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## INTERNATIONAL MARITIME HEALTH

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# Healthcare seeking preferences of Myanmar migrant seafarers in the deep south of Thailand

Pyae Phyo Kyaw<sup>1,2</sup> , Alan F. Geater<sup>1</sup> 

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## ABSTRACT

**Background:** The Thai marine fishing industry depends on migrant workers. Public healthcare services are officially available to all registered migrant workers, but the extent of their utilisation by migrant seafarers is unknown. The aim of the study was to document sociodemographic characteristics, working conditions, illness history and healthcare-seeking preference among Myanmar migrant seafarers in southern Thailand.

**Materials and methods:** Questionnaire-based interviews were conducted among 385 migrant seafarers and selected participants qualitatively interviewed. Factors related to illness experience and to healthcare-seeking preference were identified using logistic regression.

**Results:** Past-one-year illness was reported by 307 (80%) participants, among whom 91% had illness while at sea and 22% an emergency condition requiring immediate transfer ashore. Only 118 (38%) illness events involved visiting a public hospital; another 38% involved private healthcare facilities or drug stores. Illness was associated with supervisory job, alcohol consumption habit, age > 20 years, ethnicity and exposure to hazardous marine life. Compared with the choice of public hospital, use of private healthcare facilities was associated with having at least primary school education and shorter-duration trips at sea. Obtaining medications from a drug store was associated with the job of sorting, packing/storing the catch, non-drinking and low income. Not holding their identity and health-insurance documents and language barrier were major reasons for reluctance to seek treatment at a public hospital.

**Conclusions:** Illness was common among the migrant seafarers. Utilisation of public hospitals was low. Allowing migrants to keep their identity and health insurance documents themselves and providing materials in the Myanmar language might promote utilisation of public health facilities.

(Int Marit Health 2021; 72, 1: 1–9)

**Key words:** Myanmar migrant seafarers, illness, healthcare-seeking preferences

## INTRODUCTION

The international migrant population has been increasing globally over the past few decades. According to World Migration Report launched by International Organization for Migration, in 2015, 3.3% of the world's population migrates around the world and work was the major reason for migration [1]. According to Thailand migration report, in 2018, there were about 4.9 millions of migrant workers working in different sectors [2]. Migrant workers who come

to Thailand typically work in industries such as fisheries, agriculture, manufacturing, construction and the service industries, the majority of them are working in physically demanding manual labour or low or semi-skilled jobs [3].

The Gulf of Thailand and the Andaman coastal area are the main marine fishing hubs occupying all the coastal provinces, where 600,000 migrant workers are working in fishing and seafood processing industries [2]. As of 2016 statistics from the Labour Office, in Pattani province alone, which is

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one of the deep southern provinces of Thailand, registered 12,000 migrant workers were working, mainly in fisheries [4]. Fishing communities are socially, economically and educationally disadvantaged and characterized by overcrowding and congestion with extremely poor sanitation [5]. Fishing itself is a particular type of hazardous and stressful job as it presents prolonged hours of continuous monotonous fishing trips, adverse weather, and stressful working condition at sea [6]. Long working days, heat in the work place, separation from families and hectic working activities are important stressors for seafarers [7]. Apart from risk of fatal injuries and accidents, lifestyle of seafarers involving irregular diet, drugs and alcohol misuse and risky sexual behaviours has a negative influence on their health [6].

Health needs and limitations of accessibility to health care services are frequently encountered among migrants [8]. Health insurance coverage has an influence on health-seeking behaviour of migrants in China [9]. In Thailand, migrants who have work permits are fully covered by Thai social security scheme, which mandates equal rights of access to health services with Thai nationals [10]. Although all documented and non-documented migrants can purchase migrant health insurance, utilisation of health service among insurance members is still low [3]. Moreover, though the uninsured migrants have formal access to healthcare services, they have to pay all expenses on their own as they do not have insurance [11]. Apart from major health problems, migrants tended to seek health care at private clinics or took medicine pills from drug store as service providers did not request identification cards or information on their background [12].

A study in Ranong province highlighted the nature of seafarers' healthcare preference that they were at sea for a long time and likely to ignore their health problems [12]. It has been reported that seafarers have been involved in medical emergencies at sea which required them being taken ashore, thus emphasizing the very dangerous nature of their job [13]. Unlike other migrants, migrant-seafarers have different working experiences and they are in a high-risk occupation. However, little health research on migrant workers in Thailand's fishing and seafood industry has been conducted.

