a barofunction test (BFT) to assess their diving fitness and the passability of the Eustachian tubes. In a typical BFT divers are compressing and decompressing to a pressure of 2.2 ATA for 1 min in a hyperbaric chamber. Based on results from previous studies we are using a 20 daPa cut-off point on the ETF test to predict Eustachian tube passability and a successful BFT.*

Results: *In the current study 24 divers received ETF test results higher than 20 daPa; 3 divers had ETF test values lower than 20 daPa in both ears, but none of them displayed difficulties in the BFT; 8 divers had ETF values lower than 20 daPa in one ear and higher than 20 daPa in the other; 7 divers of the last group displayed difficulties with the BFT in the ear with poor ETF result.*

Conclusions: *We consider that the ETF test can be used to assess diving fitness as a screening method before performing a BFT, as values above 20 daPa guarantee Eustachian tube passability sufficient for diving activities. Values of 20 daPa and less are not a definite predictor for the barofunction results. The results of the ETF test can also be used in the usual work of an otorhinolaryngologist to evaluate Eustachian function in cases of unilateral disease of middle ear.*

(Int Marit Health 2020; 71, 3: 195–200)

Key words: Eustachian tube function test, Eustachian tube passability, barofunction test, middle ear barotrauma

INTRODUCTION

There are many tests for evaluation of Eustachian tube passability, such as Bluestone Nine-Step Test, Tubo-tympano-aerodynamic-graphy (TTAG), Tubomanometry, Sonotubometry, Continuous impedance, etc. Many publications evaluate instrumental findings in patients with barotrauma of the middle ear. However, studies of methods for assessing the risk of possible barotrauma are rare.

In XVIII century Valsalva proposed a simple test to evaluate the Eustachian tube passability. The Valsalva manoeuvre is a forceful exhalation against a closed airway. It is usually performed with the nostrils and mouth held shut, while blowing out air. This manoeuvre results in an increased nasopharyngeal pressure and opening of the Eustachian tubes [1]. It leads to an increase in intratympanic pressure and is commonly used in diving to equalise middle ear pressure during submersion. In XIX century Toynbee proposed another technique. The Toynbee manoeuvre is performed by pinching the nostrils shut while swallowing. The muscles in the back of the throat pull open the Eustachian tube and

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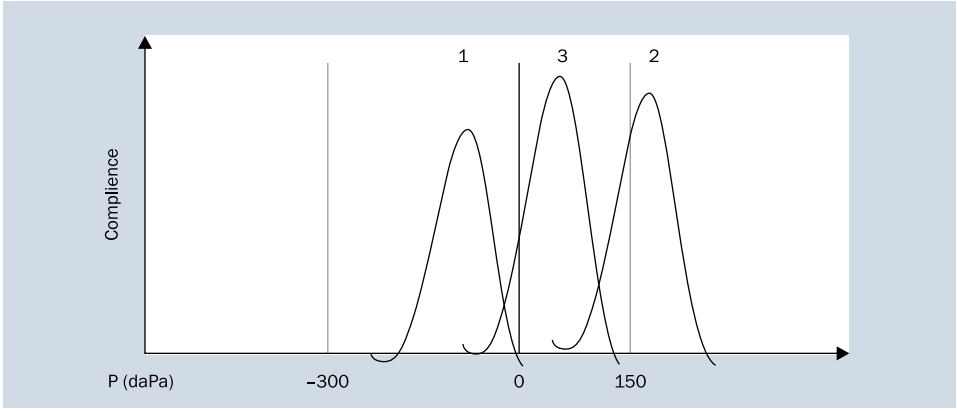

Figure 1. Normal Eustachian tube function test recorded by a tympanometer; 1 — intratympanic pressure during rest in daPa; 2 — pressure after the performing the manoeuvre of Valsalva; 3 — pressure after deep sniffing or after the Toynbee manoeuvre

allow air to equalise if a pressure gradient is present [2]. With the discovery of tympanometry, (Metz, 1948) it became possible to document these tests in charts and graphs.

Eustachian tube function (ETF) test is a test that examines the passability of the Eustachian tubes using a tympanometer. Figure 1 graphically presents the results of an ETF test. It consists of measuring the intratympanic pressure during rest, after performing the manoeuvre of Valsalva, and after deep sniffing or the Toynbee manoeuvre [3, 4]. The further away from curve 2 is from curves 1 and 3, the better is the Eustachian tube passability. Tympanometry and ETF test can be performed even in a hyperbaric chamber [5].

Barofunction test (BFT) measures the ability of the body to react to fluctuations of the surrounding gas pressure. By design it is performed in a hyperbaric chamber. Usually divers perform manoeuvres of Valsalva and Toynbee to equalise the changes of surrounding gas pressure. In different countries the pressure in the hyperbaric chamber is increased from 1.0 up to 2.0–2.8 ATA (10–18 m water depth) for 40 seconds to a minute. In Bulgaria the protocol is 2.2 ATA (12 m water depth) for 1 minute. Barofunction test is used in the assessment of the suitability of diving training candidates or in the periodic examinations for diving fitness of professional divers. Since it is performed in a hyperbaric chamber with actual rapid change of the ambient pressure, divers occasionally suffer from barotrauma of the middle ear even during a barofunction test.

Additionally, non-divers are often treated in hyperbaric chambers with pressure changes of a much lower rate — 0.3 ATA/min. Occasionally, even in these soft regimes, patients suffer from barotrauma of paranasal sinuses and of the middle ear. Eustachian tube dysfunction and incorrect execution of the manoeuvres are the most important causes of barotraumas of the middle ear. This is why it is essential to find a quick and efficient method to screen out patients and divers with possible Eustachian tube dysfunction, so that middle ear barotraumas are prevented.

The purpose of the current study is to evaluate the ETF test as a predictor of middle ear barotraumas in divers. Based on previous studies we have estimated that ETF test values above 20 daPa guarantee Eustachian tube passability sufficient for diving activities [6]. Our hypothesis states that an ETF test value above that cut-off point (20 daPa) would mean that the diver will not suffer barotraumas during the BFT. This is how the 20 daPa cut-off point could be successfully used to screen for patients/ divers with possible Eustachian tube dysfunction.

MATERIALS AND METHODS

From November 2019 until January 2020 we performed annual examinations of 35 professional, highly motivated and qualified divers with different diving experience. With all subjects first we measured intratympanic pressure at rest, then after the manoeuvre of Valsalva, with MAICO MI-24 tympanometer. We used only the manoeuvre of Valsalva part of the ETF test, because most of the difficulties in the BFT appear at times of compression.

We compared the results of the ETF test with the results of a following barofunction test in "PDK-2" — hyperbaric chamber. We accepted that the ability to successfully tolerate compression up to 2.2 ATA for 1 minute is the criterion for normal passability of the Eustachian tube for divers.

All data were processed with MS Office Excel and IBM SPSS products.

We used a receiver operating characteristic (ROC) analysis to check the accuracy, sensitivity and specificity of the ETF test. ROC analysis is usually used to assess the diagnostic power of a binary classifier system, comparing it to a "gold standard". In this case the gold standard is the success in a BFT as described above. The graphical representation of this analysis is a ROC curve. It illustrates the true positive rate against the false positive rate at various threshold settings. The true-positive rate is also known as sensitivity,

Table 1. Descriptive statistics of the divers sample

Descriptive statistics	N	Minimum	Maximum	Mean	Standard deviation
Pressure rest	70	–180.00	79.00	–22.7571	31.41699
ETF result	70	8.00	226.00	74.6571	59.17792
Difficulties	70	0.00	1.00	0.1000	0.30217
Valid N (listwise)	70				

In the column N are included the number of ears tested, not subjects; ETF — Eustachian tube function

Table 2. Descriptive statistics of the subgroup of divers with unilateral difficulties

Descriptive statistics	N	Minimum	Maximum	Mean	Standard deviation
Pressure rest	16	–50	79	–15.31	29.678
ETF	16	8	210	45.63	54.993
Difficulties	16	0	1	0.44	0.512
Valid N (listwise)	16				

In the column N are included the number of ears tested, not subjects; ETF — Eustachian tube function

or probability of detection. The false-positive rate is also known as specificity or the probability of false alarm [7].

ETHICAL CONSIDERATIONS

The research is conducted in compliance with the ethical considerations and all principles for medical research involving human subjects according to the WMA Declaration of Helsinki.

RESULTS

In our sample 24 divers (68.6% of the sample) received ETF-test results higher than 20 daPa. None of them displayed difficulties in the barofunction test. Three divers (8.6% of the sample) had ETF-test results lower than 20 daPa (8–18 daPa) in both ears, but none of them displayed difficulties in the barofunction test. Eight divers (22.8% of all tested subjects) received ETF test results lower than 20 daPa in one ear and higher than 20 daPa in the other. Seven of them (20% of all tested subjects and 87.5% of the subjects with unilateral poor ETF test results) had difficulties with the BFT in the ear with poor ETF result. One diver had ETF test result of 18 daPa — close to the critical value, but had no difficulties with the barofunction test.

We discovered subjects with large differences of normal intratympanic pressure in rest without any complaints or difficulties in barofunction (minimal pressure was –180 daPa, maximal pressure was 79 daPa, average pressure was –22.7571 daPa, standard deviation 31.417; Table 1).

In the subgroup of divers with unilateral difficulties we can assume that the failure on the BFT is due to Eustachian tube impassability, since the difficulties occur in one ear only. This means that the diver can apply a proper technique but there is an objective cause for the failure on the BFT. This is why we analysed the results of this subgroup separately (Table 2).

Table 3. Correlation between the intratympanic pressure at rest and the barofunction test results for all divers

Correlations		Pressure rest	Difficulties
Pressure rest	Pearson correlation	1	0.141
	Sig. (2-tailed)		0.245
	N	70	70

Table 4. Correlation between the intratympanic pressure at rest and the barofunction test results for divers with unilateral difficulties

Correlations		Pressure rest	Difficulties
Pressure rest	Pearson correlation	1	0.176
	Sig. (2-tailed)		0.514
	N	16	16

We did not discover any significant correlation between intratympanic pressure at rest and difficulties in barofunction ($r = 0.141$, $p = 0.245$ as shown in Table 2). These results correspond to the results from previous studies (Table 3) [6, 8].

Even in the subgroup of divers with unilateral difficulties we found no significant correlation between the intratympanic pressure at rest and the result from the barofunction test ($r = 0.176$, $p = 0.514$). This result shows that the single value of intratympanic pressure is not related to and cannot provide reliable information about the Eustachian tube function (Table 4).