Therefore, the objective of this study was to explore the socio-demographic profile of Myanmar migrant seafarers in Pattani province, Thailand, to document their healthcare-seeking preferences and to identify the factors responsible for their decision of those preferences. Seafarers' working condition at sea, living condition offshore, their health-related experiences and their preferences for seeking health treatments were considered in this study. The findings in this study are expected to partially fill the research gaps in migrant seafarers' health issues and could provide evaluation feedback to healthcare policy makers.

## MATERIALS AND METHODS

### STUDY SETTINGS AND DESIGN

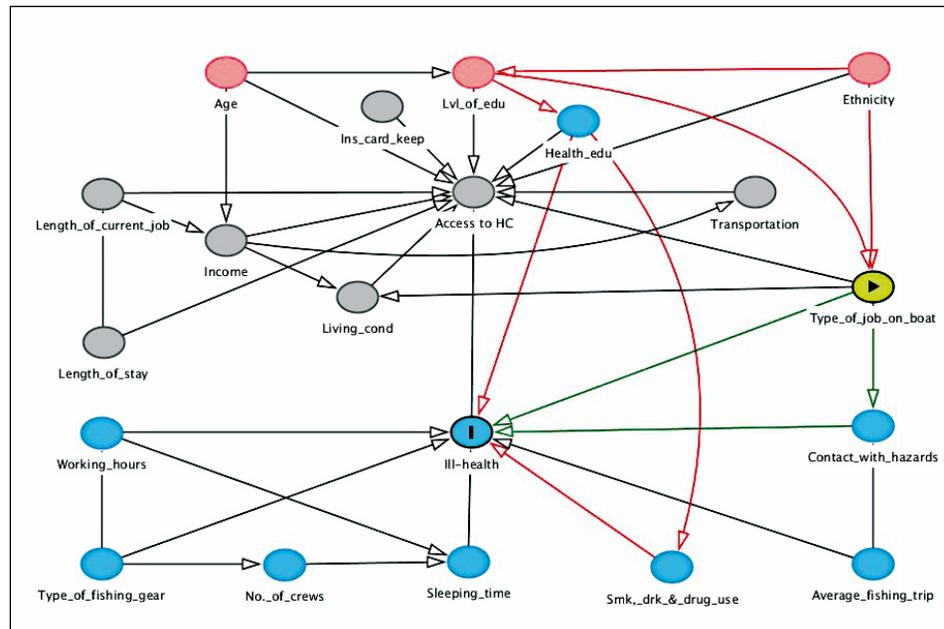
A community-based study was conducted during November, 2016 to April, 2017 in Pattani, one of the deep south provinces of Thailand bordering Malaysia. With the help of key informants, the seafarer community in Meuang district was approached and observed to obtain information at major sites of migrant residence and at fishing piers. Details of types of fishing boats, job types, ethnic groups and life styles were noted. A cross-sectional survey was then conducted using a questionnaire which was developed based on initial observation data. Inclusion criteria for recruitment were: being an adult male Myanmar migrant seafarer, having resided in Mueang district of Pattani province for at least one year, and having experience of going to sea. A subset of these migrants was subsequently interviewed qualitatively to clarify the findings of the quantitative questionnaire.

### SAMPLE SIZE AND SAMPLING METHODS

We assumed a prevalence of various health characteristics, needs, nature of accessibility to health care services, health perception and health-related experiences of 50% (no previous data) with a margin of error of  $\pm 5\%$ , for which a sample of 385 was required. Based on information from the Pattani Labour Office, it was estimated that there would be around 7000 male Myanmar migrant seafarers based in Pattani, so the sampling fraction would be around 5%.

When not at sea, most seafarers lived in camps but some stayed on the boat even while docked at the fishing piers. Sampling was done in the seafarers' housing as well as at fishing piers by snowball methodology. Successive places were introduced by key informants from each housing camp to another. Within each camp, all the rooms in the camp were numbered, and selected for interview using a random number table. We interviewed a random-number-generated respondent from each selected room to fulfil the expected sample size in accordance with the inclusion and exclusion criteria. If a selected participant had difficulty in speaking Myanmar language, an interpreter was engaged. No restriction on ethnicity was applied but the respondent had to originate from Myanmar.

Of the seafarers, 385 respondents were chosen in accordance with the inclusion and exclusion criteria. Written informed consent was obtained after providing thorough explanation to each potential subject. For the qualitative component, participants were selected based on their type of job and rank, and their willingness to participate in the interview and reveal their living experience and their working experience. Six crew supervisors and fifteen crew members were participated in in-depth interviews.



**Figure 1.** Directed acyclic graph showing the hypothesized relationships of sociodemographic characteristics, work conditions and other health-related exposures with occurrence of ill health and healthcare-seeking preferences among migrant Myanmar seafarers in Meuang Pattani, Thailand

### ETHICAL CONSIDERATION

The study was approved by the Ethics Committee of the Faculty of Medicine (Document number 59-322-18-5) and performed in line with the principles of the Declaration of Helsinki. Participants’ anonymity and confidentiality was stringently maintained throughout the study.

### DATA MANAGEMENT AND STATISTICAL ANALYSIS

The data obtained using the structured questionnaire were checked for completeness, accuracy and consistency and double entered using Epidata version 3.1. All analysis was performed using R version 3.2.5. Descriptive summaries of socio-demographic characteristics, working conditions, accessibility to healthcare services and health related characteristics were made using tabulation. A directed acyclic graph (DAG) was constructed to represent the possible pathways influencing the risk of illness of seafarers and for the choice of healthcare centre to access healthcare (Fig. 1). Associations between the independent variables (illness in the previous year, choice of healthcare facility) and dependent variables were done by univariate analysis. Binary logistic regression controlling for confounding as indicated by the DAG, was used to identify factors related to experience of illness in the previous year.

Multinomial logistic regression models, similarly controlled for minimal required sets of adjustment variables as indicated by the DAG, were constructed to identify factors influencing choice of type of healthcare facility among those who had experienced illness within the previous year.

Considering the baseline category of health facility to be public hospital, a relative risk ratio greater than 1 for the choice of private facility, drug store or no healthcare visit indicates higher relative probability of choosing the relevant health facility given the corresponding level of predictor compared with the reference. A likelihood ratio test p-value of < 0.05 was used as the level of significance for each variable, and for the multinomial models the significance of each outcome comparison was indicated using the Wald test.

## RESULTS

### GENERAL CHARACTERISTICS AND WORKING CONDITIONS OF MYANMAR MIGRANT SEAFARERS IN PATTANI DISTRICT, THAILAND

All 385 seafarers who were approached agreed to participate. Ages ranged from 17 to 53 years and 88% were more than 20 years old. The major ethnic groups were Rakhine (68%), followed by Bamar (20%), Dawei and various other ethnicities (12%) and 31% had less than primary education. 30% of migrant seafarers lived in Thailand for more than 5 years and majority of seafarers (75%) had been working in current job for less than 5 years. A majority of the respondents (75%) were current or ex-drinkers.

Although almost all had received regular screening at hospital, only one fourth (27%) had ever attended a health education session. Almost all respondents had health insurance provided by their employer but only 2.3% kept the card themselves or with a friend, relative, and with the head of the work group, whereas for the vast majority of seafarers

**Table 1.** General characteristics and working conditions of Myanmar migrant seafarers in Pattani district, Thailand

Variables		Frequency	Percentage
Age group	≤ 20	47	12.2%
	>20	338	87.8%
Ethnicity	Bamar	78	20.3%
	Rakine	261	67.8%
	Dawei and others	46	11.9%
Education level	Less than primary	121	31.4%
	Primary	188	48.8%
	Middle and above	76	19.7%
Length of stay in Thailand (years)	< 5	269	69.9%
	≥ 5	116	30.1%
Working duration in current job (years)	< 5	288	74.8%
	≥ 5	97	25.2%
Drinking history	Never	98	25.5%
	Ex and current	287	74.5%
Monthly income	5000–8000 THB	166	43.1%
	> 8000 THB	219	56.9%
Health insurance card kept in	Boss/work leader	376	97.7%
	Self/friend/relative	9	2.3%
Health education experience	Yes	104	27.0%
	No	281	73.0%
Type of job on boat	Supervise crew	33	8.6%
	Steer vessel/navigation	58	15.1%
	Mechanic/cook	15	3.9%
	Sort/pack/store catch	258	67.0%
	Guide nets/traps/line	21	5.5%
Average duration of job trip	≤ 10 days	188	48.8%
	11–15 days	92	23.9%
	> 15 days	105	27.3%
Exposure to hazardous marine life	Yes	119	30.9%
	No	266	69.1%

THB – Thai Baht

the card was kept by their boss. In respect of type of job on boat, two thirds (67%) of the respondents were general marine workers whose job was to sort, pack and store the catch, followed by those steering the vessel and navigating (15%) (Table 1).