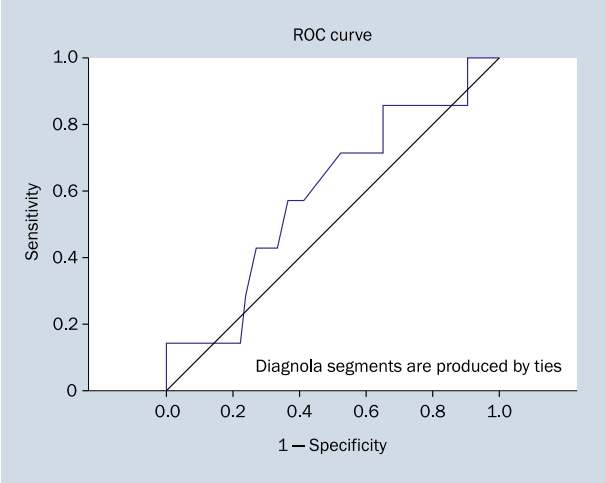

Figure 2. Receiver operating characteristic (ROC) analysis of intratympanic pressure in rest as predictor of barofunction result; area under the curve = 0.592, standard error 0.112

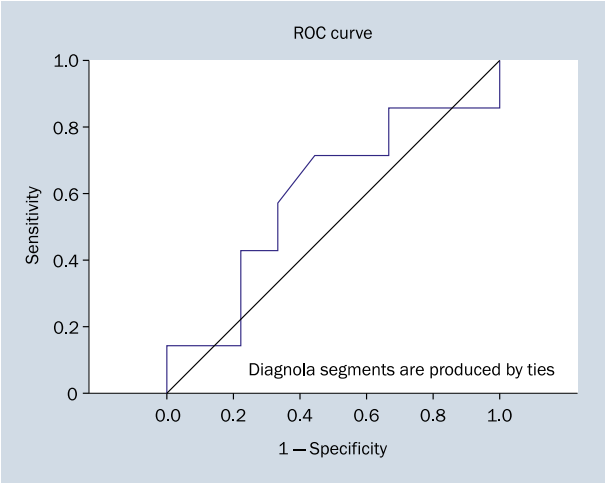

Figure 3. Receiver operating characteristic (ROC) analysis of intratympanic pressure in rest as predictor of barofunction result in group with unilateral poor Eustachian tube function-test; area under the curve = 0.595, standard error = 0.151

Since the barofunction test is measured in a nominal scale the application of correlation analysis is conditional. This is why we performed a ROC analysis, which is more suitable for bivariate data and provides information about the accuracy of a test (Figs. 2, 3).

The measure area under the curve (AUC) defines the accuracy of a given test. AUC values vary from 0 to 1. A model whose predictions are 100% correct has an AUC of 1.0. A model whose predictions are 50% correct has an AUC of 0.5. Values around 0.5 mean that a test is inaccurate, while values close to 1.0 are interpreted as a highly accurate test.

So far the results showed that the intratympanic pressure cannot be used as an accurate screening test for barofunction result neither in the whole sample (AUC = 0.592, standard error = 0.112), nor in the group with unilateral difficulties (AUC = 0.595, standard error = 0.15). Intratympanic pressure at rest is a static measure. In order to evaluate the diving fitness and Eustachian tube passability, a dynamic measure like the ETF test would be more suitable and informative.

Table 5. Correlation between the Eustachian tube function (ETF) test result and the barofunction test results for all divers

Correlations		ETF result	Difficulties
ETF result	Pearson correlation	1	–0.344*
	Sig. (2-tailed)		0.004
	N	70	70

*Correlation is significant at the 0.01 level (2-tailed)

Table 6. Correlation between the Eustachian tube function (ETF) test result and the barofunction test results for divers with unilateral difficulties

Correlations		ETF	Difficulties
ETF	Pearson correlation	1	–0.524*
	Sig. (2-tailed)		0.037
	N	16	16

*Correlation is significant at the 0.05 level (2-tailed)

This is why we compared the ETF test results with the BFT results. We discovered significant negative correlation between the ETF and BFT test results both in the whole sample ($r = -0.344$, $p < 0.01$) and in the group of divers with unilateral difficulties ($r = -0.524$, $p < 0.05$), meaning that higher ETF test results are related to lower risk of middle ear barotraumas (Tables 5 and 6).

In order to estimate the accuracy of the ETF test as a predictor for BFT result we conducted a ROC analysis (Fig. 4).

Unlike the results from tympanometry, we found that the ETF result is a highly accurate screening test for a successful BFT. This is why we compared the sensitivity and specificity at different values and confirmed that a value of 20 daPa is the cut-off point for Eustachian tube passability sufficient for diving activities (Table 7).

In the separate group of divers with unilateral poor ETF test the graph is similar (Fig. 5, Table 8).

In the current study our results display very high accuracy of the ETF test as a screening tool of Eustachian tube passability (AUC = 0.984, standard error = 0.025). Considering a cut-off point of 20 daPa (Table 8) we see that at this value the sensitivity of the ETF test is 0.889 and the specificity is 1.000. Thus 88.9% of the cases with lower results than 20 daPa will have some Eustachian tube dysfunction, and 100% of the cases with a result higher than 20 daPa will have Eustachian tube passability, sufficient

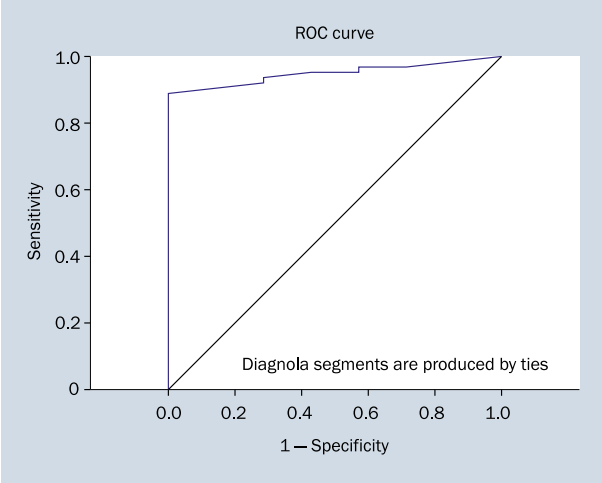

Figure 4. Receiver operating characteristic (ROC) curve of all Eustachian tube function test as predictor of barofunction result; area under the curve = 0.949, standard error = 0.026: Eustachian tube function test can be used as a predictor of the barofunction test result

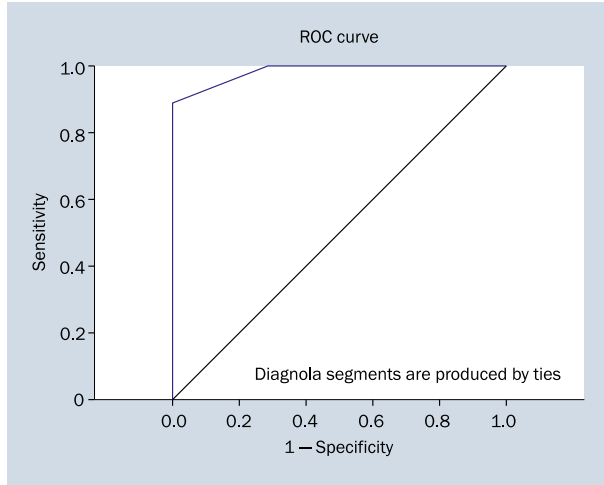

Figure 5. Receiver operating characteristic (ROC) analysis of unilateral poor Eustachian tube function test as predictor of barofunction result; area under the curve = 0.984, standard error 0.025. Eustachian tube function test can be used as a predictor of the barofunction test result

Table 7. Cut-off points of Eustachian tube function (ETF) test of all divers

ETF [daPa]	7	11.5	15.5	**19.5**	23	31.5	51	102	222
Sensitivity	1.000	0.968	0.952	**0.889**	0.841	0.746	0.635	0.302	0.016
Specificity	0.000	0.286	0.429	**1.000**	1.000	1.000	1.000	1.000	1.000

Table 8. Cut-off points in the group with unilateral poor Eustachian tube function (ETF) test

ETF [daPa]	7	9	11.5	15.5	17	**20**	23	38.5	51	112	167	211
Sensitivity	1.000	1.000	1.000	1.000	1.000	**0.889**	0.778	0.556	0.444	0.222	0.111	0.000
Specificity	0.000	0.143	0.286	0.571	0.714	**1.000**	1.000	1.000	1.000	1.000	1.000	1.000

to prevent barotraumas. Based on these results we suggest using the ETF test with a cut-off point of 20 daPa as a simple, time-consuming screening tool for the success of a BFT and/or hyperbaric chamber examination and therapy.

DISCUSSION

In a previous study we discovered that values of the ETF test higher than 20 daPa guarantee normal Eustachian passability both for divers and people without diving experience. In cases of unilateral poor results of the ETF test and the barofunction, the main reason is not a flawed technique of execution of the test, but rather a real impassability of the Eustachian tube [6]. This can explain why in a study of divers who have already suffered barotraumas, Kitajima et al. [9] found more severe symptoms in unilateral accidents. The divers in the current study are highly qualified and they made no mistakes when performing the Valsalva manoeuvre. This excluded the influence of the factor incorrect technique of pressure equalisation, so curves of Figure 4 and Figure 5 are similar.

The results from the current study show that it is not necessary for a person with bilateral poor ETF test results to have difficulties in the BFT. These may be due to increased compliance of tympanal membrane of divers, careless execution of the ETF-test or using different pressure equalisation techniques in HBC (such as Frenzel manoeuvre, Lowry technique, Edmonds technique, etc.). Nevertheless, we can expect that if the person's ETF result is above 20 daPa, he/she would not suffer from a middle ear barotrauma because the Eustachian tube function is sufficient.

Taylor et al. [10] identified 16 studies involving seven different types of ETF tests and made conclusion that currently, no single test can be recommended to be used in the clinical practice. A combination of the

nine-step test with other objective tests or patient-reported measures appears most promising as a core set of outcome measures for baro-induced Eustachian tube dysfunction.

Nine-step inflation/deflation test has a high accuracy as a predictor of middle ear barotrauma [11]. The test evaluates not only Eustachian passability, but functional state of pharyngeal structures. This way it is useful both on compression and decompression. Nevertheless, it is time consuming and complicated to implement. Most of middle ear barotrauma incidents with divers happen in time of compression. This is why we suggest that a simple test, measuring the effect of the Valsalva manoeuvre, is sufficient to predict barotraumas of the middle ear.

All divers with difficulty in the BFT were consulted with an otorhinolaryngology specialist. The main cause of the problems was nasal congestion due to an acute nasal infection. After adequate treatment, they repeated their BFT successfully.

CONCLUSIONS

Based on the above results we can make the following conclusions. Subjects with values of ETF test more than 20 daPa have adequate passability of the Eustachian tube. Values of 20 daPa and less are not a definitive predictor of the failure of the BFT. Results can prove to be useful in the usual work of an otolaryngologist to evaluate Eustachian function in cases of unilateral disease of middle ear.

REFERENCES

1. Taylor D. The Valsalva Manoeuvre: A critical review. South Pacific Underwater Medicine Society J. 1996; 26(1).
2. Kay E. Prevention of middle Ear Barotrauma. http://www.divingdoc.com/MEbaro.html.
3. Doyle WJ, Swarts JD, Banks J, et al. Sensitivity and specificity of Eustachian tube function tests in adults. JAMA Otolaryngol Head Neck Surg. 2013; 139(7): 719–727, doi: 10.1001/jamaoto.2013.3559, indexed in Pubmed: 23868429.
4. Beck DL, Spiedel DP, Prairie E, et al. Tympanometry and Acoustic Reflex: Innovation, Reviewand Application, Hearing Review, 3 April 2009.
5. Shupak A, Sharoni Z, Ostfeld E, et al. Pressure chamber tympanometry in diving candidates. Ann Otol Rhinol Laryngol. 1991; 100(8): 658–660, doi: 10.1177/000348949110000811, indexed in Pubmed: 1872517.
6. Georgiev K. Unilateral Eustachian Impasability - cutoff points for ETF test. Laryngorhinootologie. 2020; 99(S02): S314, doi: 10.1055/s-0040-1711272.
7. http://mlwiki.org/index.php/ROC_Analysis.
8. Shopov N, Georgiev K, Vazharov Iv, Bozov Hr. Evaluation of Eustachian tubes function in divers. Congress paper 23 congress BMMR, TurkeyAntalya 11-14 May 2018.
9. Kitajima N, Sugita-Kitajima A, Kitajima S. [A study of the Eustachian tube function in patients with a scuba diving accident]. Nihon Jibiinkoka Gakkai Kaiho. 2012; 115(12): 1029–1036, doi: 10.3950/jibiinkoka.115.1029, indexed in Pubmed: 23402207.
10. Tailor BV, Smith ME, Hutchinson PJA, et al. Outcome measures for baro-challenge-induced Eustachian tube dysfunction: a systematic review. Otol Neurotol. 2018; 39(2): 138–149, doi: 10.1097/MAO.0000000000001666, indexed in Pubmed: 29315176.
11. Uzun C, Adali MK, Tas A, et al. Use of the nine-step inflation/deflation test as a predictor of middle ear barotrauma in sports scuba divers. Br J Audiol. 2000; 34(3): 153–163, doi: 10.3109/03005364000000125, indexed in Pubmed: 10905449.