#### **HEALTH CONDITION, CHOICE OF HEALTHCARE FACILITY AND HEALTHCARE FACILITY VISIT EXPERIENCE (EXCLUDING DRUG STORE AND NO TREATMENT) OF MYANMAR MIGRANT SEAFARERS IN PATTANI DISTRICT, THAILAND**

Among the 385 respondents, 307 (80%) reported having been ill in the previous year. Of these 91% had been ill at sea, 79% while ashore, 70% experiencing illness both at sea and ashore. Among the 307 respondents who had experienced illness in the previous year, 118 (38%) had chosen to visit a public hospital, 17% a private healthcare facility and 21% self-medicated with medication purchased

from a drug store. The others did not seek treatment. Among respondents seeking treatment at a healthcare facility, half reported the health facility was within 2 km of their lodging and 87% reported taking less than 30 min to arrive at the facility. Only about two-fifth reported having to wait more than 30 min to be attended to by a health-service provider and the majority (87%) reported being satisfied or very satisfied with the waiting time (Table 2).

#### **ILLNESS (IN THE PREVIOUS YEAR) OF MYANMAR MIGRANT SEAFARERS IN PATTANI DISTRICT, THAILAND (N = 385)**

Binary logistic regression models to identify variables significantly associated with seafarers reported illness in the previous year after appropriately controlling for confounding as indicated by the DAG revealed that such illness was significantly associated with holding a supervisory job on the boat, (odds ratio [OR] 7.67; 95% confidence interval [CI]

**Table 2.** Health condition, choice of healthcare facility, and healthcare facility visit experience (excluding drug store and no treatment) of Myanmar migrant seafarers in Pattani district, Thailand

Variables		Frequency	Percentage
Illness history in the previous year	Yes	307	79.7
	No	78	20.3
Illness location	At sea and ashore	214	69.7
	Only at sea	66	21.5
	Only ashore	27	8.8
Choice of healthcare facility	Public hospital	118	38.4
	Private facility	52	16.9
	Drug store	66	21.5
	No treatment	71	23.1
<b>Healthcare facility visit experience</b>			
Distance to healthcare facility [km]	< 2	88	51.8
	≥ 2	71	41.7
	Missing	11	6.5
Time to healthcare facility [min]	< 30	148	87.1
	≥ 30	11	6.5
	Missing	11	6.5
Difficulty to go to healthcare facility	Difficult	9	5.3
	Easy or very easy	153	90.0
	Missing	8	4.7
Waiting time at healthcare facility [min]	< 30	92	54.0
	≥ 30	66	38.8
	Missing	12	7.1
Satisfied with waiting time at healthcare facility	Strongly satisfied	5	2.9
	Satisfied	144	84.7
	Dissatisfied and strongly dissatisfied	9	5.3
	Missing	12	7.1

1.01–57.9 compared to the job of sorting, packing and storing the catch), age > 20 years (OR 2.05; 95% CI 1.05–4.01), being a current or past alcohol drinker (OR 3.17; 95% CI 1.84–5.46), being of Dawei or other minority ethnicity compared with Rakhine (OR 4.46; 95% CI 1.34–14.9), and exposure to hazardous marine animals or plants (OR 2.36; 95% CI 1.24–4.48) (Table 3). There appeared also to be a positive association between longer residence in the country and longer duration in the current job and probability of experiencing illness in the previous year.

#### **CHOICE OF HEALTHCARE FACILITY AMONG MYANMAR MIGRANT SEAFARERS WHO SOUGHT HEALTHCARE FOR ILLNESS WITHIN THE PREVIOUS YEAR IN PATTANI DISTRICT, THAILAND (N = 236)**

A series of multivariate logistic regression model was constructed for choice of healthcare, comparing private care and drugstore to use of public health care facility, similarly controlling for potential confounding factors as indicated by the DAG. Using public health facility as the baseline outcome, there was evidence that private healthcare facilities were

relatively more likely to have been utilised by seafarers with primary school education (relative probability ratio [RPR] 2.40; 1.10, 5.22) compared with lower than primary education and by seafarers whose average duration of fishing trip was no more than 10 days. There was some indication that being a mechanic or cook was associated with a higher relative probability of using a private rather than public healthcare facility compared with being a crew supervisor.