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The changes in pulmonary functions in occupational divers: smoking, diving experience, occupational group effects

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ABSTRACT

Background: *Diving challenges the respiratory system because of the pressure changes, breathing gases, and cardiovascular effects. We aimed to analyse the long term effect of occupational diving on pulmonary functions in terms of diving experience (year), smoking history, and occupational groups (commercial divers and SCUBA instructors).*

Materials and methods: *We retrospectively analysed respiratory system examination results of the experienced occupational divers who were admitted to the Undersea and Hyperbaric Medicine Department for periodic medical examination between January 1, 2013 and February 28, 2019.*

Results: *Sixty-four divers applied to our department. Candidate divers were not included in our study. The mean diving experience (year) was 13.6 ± 7.3. None of the divers complained of pulmonary symptoms. Pulmonary auscultation and chest radiography were normal in all cases. In divers with 20 years or more experience, the FEV1/FVC ratio and FEF25–75(%) was significantly lower ($p < 0.001$, $p < 0.05$, respectively). In addition, there was a statistically significant negative correlation between FEV1/FVC ratio and FEF25–75(%) and diving experience (year) ($p < 0.05$, $r = -0.444$, $p < 0.05$, $r = -0.300$, respectively). As the diving experience increase per 1 year, the FEF25–75(%) value decreases by 1.04% according to linear regression analyses. However, smoking and occupational groups did not show any significant influence on pulmonary function test parameters.*

Conclusions: *Occupational diving seems to create clinically asymptomatic pulmonary function test changes related to small airway obstruction after long years of exposure.*

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Key words: diving, respiratory, pulmonary function, occupational health, occupational diving, commercial divers

INTRODUCTION

The human respiratory system is not physiologically adapted to breathing underwater. However, the human race has always been pushing the limits of their physiology. Diving leads to physiologic alterations in the human body, even in the shallow water, mainly on the respiratory system [1]. While the breath-holding duration limits breath-hold diving, diving with breathing support provides longer dives and longer extreme environmental exposures. It challenges the human respiratory system due to the pressure changes, breathing different gases, altered gas characteristics, increased work of breathing, increased respiratory heat loss, and cardiovascular effects of immersion [1].

The question of interest is about the prolonged effects of diving and the possibility of persistent changes in the pulmonary functions [2]. There is more attention growing on the divers' future health impact. This interest has been supported by the workplace health and safety aspects of occupational diving [3]. Many studies have been conducted about the long term pulmonary effects of diving on commer-

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cial divers, military divers, recreational SCUBA divers, and special populations. However, the results are conflicting. Some authors report a decrease in pulmonary function, others suggesting an increase, while some reports find no difference at all [1, 2, 4–13].

Occupational divers are the main population who are exposed to a deep water environment regularly for long years. We aimed to analyse the long term effect of occupational diving on pulmonary functions in terms of diving experience (year). Also, we aimed to determine the impact of smoking consumption and the occupational groups (commercial divers and SCUBA instructors) on pulmonary functions.

MATERIALS AND METHODS

We retrospectively analysed the medical records of occupational divers who presented to Undersea and Hyperbaric Medicine Department for routine medical examination between January 1, 2013 and February 28, 2019. Occupational divers older than 18 years old were included in our study. SCUBA instructors were also accepted as occupational divers. However, occupational diver candidates without any professional diving experience, medical records with inadequate data, and military divers were excluded. The demographic data, body mass index (BMI), diving experience (years), past medical history, smoking habit, respiratory system physical examination results, radiological examination results, and pulmonary function test (PFT) results were recorded. The divers who quitted smoking for more than 1 year were defined as ex-smokers. The PFTs were completed in the same laboratory for each diver according to the recommendations of the European Respiratory Society guidelines. Functional vital capacity (FVC), forced expired volume in 1 second (FEV1), the FEV1/FVC ratio, forced expiratory flow between 25% and 75% of FVC (FEF25–75) were collected. The statistical analyses conducted with the predicted values (%) values of these parameters. As we chose to use predicted values, age, and BMI was not used as a comparison parameter for PFT results. This study was approved by the Ethical Committee of Gülhane Non-invasive Investigations (approval number = 19/309, Date = 08/10/2019).

STATISTICAL ANALYSIS

Data analysis was performed using SPSS Statistics Version 21 (IBM Corp., Armonk, NY). The data are reported as % (n) and mean ± standard deviation. Kolmogorov-Smirnov test or Shapiro-Wilk test was performed to determine the normal distribution of continuous variables. Pearson or Spearman correlation analysis was performed to analyse the linear correlation between continuous variables (PFT values, diving year, smoking consumption). Simple linear regression analysis was performed to study the effect of diving experience (year) on FEF25–75(%) value because only the FEF25–75(%) data was normally distributed and has a statistically significant linear correlation. The comparison of PFT values and occupational groups were analysed with Student t-test or Mann-Whitney U. On the other hand, ANOVA or Kruskal-Wallis was performed for the comparison between PFT values and diving experience (year) group, smoking history. The Tukey test was used for post-hoc analysis. A χ^2 test was used for the smoking habit and occupational group comparison. $P < 0.05$ was considered statistically significant.

RESULTS

Between January 1, 2013 and February 28, 2019, 64 experienced occupational divers applied to our department to obtain fitness to dive medical reports. The demographic data of the divers were analysed in Table 1. According to the World Health Organization classification, 50% of divers were overweight (BMI 25–29.9), and 12.5% were obese (BMI 30–34.9). The mean pack-years of smoking was 15.5 ± ± 18.9. None of the divers had any respiratory system-related medical condition. None of the divers complained about any related pulmonary symptoms such as dyspnoea, or cough. Pulmonary auscultation and chest radiography were normal in all of the divers.

The comparison of demographic data and PFT results according to the occupational group is available in Table 1. While both diver groups were demographically similar, there wasn't any statistically significant difference for none of the PFT parameters (Table 1).

The relationship between each PFT parameter and the smoking habit was analysed. Only the FEV1/FVC results didn't fit normal distribution according to the Kolmogorov-Smirnov test among all PFT parameters. There was not any statistically significant difference for any PFT value between active smokers, those who quit smoking, and those who never smoked (Table 2).

The effect of diving experience (year) on PFT values were studied. Diving experience was classified as three groups; 0–9 years (n = 14), 10–19 years (n = 23) and ≥ 20 years (n = 10) experience. The FEV1/FVC ratio and FEF25–75(%) values in divers with ≥ 20 years diving experience were found to be statistically significantly lower than both of the other groups ($p < 0.001$, $p < 0.05$, respectively; Fig. 1).

The correlation between the diving experience (year), smoking consumption (package/year), and PFT values were studied. There was a statistically significant moderate negative correlation between the diving experience (year) and the FEV1/FVC ratio ($p < 0.05$, $r = -0.444$), according to Spearman correlation analysis. Similarly, there was a statistically moderate negative correlation between diving year

Table 1. The comparison of demographic data and pulmonary function test parameters among commercial divers and SCUBA instructors (Student t-test, Chi-square, and Mann-Whitney U were used)

	Total population Mean (SD) or n (%)	SCUBA instructors Mean (SD) or n (%)	Commercial divers Mean (SD) or n (%)	P-value
Age [years]	43.7 (10.6)	45 (9.9)	39.4 (11.5)	0.070
BMI [kg/m^2]	26 (3)	25.9 (3.1)	26.4 (2.9)	0.558
Smoking habit				0.087
Active smokers	20 (31.3%)	17 (34.7%)	3 (20%)	
Ex-smokers	10 (15.6%)	5 (10.2%)	5 (33.3%)	
Never-smokers	34 (53.1%)	27 (55.1%)	7 (46.7%)	
Diving experience (year)	13.6 (7.3)	13.4 (7.3)	14.1 (7.7)	0.779
PFT parameters				
FEV1 (%)	106.212.7)	106.8 (13.4)	104.2 (10.1)	0.283
FVC (%)	105.1 (10.7)	105.9 (11.1)	102.5 (9.7)	0.500
FEV1/FVC (%)	102.1 (11.3)	101.6 (10.6)	103.7 (13.5)	0.421
FEF25–75 (%)	99.7 (24.7)	98.6 (25.4)	102.9 (23.1)	0.566
PEF (%)	109.2 (18)	108.8 (18.8)	110.5 (15.9)	0.746

SD –standard deviation; BMI — body mass index; FVC — functional vital capacity; FEV1 — forced expired volume in 1 second; FEF25–75 — forced expiratory flow between 25% and 75% of FVC; PEF — peak expiratory flow

Table 2. The pulmonary function test (PFT) values for total population and the detailed PFT analyses due to smoking habits (ANOVA and Kruskal-Wallis)

	Smoking habit — mean (standard deviation)			
	Active smokers (n = 20)	Ex-smokers (n = 10)	Never-smokers (n = 34)	P-value
FEV1 (%)	102 (12.4)	109.7 (17.9)	107.5 (10.7)	0.194
FVC (%)	101.5 (9.8)	111.2 (12.3)	105.5 (10.2)	0.065
FEV1/FVC (%)	102.2 (11.8)	99.5 (13.8)	102.7 (10.3)	0.916
FEF25–75 (%)	91.7 (27.6)	102.2 (33.1)	103.2 (19.5)	0.268
PEF (%)	107.9 (22.1)	108.4 (11.8)	110.0 (17.6)	0.917

FVC — functional vital capacity; FEV1 — forced expired volume in 1 second; FEF25–75 — forced expiratory flow between 25% and 75% of FVC; PEF — peak expiratory flow

and FEF25–75(%) ($p < 0.05$, $r = -0.300$), according to the Pearson correlation analysis. Similarly, there was no statistically significant correlation between smoking history (for active smokers) and any PFT parameter due to correlation analyses (Table 3).

Linear regression analysis was performed between the diving experience (year) and FEF25–75(%). The regression equation was found to be statistically significant ($R^2 = 0.90$, $F_{1,43} = 4.244$, $p < 0.05$). According to this analysis, as the diving experience increase per 1 year, FEF25–75(%) value decreases by 1.04%.

DISCUSSION

In this study, we analysed the effects of diving year, smoking, and occupational groups on experienced professional divers' pulmonary functions. We found that FEV1/FVC(%) and FEF25–75(%) are statistically significantly lower among divers who had 20 years or more diving experience ($p < 0.001$, $p < 0.05$, respectively) Additionally, FEV1/FVC(%) and diving experience (year) had a statistically significant moderate negative correlation ($p < 0.05$, $r = -0.443$). Similarly, there was a statistically moderate negative correlation between diving year and FEF25–75(%) ($p < 0.05$, $r = -0.300$). According to the linear regression analysis, as the diving experience increase per 1 year, FEF25–75(%) value decreases by 1.04%. On the other hand, smoking and occupational groups did not show any significant influence on PFT parameters.

Cigarette smoking is known as a risk factor affecting respiration and oxygen delivery. It is related to a reduction in respiratory volumes. Ergun et al. [14] found that current smokers have lower FEV1(%) and FVC(%) levels than never

smokers in a healthy normal population without chronic obstructive pulmonary disease. The smoking effect has also been questioned in divers. Sekulic and Tocilj [15] conducted a study about the relationship between smoking and PFT results on 57 military divers. There was not any statistically significant relation between smoking status and PFT values. The authors concluded that in military divers, respiratory muscle training might partially offset the negative effect of smoking on PFTs [15]. Similarly, Chong et al. [16] and Sames et al. [13] did not find any relation between PFT values and smoking history in occupational divers. The active smokers' ratio was 31.3% (n = 20) in our study, which is relatively higher than worldwide smoking prevalence (20.4%) and our national smoking prevalence (27.2%) in 2016 [17]. Although our smoking ratio was higher than both the worldwide and the national smoking ratio, we also have not found any statistically significant relationship between smoking habits and PFT values. The physical training effect may be beneficial for lessening the smoking effect on the lungs [15]. On the other hand, there might be a healthy worker effect in two ways. Firstly, the selected population consists of workers who have to be medically fit continuously. Secondly, divers experiencing pulmonary difficulties would quit this occupation [18].

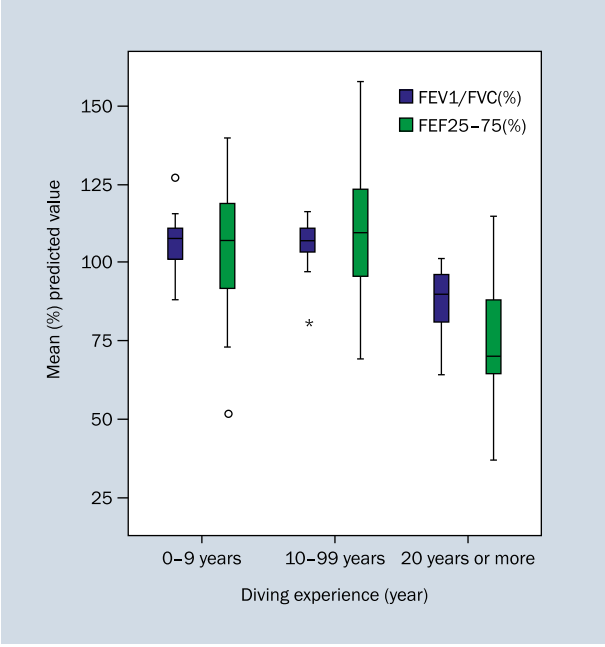

Figure 1. Comparison of FEV1/FVC and FEF25–75(%) between diving experience (years) groups (ANOVA and Kruskal-Wallis); FVC — functional vital capacity; FEV1 — forced expired volume in 1 second; FEF25–75 — forced expiratory flow between 25% and 75% of FVC

Human physiology adapts to diving exposure [1]. In this respect, mainly pulmonary functions have been studied in the diver population. The previous studies showed that divers have larger lung volumes. The most related evidence is a more significant increase in FVC than FEV1, which leads to a decrease in the FEV1/FVC ratio. This is interpreted as a natural selection of people who want to dive but also related to repetitive breath-holding and resistance for breathing during diving [19–21]. Some studies reported a reduction in expiratory flows at low pulmonary volumes, possibly due to pathological changes in the lung periphery [22]. Skogstad et al. [11] followed 69 pre-exposed divers and 18 never-exposed divers for 3 years. After this period, there was a significant decrease in the mean FEV1(%), FEF25–75(%), and FEF75(%) values. Authors concluded that diving might lead to changes in PFT, mostly affecting small airways conductance and dysfunction. Skogstad et al. [23] showed a decrease in FEF25–75(%), also after 12 years of diving. Besides, Shopov [9] studied PFT results in military divers (n = 52) and compared with a control group (n = 48) who were

Table 3. Correlation between pulmonary function test values, diving experience (year) and smoking consumption

	P-value	r value		P-value	r value
Diving year	0.625	–0.073	Smoking (pack/year)	0.274	–0.232
FEV1 (%)			FEV1 (%)		
Diving year	0.065	0.271	Smoking (pack/year)	0.700	–0.083
FVC (%)			FVC (%)		
Diving year	0.016*	*–0.444*	Smoking (pack/year)	0.167	–0.298
FEV1/FVC (%)			FEV1/FVC (%)		
Diving year	0.045*	*–0.300*	Smoking (pack/year)	0.101	–0.315
FEF25–75 (%)			FEF25–75 (%)		
Diving year	0.364	–0.138	Smoking (pack/year)	0.336	0.210
PEF (%)			PEF (%)		

FVC — functional vital capacity; FEV1 — forced expired volume in 1 second; FEF25–75 — forced expiratory flow between 25% and 75% of FVC; PEF — peak expiratory flow

the deck personnel with similar physiological characteristics. Divers had a mean of 10.2 ± 2.5 years of diving experience. The smoking ratio was 25% in divers and 22.9% in the control group. Authors showed a statistically significant increase in FVC (both in percentage and litres), a decrease in FEF25–75 (both in percentage and litres), and FEV1/FVC. On the other hand, FEV1 and PEF showed no significant change. Recent studies suggest FEF25–75 or FEF25–50 might be more sensitive to change than FEV1. The authors concluded that diving might lead to PFT changes consistent with small airway obstruction [9]. In the study of Pougnet et al. [10], the FEV1/FVC ratio and FEF25(%) significantly decreased in 15 years period ($p = 0.02$). Our study is one of the rare studies comparing the PFT changes of ≥ 20 years of diving experience in a healthy, active occupational diver population [1, 10, 12, 18]. In our research, we found that the FEV1/FVC ratio and FEF25–75(%) values of divers with 20 years or more diving experience were statistically significantly lower ($p < 0.001$, $p < 0.05$, respectively). Small airway diseases can be assessed with obstructive parameters (FEF25–75, FEV3/FVC, 1-FEV3/FVC, FEV3/FEV6), flow-volume curve indices, and lung volumes (FVC, RV, FRC, TLC). While the reduction in FEV1/FVC ratio can be used in determining obstructive ventilation disorder, FEF25–75(%) is the simplest test for small airway assessment [24]. Our findings are consistent with persistent PFT changes, possibly reflecting small airway disease in highly experienced diver populations, similar to previous studies.

During diving, chronic inflammation may occur along with the thickening of the bronchioles or impaired lung elasticity, leading to dynamic compression of the airways during forced expiration [11]. Several factors may influence the airflow limitation in divers. A diver breathes cold and dry gas with a higher density during diving with breathing support [22]. The work of breathing increases due to increased resistance of breathing mainly caused by the regulator and the effects of immersion, including increased gas density [1, 4]. The partial pressures of breathed gases increase during diving [22]. Hyperoxia leads to inflammation and oxidative stress. Similarly, the increase in the partial pressure of nitrogen leads to microbubbles during decompression [1]. These bubbles are filtered through the lungs. However, this process may cause inflammation in the lung's vascular structures and may influence pulmonary function. On the other hand, carbon monoxide and other aromatic gases, water vapour and oil can be involved in the breathing gas mixture due to insufficient cleaning and care of the compressors. These factors may also harm lung tissue [4]. The consensus of an international conference was that deep-diving has weak but definite long term effects on the human pulmonary system and may lead to an increase in total lung capacity and a decrease in small airways conductance and gas transfer capacity [11]. Unfortunately, causes, mechanisms, and the clinical impact of PFT changes still have not been clarified in this relatively healthy group [9]. There should be more prospective studies about the long term effects of diving on pulmonary functions to reveal the clinical impact of these changes.

Occupational diver groups (commercial divers, military divers, firemen divers, saturation divers, scientific divers, SCUBA instructors, ...) are a wide range. Their physical capabilities, diving exposures may differ from each other, even in the same group. The studies were occasionally conducted on specific groups such as military divers or overall occupational diver groups [1, 13, 15, 16, 18]. Nevertheless, commercial divers work in higher-risk environments with physically exhausting tasks and different working conditions, long exposures with various types of equipment, and even different dive profiles than SCUBA instructors. In our study, we also aimed to determine the difference between SCUBA instructors and commercial divers. We did not found any significant difference for PFT parameters between these two different occupational groups. According to our study, tougher diving conditions do not seem to create any difference in pulmonary function changes. Diving experience (year) appears to be the shared main parameter affecting respiratory functions without revealing any related clinical symptom in both occupational groups. However, we cannot reach a definitive conclusion due to the limitations of our study. The number of total dives, diving depth, diving environment, water temperature, diving suit, breathing gases, types of equipment, diving profile, time spent in diving might also influence these PFT changes. It should be known that decompression profiles can be different even between diving companies.

Unfortunately, the previous PFT records of these divers could not be obtained for statistical analyses. Sports activities other than diving were not found in medical records of divers, which might influence pulmonary functions. A combination of sports activities may increase the strength and endurance of the inspiratory muscles [15, 25]. The military divers who are more physically trained than all occupational diving groups were excluded from our study. However, the diving effect on respiratory functions should be analysed solely. Besides, diving exposure should be defined with diving years, diving depths, and mixed gas experience. Unfortunately, we only had the data on the diving years. Also, the small sample size is another limitation. Lastly, further functional examinations such as the carbon monoxide diffusion test and functional residual capacity tests might reveal useful data. These were the main limitations of our study due to the retrospective nature of data collection.

CONCLUSIONS

In conclusion, occupational diving seems to lead PFT changes related to small airway disease after long years of exposure without any clinically relevant symptoms such as dyspnoea. There is no consensus about these changes, whether they are a pathological or physiological consequence of diving. Other environmental factors, such as high air pollution, may be confounding factors that might be studied in further studies. After determining the leading cause of these PFT changes, which is shown repeatedly in many studies, it will help to work on measures to be taken in terms of long-term respiratory health in occupational divers.

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CONFLICTS OF INTEREST

The authors report no conflict of interest.