By contrast, compared with the baseline outcome of using a public healthcare facility, seeking healthcare from drug stores was relatively more likely among non-drinkers (RPR 2.50; 1.19, 5.15), and those with low income (≤ 8000 Baht/month) (RPR 6.13; 1.32, 28.4), and basic marine workers with the job of sorting, packing and storing the catch compared with workers responsible for steering and/or navigation (Table 4).

#### **QUALITATIVE INFORMATION**

The most common health-related experiences that occurred at sea were reported to be abdominal discomfort, loose motion, sea-sickness, body aches, alcohol withdrawal

**Table 3.** Illness (in the previous year) of Myanmar migrant seafarers in Pattani district, Thailand (n = 385)

Exposure	Adjustment set	Exposure variable level	OR (95% CI)	P value (LR test)
Type of job on boat	Health education, education level	Supervise crew	7.67 (1.01–57.9) <sup>a</sup>	0.031
		Steer vessel and navigation	1.09 (0.52–2.28) <sup>ab</sup>	
		Mechanic and cook	0.57 (0.18–1.74) <sup>b</sup>	
		Sort, pack and store catch	1 <sup>b</sup>	
		Guide nets, traps and line	0.52 (0.20–1.36) <sup>b</sup>	
Age [years]	–	≤ 20	1	0.043
		> 20	2.05 (1.05–4.01)	
Drinking	Health education	Ex and current	3.17 (1.84–5.46)	< 0.001
		Never	1	
Ethnicity	–	Bamar	1.56 (0.80–3.05) <sup>ab</sup>	0.009
		Rakhine	1 <sup>a</sup>	
		Dawei and others	4.46 (1.34–14.9) <sup>b</sup>	
Exposure to hazardous marine life	Job type, fishing trip duration	No	1	0.006
		Yes	2.36 (1.24–4.48)	
Length of stay in Thailand [years]	–	< 5	1	< 0.001
		≥ 5	4.10 (1.97–8.54)	
Working duration in current job [years]	–	< 5	1	< 0.001
		≥ 5	4.21 (1.86–9.50)	

<sup>a,b,ab</sup>: Odds ratio values within exposure not having a superscript in common differ significantly (Wald test p-value < 0.05); CI – confidence interval; OR – odds ratio; LR test – likelihood ratio test

**Table 4.** Choice of healthcare facility among Myanmar migrant seafarers who sought healthcare for illness within the previous year in Pattani district, Thailand (n = 236)

Exposure	Adjustment set	Exposure variable level	Relative probability ratio				P value (LR test)
			Private care vs. public hospital	P value (Wald test)	Drug store vs. public hospital	P value (Wald test)	
Drinking	Health education	No	0.82 (0.32, 2.12)	0.685	2.50 (1.19, 5.15)	0.015	0.022
		Ex- or current drinker	1				
Level of education	Age, ethnicity	< Primary school	1	0.022	1	0.784	0.042
		Primary school and above	2.40 (1.10, 5.22)				
Income (Baht/mo.)	Age, working duration, job type	> 8000	1	0.081	1	0.020	0.049
		< 8000	2.02 (0.92, 4.47)				
Type of job on boat	Ethnicity, education level	Supervise crew	0.33 (0.10, 1.11) <sup>a</sup>	0.181	0.42 (0.15, 1.15) <sup>ab</sup>	0.042	0.044
		Steer vessel and navigation	0.51 (0.20, 1.31) <sup>ab</sup>				
		Mechanic and cook	2.80 (0.50, 15.7) <sup>b</sup>				
		Sort, pack and store catch	1 <sup>ab</sup>				
		Guide nets, traps and line	0.48 (0.04, 5.12) <sup>ab</sup>				
Average fishing trip days	–	≤ 10	1 <sup>c</sup>	0.003	1	0.997	0.005
		11–15	0.18 (0.06, 0.55) <sup>a</sup>				
		> 16	0.41 (0.18, 0.93) <sup>b</sup>				

<sup>a,ab,b,c</sup>: Relative probability ratio values within exposure not having a superscript in common differ significantly (Wald test p-value < 0.05); LR test – likelihood ratio test

symptoms, illicit drug reaction, accidental injuries and minor cutaneous lesions. The crew supervisor took care of health for crew members when minor illness occurred at sea with the help of emergency kit medicines. If the disease condition became worse, other options to obtain health treatment were considered such as sending the patient back to shore

via fishing boat or other carrier boat. A one-time explosion and fire at sea was reported and in that situation, the injured seafarers received treatment and medical aids from a nearby offshore oil and gas production rig.

Regarding health-related experience on land, as Thai employers usually kept the employee’s health insurance

card, seafarers quite commonly went to a private clinic or requested treatment at a home visit by nurse or paramedic rather than visit a public hospital. The language barrier, transportation cost and caretaker charges (fees for accompanying translator) were mentioned as additional reasons for seeking healthcare privately rather than visiting a public healthcare facility. Sometimes, seafarers avoided seeking professional treatment and instead self-medicated with medicine bought at a nearby drug store. Some generous and dutiful employers took care of their employee and shared high health cost. Seafarers wanted employers to eliminate unfair wage deductions and ensure timely payment of wages in full.

While staying ashore, seafarers were not allowed to go outside the camps or travel across the province as they did not have their identification documentation in their hands. A few seafarers pointed out that a seafarer's life was harder in Thailand than in their mother country as they earned less than expected and because of their being in debt for recruitment fees. However, one long-service fisherman said that current conditions were considerably better than in the early years of his seafaring occupation: today's seafarers, he said, had full documentation for fishing, work permits and health insurance benefits and their boss also took full responsibility for migrant seafarer's health, families and social wellbeing.

## DISCUSSION

This study of Myanmar migrant seafarers aged 17–53 years from one fishing community in a southern Thailand coastal port recorded their working conditions at sea and their healthcare seeking preferences. A small qualitative interview highlighted the relationship of migrant seafarers with their employers and the suggested labour abuses in the Thailand fishing and seafood industry. Healthcare utilisation by migrant seafarers at public hospitals was quite low.

Overall, less than 40% of the migrant seafarers went to a public hospital when they were sick, with most crew members other than supervisors and navigators choosing to visit private facilities or simply obtain medication from drug stores. This may be owing to the fact that the seafarers' health insurance cards were mostly kept by their boss. Nevertheless, almost all seafarers had undergone health screening services as this was mandated for being provided with a work permit and health insurance. Although law prohibits withholding of identification documents [2], Thai employers of almost all migrant employees' kept the seafarers' identity cards. In this study, only 2.3% of migrant workers could keep their cards themselves or with a friend or relative.

Over 70% of seafarers in this study were or had been smokers and/or alcohol consumers. A few of them also

used illicit drugs. Thus, not only were the seafarers working in a physically hazardous job but the use of alcohol and illicit drugs would likely add to the risk of their having risky behaviours for sexually transmitted diseases (STI) and other communicable diseases. A cross-sectional study conducted among Myanmar fishermen in Ranong, Thailand described their risky sexual behaviours such as penile oil injection, penile implantation and poor condom use [14]. According to the nationwide hospital database for 2011, tuberculosis, malaria and STI were prevalent in male migrant workers in Thailand [15]. A study done in a fisherman community stated that self-treatment of STI was significantly more frequent among Myanmar migrant fishermen than Khmer or Thai [16]. Though the current study did not collect data on the types of illness experienced, the results showed that those who drank alcohol were more likely to have been ill in the previous year.

Seafarers who had received at least primary level education more commonly chose to seek healthcare at private clinics, while those who no more than 8000 Baht per month were more likely to seek medication from a drug store. Preferring to seek private treatment or adopt self-medication may be because seafarers would need to retrieve their identity and health insurance documents from their boss to visit a public hospital and may feel reluctant to discuss with their crew supervisor or boss about their illness. Alternatively, they may decide their illness is only minor and ignore it. A fishermen study done in Thailand reported higher proportion of self-medication among Myanmar and Khmer fishermen than among Thai fishermen [16]. To encourage greater utilisation of migrant health insurance at public health facilities, migrant seafarers should be allowed to keep their identity and health insurance documents themselves.

Seafarers who went to sea for on average less than 10 days per trip were more likely to get treatment at private clinics or have home visit treatment. Except for major injury and illness, they wanted to avoid long queues and subsequent follow up visits at hospital, disregarding the need for proper investigation and treatment. Without long hospital stay, seafarers assumed that they were not absent from their duty station and could maintain their income intact. Moreover, half of the fishermen in the study were unmarried, and being far from their families and relatives could rely for support only on their coworkers when they were ill.