REFERENCES

1. Tetzlaff K, Thomas PS. Short- and long-term effects of diving on pulmonary function. Eur Respir Rev. 2017; 26(143), doi: 10.1183/16000617.0097-2016, indexed in Pubmed: 28356403.
2. Wingelaar TT, Clarijs P, van Ooij PJAm, et al. Modern assessment of pulmonary function in divers cannot rely on old reference values. Diving Hyperb Med. 2018; 48(1): 17–22, doi: 10.28920/dhm48.1.17-22, indexed in Pubmed: 29557097.
3. Edmonds C, Bennett M, Lippmann J, Mitchell SJ. (eds) Diving and Subaquatic Medicine 5th Edition. CRC Press Taylor and Francis Group, Boca Raton, FL 2016.
4. Mirasoğlu B, Özen Ş, Aktaş Ş. The effects of short term SCUBA diving on respiratory functions. Int J Sport, Exercise Training Scien. 2018: 105–113, doi: 10.18826/useeabd.446699.
5. Skogstad M, Thorsen E, Haldorsen T, et al. Divers' pulmonary function after open-sea bounce dives to 10 and 50 meters. 1996; 23: 71–75. Undersea Hyperb Med. 1996, indexed in Pubmed: 8840474.
6. Wilson A. Prevalence and characteristics of lung function changes in recreational scuba divers. Prim Care Respir J. 2011; 20(1): 59–63, doi: 10.4104/pcrj.2010.00063, indexed in Pubmed: 21085916.
7. Thorsen E, Segadal K, Kambestad BK. Mechanisms of reduced pulmonary function after a saturation dive. Eur Respir J. 1994; 7(1): 4–10, doi: 10.1183/09031936.94.07010004, indexed in Pubmed: 8143830.
8. Thorsen E, Segadal K, Stuhr LE, et al. No changes in lung function after a saturation dive to 2.5 MPa with intermittent reduction in Po2 during decompression. Eur J Appl Physiol. 2006; 98(3): 270–275, doi: 10.1007/s00421-006-0276-8, indexed in Pubmed: 16969641.
9. Shopov NG. Study of the changes in respiratory function in self-contained underwater breathing apparatus divers. Int Marit Health. 2019; 70(1): 61–64, doi: 10.5603/IMH.2019.0009, indexed in Pubmed: 30931519.
10. Pougnet R, Pougnet L, Henckes A, et al. Evolution of the respiratory function of professional divers over 15 years. Int Marit Health. 2019; 70(2): 119–124, doi: 10.5603/IMH.2019.0019, indexed in Pubmed: 31237672.
11. Skogstad M, Thorsen E, Haldorsen T. Lung function over the first 3 years of a professional diving career. Occup Environ Med. 2000; 57(6): 390–395, doi: 10.1136/oem.57.6.390, indexed in Pubmed: 10810128.
12. Voortman M, van Hulst R. Pulmonary function changes in Navy divers during their professional careers. Undersea Hyperb Med. 2016; 43: 649–657.
13. Sames C, Gorman DF, Mitchell SJ, et al. Long-term changes in spirometry in occupational divers: a 10-25 year audit. Diving Hyperb Med. 2018; 48(1): 10–16, doi: 10.28920/dhm48.1.10-16, indexed in Pubmed: 29557096.
14. Ergun DD, Karis D, Alkan FA, et al. Effects of cigarette smoking on hemorheologic parameters, plasma osmolality and lung function. Clin Hemorheol Microcirc. 2016; 63(4): 313–324, doi: 10.3233/CH-152018, indexed in Pubmed: 26484720.
15. Sekulic D, Tocilj J. Pulmonary function in military divers: smoking habits and physical fitness training influence. Mil Med. 2006; 171(11): 1071–1075, doi: 10.7205/milmed.171.11.1071, indexed in Pubmed: 17153544.
16. Chong SJ, Tan TW, Lim JY. Changes in lung function in Republic of Singapore Navy. Diving Hyperb Med. 2008; 38: 68–70.
17. Smoking prevalence, total (ages +15) Databank World Development Indicators. https://data.worldbank.org/indicator/SH.PRV.SMOK (cited 2020 March 25).
18. Pougnet R, Pougnet L, Lucas D, et al. Longitudinal change in professional divers' lung function: literature review. Int Marit Health. 2014; 65(4): 223–229, doi: 10.5603/IMH.2014.0042, indexed in Pubmed: 25522707.
19. Crosbie WA, Clarke MB, Cox RA, et al. Physical characteristics and ventilatory function of 404 commercial divers working in the North Sea. Br J Ind Med. 1977; 34(1): 19–25, doi: 10.1136/oem.34.1.19, indexed in Pubmed: 843459.
20. Crosbie WA, Reed JW, Clarke MC. Functional characteristics of the large lungs found in commercial divers. J Appl Physiol Respir Environ Exerc Physiol. 1979; 46(4): 639–645, doi: 10.1152/jappl.1979.46.4.639, indexed in Pubmed: 457539.
21. Adir Y, Shupak A, Laor A, et al. Large lungs in divers: natural selection or a training effect? Chest. 2005; 128(1): 224–228, doi: 10.1378/chest.128.1.224, indexed in Pubmed: 16002939.
22. Godden D, Currie G, Denison D, et al. British Thoracic Society guidelines on respiratory aspects of fitness for diving. Thorax. 2003; 58(1): 3–13, doi: 10.1136/thorax.58.1.3.
23. Skogstad M, Skare O. Pulmonary function among professional divers over 12 years and the effect of total number of dives. Aviat Space Environ Med. 2008; 79(9): 883–887, doi: 10.3357/asem.2333.2008, indexed in Pubmed: 18785357.
24. Ulubay G, Dilektaşlı AG, Börekçi Ş, et al. Turkish Thoracic Society Consensus Report: Interpretation of Spirometry. Turk Thorac J. 2019; 20(1): 69–89, doi: 10.5152/TurkThoracJ.2018.180175, indexed in Pubmed: 30664428.
25. Clanton TL, Dixon GF, Drake J, et al. Effects of swim training on lung volumes and inspiratory muscle conditioning. J Appl Physiol (1985). 1987; 62(1): 39–46, doi: 10.1152/jappl.1987.62.1.39, indexed in Pubmed: 3558196.

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Sexually transmitted infections in the military environment

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ABSTRACT

Sexually transmitted infections (STIs) have always been a major health issue affecting military personnel in all types of services and in all armed forces around the world, especially during deployments and in operational settings. Although the research shows that STIs are still reported in the military, the epidemiological risk for contracting a sexually transmitted infection is much lower nowadays than it was in the past. It is important, however, that service members are routinely screened for sexually transmitted diseases. Because of a high prevalence of STIs in the general population as well as the asymptomatic nature of some infections (e.g. HIV, Chlamydia trachomatis*), screening of the sexually active service personnel is recommended as a practical method of preventing the spread of STIs and their sequelae, such as pelvic inflammatory disease, ectopic pregnancy, infertility in women or epididymitis, prostatitis, infertility in men. The rates of STIs in service members have been on the increase in recent years, which may be associated with the fact that more and more women are now seeking a career in the armed forces. Currently, STIs do not only affect male soldiers or their civilian sexual partners (either long-term or casual), but both male and female soldiers alike, especially if they are serving together. The article focuses on the prevalence of STIs in the military in the past and at present, the common STI risk factors and prevention measures.*

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Key words: sexually transmitted infections, soldiers, epidemiology, risk factors, prevention

INTRODUCTION

Sexually transmitted infections (STIs) have always been a major health issue affecting military personnel all over the world, especially during deployments or in operational settings [1–3]. In the past commercial sex services were easily available wherever the troops were deployed and service members, mostly young and sexually active men, were often using the services offered by commercial sex workers (CSWs). In general, the history of STIs in the military can be organized into four major stages. During the first stage, which lasted until the early 20th century, STIs were widespread in all armies and although they had a significant impact on individual as well as unit readiness, they were widely ignored by army officials. The second stage, lasting until 1940s, was a period of spectacular scientific advance, also in the field of laboratory diagnostics, which allowed for the identification of the common sexually transmitted pathogens. Once the etiological factors responsible for STIs were discovered, it was possible to limit transmission in the armed forces by implementing appropriate disease prevention measures. The third stage in the history of STIs began a few years later, when penicillin started to be mass-produced and used to treat gonorrhea and syphilis. The last stage, which lasts until today, started in the early 1980s when laboratory tests for viral (HIV, HSV, HPV) as well as bacterial STIs (*Chlamydia trachomatis* and *Neisseria gonorrhoeae*) became more widespread [4–7]. STIs, especially those which are asymptomatic, like HIV or *Chlamydia trachomatis* infection, pose a serious epidemiological risk in closed communities, such as the military. Therefore, regular

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screening of the sexually active service men and women should become a priority for the military officials. Over the last 30 years, more and more women have been seeking a career in the armies of many NATO member states. In the late 1990s, women accounted for 17% of all new recruits in the United States (US) Forces [8]. STI screening of new female Army recruits has demonstrated a prevalence of more than 9% in a cohort of > 13,000 women. The results have clearly shown that STIs do not only affect male military personnel or their civilian sexual partners (either long-term or casual) but male and female soldiers alike, especially if they are serving together [5]. The US Military Health Service has created and maintained an excellent system for the surveillance of communicable diseases and STIs. Thanks to the system, the US troops consisting of approximately 1.5 million personnel are the best diagnosed and medically consulted professional group in the US. According to the available data from the US military health service, the prevalence of STIs in the military personnel serving in the United States of America (USA) is similar to infection rates reported in the general American population. In operational settings, however, the epidemiological situation as regards the prevalence of STIs can change dramatically, especially if soldiers are deployed on operations to areas where STIs are more widespread [9].

EPIDEMIOLOGY OF STIs IN THE MILITARY

Sexually transmitted infections, mostly syphilis and gonorrhea, were the second most common factor affecting individual and unit readiness during World War I (the major factor was the 1918 flu pandemic) [2]. During World War II, the prevalence rates of STIs in the United States service personnel were estimated at 43/1000 soldiers. Soon after the war ended in Europe (May 1945) the prevalence of STIs (mainly gonorrhea) in American service members who were stationing in Germany reached the level of 190 cases/1000 soldiers [10]. Later, during the Korean War, i.e. between 1951 and 1955, STI prevalence in the US Forces personnel was reported to be 184 cases/1000 soldiers (with gonorrhea accounting for over 70% of all STI cases); in some units of the US Forces, however, the prevalence of STIs was as high as 500 cases per 1000 person-years [11]. Exceptionally high rates of STIs were also reported during the Vietnam War. At the time, STIs were listed as the number one diagnosis in the US military health service monthly reports. Between 1963 and 1972, the prevalence rates of STIs in American service members deployed to South-East Asia were estimated at 260 cases per 1000 person-years, with gonorrhea being the top diagnosis (90% of cases) [2]. During the Vietnam War, all services of the US Armed Forces reported markedly increased prevalence of STIs. A study which involved the crew of a US Navy aircraft carrier demonstrated an annual rate of gonorrhea at 582 cases/1000 soldiers and of non-gonococcal urethritis at 459/1000 [12]. Most of the study subjects included in the study contracted an STI on a leave in the port during anonymous sexual encounters with CSWs. The common STIs diagnosed in service members during the conflicts in Korea and Vietnam were both of cosmopolitan and tropical nature, e.g. during the Korean War chancroid was the leading STI diagnosis in many US Forces units [13], and in Vietnam it was the second most common diagnosis after gonorrhea [14].

Sexually transmitted infections are extremely common in South-East Asia and Sub-Saharan Africa regions. The troops deployed on military operations (e.g. as part of the United Nations [UN] Forces) to either of the two regions will therefore have a much higher risk of exposure to STIs, especially if they maintain sexual relations with the locals or engage in sexual behavior with CSW [15]. In a group of Dutch soldiers deployed on a mission to Cambodia 45% reported sexual contacts with CSWs during their deployment [16]. The UN peacekeeping mission to Cambodia which was carried out in the early 1990s was of special interest to the military health services owing to a particularly high incidence of STIs among local CSWs. A study which involved 437 Cambodian CSWs demonstrated that over 40.5% were infected with HIV, 38.7% with *Chlamydia trachomatis* or *Neisseria gonorrhoeae*, and 13.8% with *Treponema pallidum* [17]. The lack of condom use or inconsistent use of condoms among Cambodian CSWs was the principle factor responsible for the increased risk of STI transmission. In a study of 140 female CSWs from Siem Reap consistent condom use with their clients was reported by 78% of the surveyed sex workers compared to only 20% with their non-paying partners [18]. A study which involved more than 700 Polish soldiers deployed on the UNTAC operation between 1992 and 1993 demonstrated the STI prevalence of 13% (a total of 92 STI cases, including gonorrhea — 85 cases, HIV — 5 cases and syphilis — 1 case). All of the infected soldiers reported sexual contact with local women or CSWs. The younger, lower-ranking troops (mostly privates) were markedly more affected compared to other soldiers [19]. All Polish soldiers who were taking part in the UN mission in Cambodia (n = 1254) were screened for communicable diseases as well as STIs after they had returned to Poland. Ninety-seven of the soldiers were diagnosed with STIs. The cases included: HIV infections (9 cases, including 1 case of acquired immunodeficiency syndrome [AIDS]), gonorrhea (55 cases), syphilis (8 cases), genital warts (17), genital herpes (5), granuloma inguinale (2), lymphogranuloma venereum (1) [20]. Over the last 30 years, there has been a significant reduction in the number of STI cases on overseas operations in all NATO member armies (the estimates were primarily based on the US Forces medical data). As an

example, the prevalence rate of STIs in the US service members during *Operation Desert Storm* (the Persian Gulf War) or *Operation Restore Hope* (Somalia) did not exceed 1%. Such a drastic reduction in the number of STI cases was undoubtedly culture-specific as both operations took place in Muslim countries, where commercial sex services were not easily available. On operations to the Middle East or Central Asia, where the Islamic code of behavior is strictly enforced, the deployed military personnel have limited contact with the locals, especially with women, and are strongly discouraged from having any sexual relations with the local people or the local CSWs [21]. Although limiting sexual contacts with CSWs in operational settings resulted in the reduction of STI prevalence during the NATO-led operations and missions, sexually transmitted diseases remain a major health issue in the military, especially in the group of younger soldiers who are more likely to have sex with casual partners, both the military personnel and civilians. The results of the STI screening, which was conducted in the early 1990s, showed that 7% of American service members aged under 25 were infected with gonorrhea and 15% had a chlamydial infection [22, 23]. Further studies, carried out between 2004 and 2009, also demonstrated high prevalence of *Chlamydia trachomatis* infections in the US Forces personnel, particularly among young women (770/100,000 vs. men 192/100,000) [24]. High prevalence of STIs in young female soldiers led to the introduction of the Preventive Services Task Force guidelines. The guidelines recommend that all sexually active female soldiers under the age of 25 as well as all other soldiers over the age of 25 from high-risk groups should be screened for chlamydia and gonorrhea once every year [25]. Currently, *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections are the most prevalent of all STIs reported in the US Forces, with soldiers aged 17–24 being at the highest risk of transmission. Between 2006 and 2015, the mean prevalence of chlamydia and gonorrhea in active-duty personnel of the US Forces was reported to be 1.3% and 0.2%, respectively [26]. Because of the asymptomatic nature of some STIs (e.g. *Chlamydia* infection is asymptomatic in nearly 90% of infected men and 70% of women), STI screening of the sexually active service personnel is recommended as a practical method of preventing the spread of STIs (both in the military and among civilians) and their sequelae such as pelvic inflammatory disease, ectopic pregnancy, infertility in women or epididymitis, prostatitis, infertility in men [27]. It has been estimated that chlamydia is the most common of all STIs in the US (both in the general population and in the military) [28]. The Defense Medical Surveillance System reports issued between 2000 and 2008 focusing on non-deployed American service personnel demonstrated an overall incidence of 922 cases of *Chlamydia* infections per 100,000 person-years (392/100,000 in the Navy; 1431/100,000 in the Army); a total of 103,000 cases of chlamydia were reported within the period [29]. Gonorrhea, a disease caused by *Neisseria gonorrhoeae*, is the second most common STI in the US Forces service personnel. In the past the disease was a leading STI diagnosis and formed a point of reference for estimating morbidity rates in the military [3]. In 2003, the prevalence of gonorrhea in the US Forces was estimated at 143 cases/100,000 person compared to 116/100,000 reported in the general population. Such high rates are mainly due to a large number of asymptomatic cases, especially in females. *N. gonorrhoeae* infections are asymptomatic in 50% of infected women and in 10% of infected men [28]. Since AIDS emerged in the 1980s, the disease has become a major area of concern for the military medical services in terms of epidemiology (asymptomatic cases) and treatment (clinically severe cases, high mortality). As early as in1985, the US Forces officials introduced a HIV testing requirement for all military blood donors, recruits, active-duty soldiers, Reserve Soldiers and the National Guard [30]. Until the late 1990s, HIV incidence in the US service personnel remained at a relatively low level [31] and seroconversion was reported in 1275 of all the US service members [32]. In the following years, however, the number of cases began to rise. Until 2004, the US Air Force medical services reported 1373 HIV infections among their ranks; a total of 561 American soldiers died of AIDS [2]. Between 2011 and 2019, the US Forces personnel were screened for chlamydia, gonorrhea, HSV, HPV and syphilis. The prevalence rates were found to be 184.6, 28.4, 23.3, 56.4 and 4.3/10,000 person-years, respectively. The groups which exhibited higher STI rates included young females, Afro-Americans, US Army personnel, junior enlisted personnel (E1–E4) and poorly educated personnel [33]. Higher transmission rates are reported among military personnel assigned to a duty on the base. Screening of more than 1700 American troops preparing for their deployments to Iraq and Afghanistan in Camp Doha, Kuwait showed 44 cases of STIs, mostly genital herpes (HSV), genital warts (HPV) and chlamydia. It was estimated that the biggest risk of transmission on the base is from asymptomatic female soldiers [34]. According to the reports from the military medical services, the highest prevalence of STIs is seen among young recruits, whose unhealthy habits and high-risk behaviors are attributable to their background and education [35, 36]. Nearly 50% of all the STI cases reported in the USA are diagnosed in people aged 17–24 [37]. All applicants to the US Forces must undergo a thorough medical examination, including a compulsory HIV test, but they are not screened for any other sexually transmitted pathogens. Thus, it may be assumed that a large percentage of recruits entering the US Forces are infected

with an STI of either viral of bacterial etiology [38, 39]. The Center for Disease Control and Prevention (CDC) estimates that there are several million new STIs in the USA each year [37]; nearly 50% of those cases are reported among young people who are generally more likely to engage in high-risk sexual behaviors such as anonymous sex encounter or sex without a condom. According to the CDC reports, the three most commonly reported STIs in the USA include chlamydia, gonorrhea and syphilis. In 2018, there were 1.8 million *Chlamydia trachomatis* infections (540/100,000), 583,000 *Neisseria gonorrhoeae* infections (179/100,000) and 35,000 *Treponema pallidum* infections (10/100,000) [40].

RISK FACTORS AND STIs PREVENTION

Military personnel are predominantly young, sexually active people who are more likely to engage in high-risk sexual behaviors than older people. The highest overall rates of STIs are seen in young, lower ranking enlisted personnel. On the other hand, higher-ranking, older and better educated service members have a much lower risk of contracting an STI because they are more likely to use condoms with casual partners [41]. STI screening of service men from the US Navy and Marine Corps (n = 1744; mean age 23 years) during their deployment to South America and Africa demonstrated the STI prevalence of 10%, of which 90% was reported in enlisted personnel. More than 40% of the Navy or Marines personnel included in the study reported casual sex with CSWs during port calls [9]. The modes of transmission for STIs and other communicable diseases are obviously quite different. Although STIs do not affect the population as whole but rather sexually active individuals, STI surveillance and control remains problematic for a number of reasons. First of all, a majority of infections are transmitted from asymptomatic carriers or from people who often engage in casual sex with multiple partners [42]. Secondly, recovery from an STI does not confer lifelong immunity. And finally, non-specific clinical picture or co-infection with several different STIs may impede the diagnosis and treatment. In view of these facts, STI screening seems to be the most effective method of controlling the spread of STIs [43].

The most common risk factors for STIs, both in the military and among civilians, include sexual contacts with CSWs, sex with casual partners, sexual contacts with multiple partners, homosexual contacts, sexual contacts with partners injecting drugs and unprotected sexual contacts (lack of condom use). Other risk factors comprise early sexual initiation, lack of STI testing and avoiding medical treatment [44] as well as misuse of alcohol and use of drugs, having a history of STIs and lack of circumcision [41]. It is considered that substance misuse can inhibit judgment and affect soldiers' morale which in turn makes them more willing to engage in risky sexual behaviors [45]. A vast majority of STIs that are reported in the military are diagnosed among the youngest troops who tend to have lower inhibitions and are more likely to engage in casual sex in order to relieve stress. It is not uncommon that younger soldiers are encouraged by their older colleagues to have sexual relations with CSWs as a good way of spending their time off-duty [41]. During the war in Vietnam, sexual relations with CSWs (many of whom were infected with at least one STI) were popular among soldiers of all ages — not only the younger and lower-ranking soldiers but also with the older and more experienced service members (regardless of their age, education or marital status). According to the surveys administered to the US Forces personnel who had taken part in the Vietnam War a total of 44% of married soldiers, 56% of soldiers > 30 years and 30% of soldiers with a secondary school education considered sex with CSWs to be a natural way of spending their time off-duty [46]. Increased prevalence of STIs on overseas deployments may partly be attributable to a lack of entertainment or leisure facilities on the base, which makes soldiers look for different ways to prevent boredom and deal with stress. In terms of STI control, the primary objective of the military preventive medicine specialists is to identify the major risk factors, conduct screening tests and provide medical treatment. However, close cooperation with the local health service is just as important. For example, the cooperation between the US Navy medical services and the Department of Social Hygiene in the Philippines (regular STI screening of the local CSWs who reported sexual contacts with American service members and medical treatment of the local CSWs infected with a sexually transmitted disease) significantly reduced the number of STI cases among the American military personnel [47]. A study of the Polish Special Forces personnel identified yet other factors contributing to a lower STI incidence in operational settings. The study involved 253 service members, all sexually-active men and women, 44% of the subjects reported sexual contacts with more than one partner in the last 12 months. Screening test results showed that only two male soldiers (0.8% of the group) were infected with an STI (*Chlamydia trachomatis*). A majority of the study subjects reported consistent condom use when having casual sex or avoided casual sex because they were staying in a mutually monogamous relationship. The main reason for such self-imposed precautions was associated with the fear of getting infected with HIV and of the consequences of acquiring the infection [48].

CONCLUSIONS

From the epidemiological standpoint, sexually transmitted infections do not pose a serious health risk to the military personnel. It is, however, strongly recommended that service members are regularly screened for the most

common STIs. Unprotected casual sex carries a high risk of STI transmission, especially in case of contacts with infected CSWs or with asymptomatic carriers (both groups being the major source of transmission). Because of the asymptomatic nature of some STIs, STI screening of the sexually active service personnel is recommended as a practical method of preventing the spread of sexually transmitted diseases. Over the recent years, the rates of STI cases have been rising in both male and female service members, which may be attributable to the fact that military service is no longer an all-male profession but is increasingly popular with women. Currently, women account for 15% of all military personnel in the US Forces. Sexual relations between male and female soldiers who are serving together have become commonplace. The results of routine screening of the US Forces personnel, the best diagnosed and medically consulted professional group in the US, have demonstrated that the introduction of routine STI screening for both men and women has become a necessity, especially before recruitment and prior to foreign deployment. The most common STIs reported in the military personnel include chlamydia, gonorrhea, syphilis and viral STIs (HSV, HPV, HIV); with *Chlamydia trachomatis* infection being the leading diagnosis, but the growing concern is about largely asymptomatic HIV and chlamydial infections. In order to limit transmission, mandatory HIV testing is regularly carried out in most armed forces around the world. The rates of STI cases are reported to rise in operational settings, especially in war zones. Military personnel are predominantly young, sexually active men who are likely to engage in casual sex in order to relieve stress. The rates of STI cases will much depend on the operational setting itself. On operations to the Middle East or Central Asia, where the Islamic code of behavior is strictly enforced, the deployed military personnel are strongly discouraged from having any sexual relations with the locals. For this reason, the risk of STI transmission on operations in the above mentioned regions is estimated to be low. However, the situation is quite different on operations to South-East Asia or Sub-Saharan Africa, where the deployed military personnel will have easy access to sexual services provided by CSWs, and because a significant proportion of the local CSWs are carriers of STIs. Hence, the risk of transmission will naturally be much higher than in the Middle East or Central Asia. The spread of STIs in operational settings can be effectively controlled through coordinated actions of the military health services deployed in the region, i.e. through epidemiological surveillance, effective elimination of risk factors and the introduction of appropriate preventive measures.