The qualitative information revealed that the migrant seafarers were generally satisfied with the available treatment options at sea and on land. However, seafarers wished to keep their health insurance cards so that they could utilize their rights to healthcare access at public hospitals. Seizure of workers' identification documents by employers, delayed payments and a lack of labour protection are considered

to be employment abuses [17]. Seafarers also wanted to improve their social security and wellbeing and ensure a healthy working environment while omitting some abusive working condition. The pattern of healthcare-seeking preferences of migrants was similar from one camp to another in this study, although the perceived attitude of the boss at different camps resulted in some differences in healthcare access and benefits.

## LIMITATIONS OF THE STUDY

Limitations of this study are the cross-sectional design which limits causal inference. Also, the highly mobile nature of migrant fishermen meant that the seafarers included in the study were sampled from those who happened to be ashore at the time of the data collection. The self-reporting of illness in the previous year may also have been subject to bias; in particular, it is not certain that the illnesses reported actually occurred within the space of the previous 12 months. Indeed, the strong association between reported illness and duration of residence in Thailand suggests that some of the illnesses reported may actually have occurred earlier. Generalisability of findings to other migrant seafarer communities should be considered with caution as the study was confined to just one location in southern Thailand.

Nevertheless, the study has an important strength. The fact that seafarers and the interviewer were of the same nationality, if not all of the same ethnicity, suggests that migrant-interviewees felt safe to respond well and truthfully to the questions. The advocate skill of key informants also supported the seafarers' willingness to respond.

## CONCLUSIONS

In conclusion, despite the high insurance coverage for registered migrants and expanding coverage for undocumented migrants, Thailand still faces unresolved operational challenges. Given the pattern of healthcare-seeking preferences of migrant seamen, more migrant-friendly health services are still needed. Such health services should be supported not only by the government policy but also by employers' participation. Effective information, education, and communication materials written in mother language of migrants should be provided to promote migrant workers' knowledge on health issues and enhance sensible decision-making regarding their healthcare. Future lawful enforcement needs to be strengthened to deliver greater adherence to labour and social protection in this migrant society.

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## CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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# Physical fitness in Spanish naval cadets. A four-year study

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## ABSTRACT

**Background:** Military physical readiness largely depends on soldiers maintaining their general health and physical fitness at a level which enables them to perform their requisite occupational duties in garrison and deployment environments. Understanding the physical fitness of naval cadets throughout its formative stages will help us define a training programme tailored to their needs. The objective of this study was to analyse the physical fitness of cadets enrolled in military training in the academic year 2018–2019 in the Military Naval Academy in Marín, Spain.

**Materials and methods:** A longitudinal correlational-descriptive design was undertaken. 167 of the 292 students who participated in the global analysis participated in the pre and post (first and second semester) physical fitness tests (153 males and 14 females, mean age  $21.9 \pm 3.5$ ) and were stratified into age groups. Anthropometric measurements and data from the Spanish army physical fitness assessment system (2 min push-ups, 1000 and 50 m races, vertical jump and 50 m swimming) were used. A descriptive, inferential, and correlational analysis was carried out and the level of significance set for the study was  $p \leq 0.05$ .

**Results:** Inferential analysis between age group markers and over the total sample shows statistical differences for the total sample in the 1000 m and 50 m race ( $p < 0.001$ ) and in vertical jump test ( $p < 0.010$ ). There was significant statistical correlation between all five tests undertaken.

**Conclusions:** The level of physical fitness of cadets at the Military Naval Academy in Marín, Spain appears to be acceptable when compared to other countries' military naval corps. Coherence between training and evaluation is extremely important, and a re-evaluation of stamina and strength training is probably advisable.

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**Key words:** physical fitness, military personnel, physical conditioning, athletic performance

## INTRODUCTION

Military physical readiness largely depends on soldiers maintaining their general health and physical fitness at a level which enables them to perform their requisite occupational duties in garrison and deployment environments [1–3]. A physically capable force is required to perform essential military tasks. The importance of physical fitness applies to the general population, but for military personnel,

achieving a high level of physical fitness may be essential for them to be successful at their jobs [4–6]. Additionally, combat deployments may last for extended periods, and soldiers are expected to maintain their levels of fitness during these times. Maintaining fitness during deployment may be achieved by the physical requirements and demands of the soldier's role and duties, or through the implementation of structured physical training. Military units typically train

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The project has been developed in the Military Naval Academy in Marín, Spain.