REFERENCES

1. Gaydos JC, McKee KT, Faix DJ. Sexually transmitted infections in the military: new challenges for an old problem. Sex Transm Infect. 2015; 91(8): 536–537, doi: 10.1136/sextrans-2015-052256, indexed in Pubmed: 26586846.
2. Rasnake MS, Conger NG, McAllister K, et al. History of U.S. military contributions to the study of sexually transmitted diseases. Mil Med. 2005; 170(4 Suppl): 61–65, doi: 10.7205/milmed.170.4s.61, indexed in Pubmed: 15916284.
3. Emerson L. Sexually transmitted disease control in the armed forces, past and present. Mil Med. 1997; 162(2): 87–91, doi: 10.1093/milmed/162.2.87.
4. Gaydos CA, Quinn TC, Gaydos JC. The challenge of sexually transmitted diseases for the military: what has changed? Clin Infect Dis. 2000; 30(4): 719–722, doi: 10.1086/313758, indexed in Pubmed: 10770734.
5. Gaydos CA, Howell MR, Pare B, et al. Chlamydia trachomatis infections in female military recruits. N Engl J Med. 1998; 339(11): 739–744, doi: 10.1056/NEJM199809103391105, indexed in Pubmed: 9731090.
6. Fleming DT, McQuillan GM, Johnson RE, et al. Herpes simplex virus type 2 in the United States, 1976 to 1994. N Engl J Med. 1997; 337(16): 1105–1111, doi: 10.1056/NEJM199710163371601, indexed in Pubmed: 9329932.
7. Kotloff KL, Wasserman SS, Russ K, et al. Detection of genital human papillomavirus and associated cytological abnormalities among college women. Sex Transm Dis. 1998; 25(5): 243–250, doi: 10.1097/00007435-199805000-00005, indexed in Pubmed: 9587175.
8. Walter Reed Army Institute of Research. Accession medical standards analysis and research activity. Annual report, Washington DC 1998.
9. Malone JD, Hyams KC, Hawkins RE, et al. Risk factors for sexually-transmitted diseases among deployed U.S. military personnel. Sex Transm Dis. 1993; 20(5): 294–298, doi: 10.1097/00007435-199309000-00011, indexed in Pubmed: 8235929.
10. Sternberg HT, Howard E. Venereal diseases. In: Communicable Diseases Transmitted Through Contact or By Unknown Means. Vol. 5. In: Preventive Medicine in World War II . U.S. Department of the Army, Office of the Surgeon General, Washington DC 1960: 139.
11. McNinch JH. Venereal disease problems: U.S. Army Forces, Far East 1950-1953. Proceedings of Recent Advances in Medicine and Surgery, 19-30 April 1954. Army Medical Service Graduate School, Walter Reed Army Medical Center, Washington DC.
12. Harrison WO. Cohort study of venereal diseases, Proceedings of One-hundred — second Annual Meeting of the American Public Health Association and Related Organizations, New Orleans, USA 20-24 October 1974.
13. Asin J. Chancroid; a report of 1,402 cases. Am J Syph Gonorrhea Vener Dis. 1952; 36(5): 483–487, indexed in Pubmed: 14952691.
14. Kerber RE, Rowe CE, Gilbert KR. Treatment of chancroid. A comparison of tetracycline and sulfisoxazole. Arch Dermatol. 1969; 100(5): 604–607, indexed in Pubmed: 5350417.
15. Soeprapto W, Ertono S, Hudoyo H, et al. HIV and peacekeeping operations in Cambodia. Lancet. 1995; 346(8985): 1304–1305, doi: 10.1016/s0140-6736(95)91910-4, indexed in Pubmed: 7475754.
16. Hopperus Buma AP, Veltink RL, van Ameijden EJ, et al. Sexual behaviour and sexually transmitted diseases in Dutch marines and naval personnel on a United Nations mission in Cambodia. Genitourin Med. 1995; 71(3): 172–175, doi: 10.1136/sti.71.3.172, indexed in Pubmed: 7635494.
17. Ryan C, Vathiny O, Gorbach P, et al. Explosive spread of HIV-1 and sexually transmitted diseases in Cambodia. Lancet. 1998; 351(9110): 1175, doi: 10.1016/s0140-6736(98)24016-5.
18. Wong ML, Lubek I, Dy BC, et al. Social and behavioural factors associated with condom use among direct sex workers in Siem Reap, Cambodia. Sex Transm Infect. 2003; 79(2): 163–165, doi: 10.1136/sti.79.2.163, indexed in Pubmed: 12690144.

19. Korzeniewski K. Peacekeeping in South-East Asia. IJHS. 2008; 1(3): 88–92.
20. Korzeniewski K, Kierznikowicz B, Olszański R. Sexually transmitted diseases among Polish soldiers serving in the U.N. peace missions in Lebanon and Cambodia. Int Marit Health. 2003; 54(1–4): 101–107, indexed in Pubmed: 14974783.
21. Hyams KC, Hanson K, Wignall FS, et al. The impact of infectious diseases on the health of U.S. troops deployed to the Persian Gulf during operations Desert Shield and Desert Storm. Clin Infect Dis. 1995; 20(6): 1497–1504, doi: 10.1093/clinids/20.6.1497, indexed in Pubmed: 7548499.
22. Zenilman JM, Glass G, Shields T, et al. Geographic epidemiology of gonorrhoea and chlamydia on a large military installation: application of a GIS system. Sex Transm Infect. 2002; 78(1): 40–44, doi: 10.1136/sti.78.1.40, indexed in Pubmed: 11872858.
23. Cecil JA, Howell MR, Tawes JJ, et al. Features of Chlamydia trachomatis and Neisseria gonorrhoeae infection in male Army recruits. J Infect Dis. 2001; 184(9): 1216–1219, doi: 10.1086/323662, indexed in Pubmed: 11598849.
24. Aldous WK, Robertson JL, Robinson BJ, et al. Rates of gonorrhea and Chlamydia in U.S. military personnel deployed to Iraq and Afghanistan (2004-2009). Mil Med. 2011; 176(6): 705–710, doi: 10.7205/milmed-d-10-00218, indexed in Pubmed: 21702394.
25. USACHPPM. A Guide to Female Soldier Readiness. USACHPPM Technical Guide 281. U.S. Army Center for Health Promotion & Preventive Medicine. January 2007. http://chppm-www.apgea.army.mil/documents/TG/TECHGUID/TG281 January2007-1.pdf.
26. Rossi KR, Nowak G. Assessing the Burden of Chlamydia and Gonorrhea for Deployed and Active Duty Personnel Assigned Outside the USA. Mil Med. 2019; 184(Suppl 1): 21–27, doi: 10.1093/milmed/usy366, indexed in Pubmed: 30901398.
27. Ahmadi MH, Mirsalehian A, Bahador A. Association of Chlamydia trachomatis with infertility and clinical manifestations: a systematic review and meta-analysis of case-control studies. Infect Dis (Lond). 2016; 48(7): 517–523, doi: 10.3109/23744235.2016.1160421, indexed in Pubmed: 27064452.
28. Niebuhr DW, Tobler SK, Jordan NN, Singer DE. Sexually transmitted infections among military recruits. In: DeKoning BL (Ed.). Recruit Medicine. Borden Institute Walter Reed Army Medical Center, Office of the Surgeon General at TMM Publications, Washington DC 2006: 255–275.
29. Jordan NN, Lee Se, Nowak G, et al. Chlamydia trachomatis reported among U.S. active duty service members, 2000–2008. Mil Med. 2011; 176(3): 312–319, doi: 10.7205/milmed-d-10-00212, indexed in Pubmed: 21456359.
30. Brown A, Brundage J, Tomlinson J, et al. The U.S. Army HIV Testing Program: The First Decade. Mil Med. 1996; 161(2): 117–122, doi: 10.1093/milmed/161.2.117.
31. Vu MQ, Steketee RW, Valleroy L, et al. HIV incidence in the United States, 1978-1999. J Acquir Immune Defic Syndr. 2002; 31(2): 188–201, doi: 10.1097/00126334-200210010-00010, indexed in Pubmed: 12394798.
32. Renzullo PO, Sateren WB, Garner RP, et al. HIV-1 seroconversion in United States Army active duty personnel, 1985-1999. AIDS. 2001; 15(12): 1569–1574, doi: 10.1097/00002030-200108170-00015, indexed in Pubmed: 11504990.
33. Armed Forces Health Surveillance Branch. Sexually transmitted infections, active component, U.S. Armed Forces, 2011–2019. MSMIR. 2020; 27(3): 2–11, indexed in Pubmed: 32228001.
34. Wright J, Albright TS, Gehrich AP, et al. Sexually transmitted diseases in Operation Iraqi Freedom/Operation Enduring Freedom. Mil Med. 2006; 171(10): 1024–1026, doi: 10.7205/milmed.171.10.1024, indexed in Pubmed: 17076459.
35. Shafer MA, Boyer CB, Shaffer RA, et al. Correlates of sexually transmitted diseases in a young male deployed military operation. Mil Med. 2002; 167(6): 496–500, indexed in Pubmed: 12099086.
36. Gaydos CA, Howell MR, Quinn TC, et al. Sustained high prevalence of Chlamydia trachomatis infections in female army recruits. Sex Transm Dis. 2003; 30(7): 539–544, doi: 10.1097/00007435-200307000-00002, indexed in Pubmed: 12838080.
37. Weinstock H, Berman S, Cates W. Sexually transmitted diseases among American youth: incidence and prevalence estimates, 2000. Perspectives on Sexual and Reproductive Health. 2004; 36(1): 6–10, doi: 10.1363/3600604.
38. Deiss R, Bower R, Co E, et al. The association between sexually transmitted infections, length of service and other demographic factors in the U.S. Military. PLoS One. 2016; 11(12): e0167892, doi: 10.1371/journal.pone.0167892.
39. Shafer MAB, Boyer CB, Pollack LM, et al. Acquisition of Chlamydia trachomatis by young women during their first year of military service. Sex Transm Dis. 2008; 35(3): 255–259, doi: 10.1097/0LQ.0b013e31815c1bd0, indexed in Pubmed: 18490868.
40. Centers for Disease Control and Prevention. Sexually Transmitted Disease Surveillance 2018. National Surveillance Data for Chlamydia, Gonorrhea, and Syphilis. October 2019. http://www.cdc.gov/std/stats.
41. Berg SW. Sexually Transmitted Diseases and Human Immunodeficiency Virus Infection. In: Kelley PW. (Ed). Military Preventive Medicine: Mobilization and Deployment. Vol. 2. Borden Institute Walter Reed Army Medical Center, Office of the Surgeon General at TMM Publications, Washington DC 2005: 1146–1175.
42. Coutinho RA. Epidemiology of sexually transmitted diseases. Sex Transm Dis. 1994; 21(2 Suppl): S51–S52, indexed in Pubmed: 8042116.
43. Gottwald C, Schwarz NG, Frickmann H. Sexually Transmitted Infections in Soldiers — A Cross-Sectional Assessment in German Paratroopers and Navy Soldiers and a Literature Review. Eur J Microbiol Immunol (Bp). 2019; 9(4): 138–143, doi: 10.1556/1886.2019.00023, indexed in Pubmed: 31934366.
44. Aral SO, Holmes KK. Epidemiology of sexual behaviour and sexually transmitted diseases. In: Holmes KK, Mardh PA, Sparling PF, Wiesner PJ. (Ed). Sexually Transmitted Diseases. McGraw-Hill, New York 1990: 19–36.
45. Harbertson J, Scott PT, Lemus H, et al. Cross-Sectional Study of Sexual Behavior, Alcohol Use, and Mental Health Conditions Associated With Sexually Transmitted Infections Among Deploying Shipboard US Military Personnel. Mil Med. 2019; 184(11-12): e693–e700, doi: 10.1093/milmed/usz070, indexed in Pubmed: 31004170.
46. Hart G. Psychological aspects of venereal disease in a war environment. Soc Sci Med. 1973; 7(6): 455–467, doi: 10.1016/0037-7856(73)90012-7, indexed in Pubmed: 4740606.
47. Hooper RR, Reynolds GH, Jones OG, et al. Cohort study of venereal disease. I: the risk of gonorrhea transmission from infected women to men. Am J Epidemiol. 1978; 108(2): 136–144, doi: 10.1093/oxfordjournals.aje.a112597, indexed in Pubmed: 707474.
48. Korzeniewski K. Urogenital *Chlamydia trachomatis* in the environment of soldiers from the Polish Special Forces. Ann Agric Environ Med. 2019; 26(1): 51–54, doi: 10.26444/aaem/85591, indexed in Pubmed: 30922029.

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Cloud-based framework to mitigate the impact of COVID-19 on seafarers' mental health

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Today the entire world is flabbergasted by the sheer magnanimity of the novel corona virus disease (COVID-19). Its infection and death rates are unprecedented and are manifolds as compared to the other fatal epidemics of history [1]. This contagious disease has affected people worldwide without any discrimination of class, colour, or gender. Though the facts suggest that normalcy will return, yet the terrifying blemishes of COVID-19 will be there for a very long time on the human mind. Much psychological distress will prevail across the world.

It can also be observed that there is an instance of psychological imbalance among people working on enclosed environments such as seafarers. At this rate of infection and death worldwide, challenges are emerging to keep everyone psychologically well. Psychiatrist intervention is much required today [2]. To lessen the psychological vulnerabilities among ship workers, it is time to understand the science behind the disease rather than fearing it. Psychiatrists, psychiatric nurses, clinical psychologists, and other mental health workers should bridge the gap between fear and reality [3]. It is quite evident that there is an inherent characteristic of epidemics including COVID-19 to have comorbidity with psychological disorders related to either fear or financial distress. There are also onboard-infected people, and their caretakers in the affected area who are vulnerable to psychological disorders.

When someone gets mild symptomatic in ship environments, a greater risk of fear and stress would make that person more vulnerable. This vulnerability causes various psychological problems like distress, depression, anxiety, insomnia and even suicidal death. Online assessment to understand emotional and behaviour fear assessment can be made available to ease out stress, depression, and fear [4]. Various computational and learning algorithms need to be put in place to preempt the psychological imbalance like the risk of suicide, lessen human manoeuvrability within the affected marine environments, prediction of viral relapse and classification and containment of the disease, etc. which would amend the calibre of effectiveness during emergency interventions.

Thus, a cloud-based technology has been designed to assist seafarers from onshore by proactively managing psychiatric concerns like depression, anxiety, and other conditions with the employment of predictive analytics powered by an Artificial Intelligence models. The main contribution of this work is to present a conceptual framework for the monitoring of mental conditions of COVID-19-infected seafarers. This framework is presented in Figure 1, to support the clinical care, psychiatric issue assessment, educating onboard staff, and online self-assessment of individuals as well as depressed people. It can also help to control psychiatric issues utilising individual communications with other seafarers through simple chat sessions.

This framework model has been designed with the integration of both cloud and artificial intelligence technologies. The database of incident management system collects the local data of mental and physical states of onboard isolated (or quarantined) seafarers by COVID-19. The seafarer can be registered into the given application and record the parameters (i.e., body temperature, pulse rate, body mass index, blood pressure, heart rate, etc.) to monitor regular health conditions. When an onboard person feels that he/she got a sudden hike in body temperature, or having breathing issues, smart

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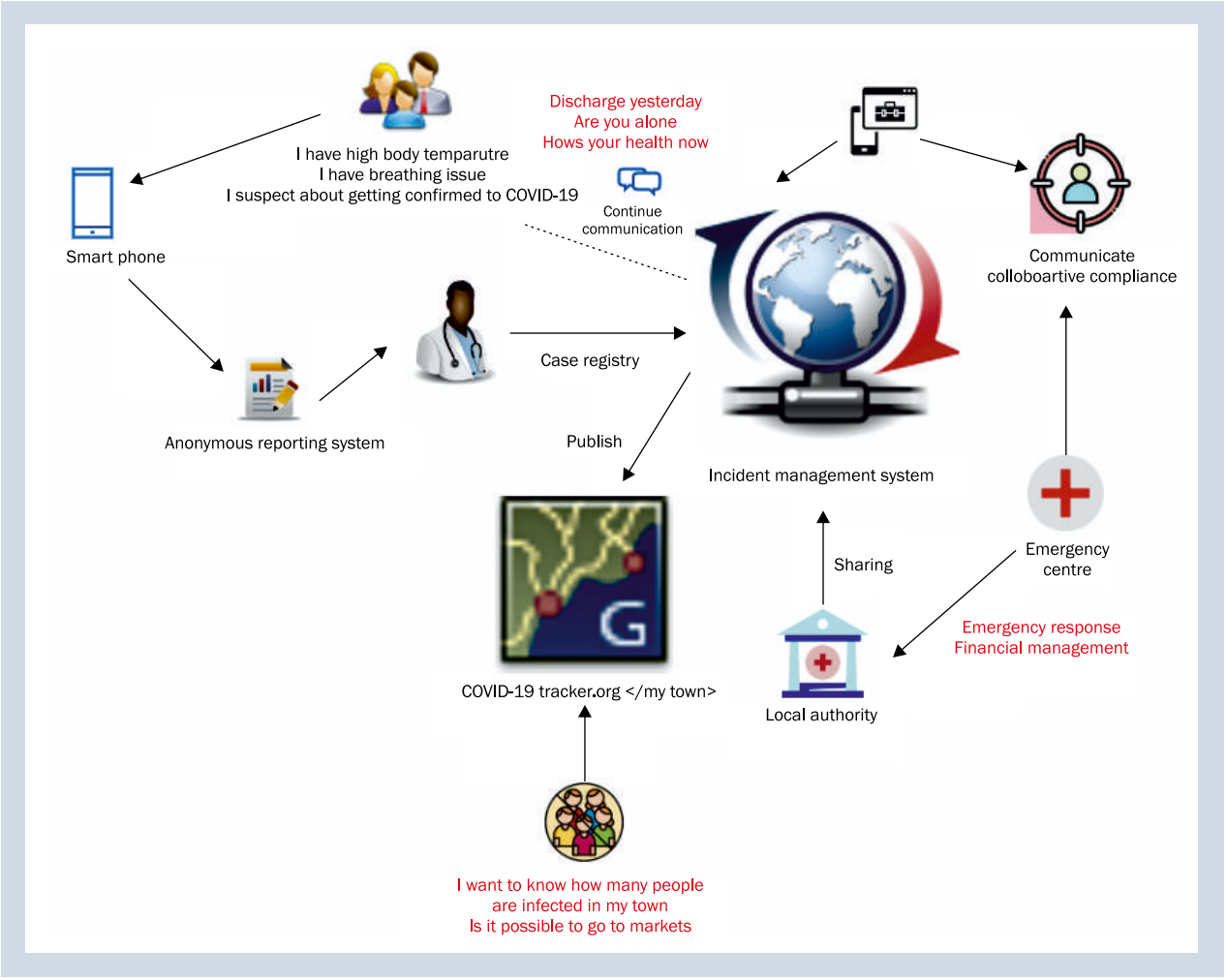

Figure 1. Cloud-based framework to monitor the mental conditions of COVID-19 infected patients

phone application alerts the seafarer and makes an immediate appointment by contacting the emergency centre. The incident management system always records the number of infected people in a particular ship and shares the daily effective infection rates with ship authorities. Thanks to publishing or sharing experiences of recovery patients enable infected onboard person can feel better and more confident to fight against COVID-19. In this way, the proposed framework can open new doors to use seafarer's safety technology to save lives during this new pandemic by providing a comprehensive way of track and manage individual's COVID-19 responses.

The supplementary material associated with artificial intelligence chatbot application during the COVID-19 pandemic can be found at: https://doi.org/10.3390/healthcare8020154.

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REFERENCES

1. Yang HY, Duan GC. Analysis on the epidemic factors for the corona virus disease. Zhonghua Yu Fang Yi Xue Za Zhi. 2020; 54(0): E021, doi: 10.3760/cma.j.cn112150-20200227-00196.
2. Banerjee D. The COVID-19 outbreak: Crucial role the psychiatrists can play. Asian J Psychiatry. 2020; 50: 102014, doi: 10.1016/j.ajp.2020.102014.
3. Shi Y, Wang J, Yang Y, et al. Knowledge and attitudes of medical staff in Chinese psychiatric hospitals regarding COVID-19. Brain Behav Immun Health. 2020; 4: 100064, doi: 10.1016/j.bbih.2020.100064, indexed in Pubmed: 32289123.
4. Ahorsu D, Lin CY, Imani V, et al. The Fear of COVID-19 Scale: development and initial validation. Int J Mental Health Addiction. 2020, doi: 10.1007/s11469-020-00270-8.

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LETTER TO THE EDITOR

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Changes in the status of COVID-19 over time necessitate major changes in academics

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Over 20 million people worldwide have contracted COVID-19, and over 750,000 have died; the disease poses a major problem for society (as of August 15, 2020) [1]. In Japan, over 53,000 people have contracted COVID-19 thus far (as of August 14, 2020) [2], and it has killed over 1,000 people (as of August 14, 2020) [3]. Japan gradually declared a state of emergency at the national level, and it declared a nationwide state of emergency in April 2020. Later, the state of emergency was gradually rescinded based on epidemiological trends, and the nationwide state of emergency was rescinded in late May 2020. Starting on March 2, 2020, the government requested that elementary, middle, and high schools and special needs schools nationwide close temporarily (enforcement was left to the discretion of individual schools and local municipalities). Most schools closed, and over 80% of all schools were closed in mid-May 2020 [4]. Some schools began to resume classes by staggering attendance, but schools are now conducting classes as normal. Japan has 47 prefectures and major metropolitan areas. When those prefectures were asked whether they plan to conduct the general entrance examination for prefectural high schools scheduled for the spring of 2021, 19 prefectures answered that the examination would take place "as usual", 21 answered that it would take place "with modifications (a smaller scope of problems or multiple-choice options based on how much students had learned)", and 7 answered that the item of the examination was "yet to be determined" [5]. COVID-19 is having a major impact on student learning. Current circumstances need to be fully understood, and in the future students will need both short-term and medium-term assistance to compensate for the delayed learning due to COVID-19.

REFERENCES

1. NHK. https://www3.nhk.or.jp/news/special/coronavirus/world-data/ (cited 2020 August 15).
2. NHK. https://www3.nhk.or.jp/news/special/coronavirus/data/ (cited 2020 August 15).
3. NHK. https://www3.nhk.or.jp/news/special/coronavirus/data-all/ (cited 2020 August 15).
4. Nihonkeizai shimbun. https://www.nikkei.com/article/DGXMZO56131560X20C20A2MM8000/ (cited 2020 August 15).
5. Yomiuri shimbun. 2020 August 11: 1 and 26.

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The International Maritime Health will publish original papers on medical and health problems of seafarers, fishermen, divers, dockers, shipyard workers and other maritime workers, as well as papers on tropical medicine, travel medicine, epidemiology, and other related topics.

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All financial and material support for the reported research and work should be identified in the manuscript.

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