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as a group when carrying out physical training. Training is used not only for the physical conditioning necessary for the demands of the job, but also for stimulating esprit de corps, teamwork, camaraderie, and mental resilience [7].

The training of new recruits, including their development of the physical capacities necessary for them to be effective operational soldiers, places important emphasis on military training systems and curricula. Furthermore, these training systems and curricula must also be sufficiently robust to ensure the satisfactory progression of recruits' or cadets' fitness within a set period of time [8, 9]. Each branch of the armed forces determines the necessary physical fitness testing needed to maintain minimal levels of fitness and strength for its members' respective duties [6, 10–12]. Physical fitness assessments are an essential component for the measurement of the physical capacities of all Service Members [1]. For example, in the United States of America (USA), soldiers must meet certain fitness criteria to remain in the military. The Army Physical Fitness Test (APFT) is taken twice a year by the active duty population, and is the tool used to assess physical fitness. It has three components: extended-leg push-ups, bent-knee sit-ups and a timed 2-mile run [13].

The importance of adequate levels of physical fitness is emphasized in military personnel due to the high physical demands which exist during military training and in warfare [10, 11]. In the USA, soldiers who fail the APFT usually participate in remedial physical training programmes, while repeated failures can lead to their discharge from military service [13].

Physical exercise/sports assignments should be oriented towards individual personal conditioning. Although leaders acknowledge that physical fitness tests are part of military service, those tests' marks are not a proven predictor of adequate military physical fitness, and the specificity of performance-related fitness requirements should vary depending on the individual's mission [10]. It is important to highlight that in Spain, different Military Corps use different tests to assess the physical fitness of military personnel, and that currently, no battery of tests has been scientifically validated. Furthermore, in Spain, each of the armed services conducts some variation of an annual or biannual physical test. These periodic physical tests carried out are in accordance with the Spanish Ministerial Order 54/2014, November 11<sup>th</sup>.

Based on the comments above, the objective of this study was to report the level of physical fitness of Spanish cadets enrolled in the Bachelor's degree and military programme for 4 years.

## MATERIALS AND METHODS

This study has a quantitative approach and uses a longitudinal correlational-descriptive design, and it is part of a longitudinal study in collaboration with Military Naval

Academy in Marín (MNAM), Spain from 2018 to 2022 under the “Admiral Álvarez-Ossorio” endowed chair.

The sample included students enrolled in the Bachelor's degree and military training programme of 5 year's duration, at the MNAM attached to the University of Vigo during the academic year 2018/2019. One hundred and sixty-seven of the 292 students who participated in the global analysis participated in the pre and post physical fitness tests and have consequently been included in the study sample (153 males and 14 women, mean age  $21.9 \pm 3.5$ ).

The anthropometric assessment was carried out by specialised technicians and took place in the multi-use room the week before the physical tests. The anthropometric assessment followed the International Working Group of Kinanthropometry (ISAK) protocol [14]. The instrument included students' weight, height, and body mass index (BMI). Height was measured using a telescopic measuring rod SECA (SECA, Germany) with a measuring accuracy of 0.1 cm. Weight was measured using a bioimpedance device Tanita (TBF300) with a measuring accuracy of 100 g. For the body composition study, the percentage of fat was calculated based on the BMI, using the following formula:  $\text{weight/height}^2$  ( $\text{kg/m}^2$ ).

The Spanish army physical fitness assessment system provides information about the physical activity training programme and the recruit's current level of fitness. This assessment allows an individual physical profile to be defined, including the three groups correspondent to the following aspects of physical condition: strength, stamina, and speed. This instrument includes the General Physical Condition Test and the Specific Physical Condition Test. Physical fitness assessment (**Supplementary Material – see journal website**) was carried out using different tests included in the General Physical Condition Test [15].

Assessments were carried out in three different locations: on an athletics track (50 m race and 1000 m race), in a multi-use room (vertical jump and 2 min push ups) and in an indoor swimming pool (50 m swimming). The first assessment was carried out over a week, in the mornings from 8:00 to 9:30, in January. The second assessment was also carried out for a week, in the mornings, from 12:30 to 14:0, in May. The first day the 1000 m race was run, the second day the 50 m swimming, the third day 2 min push ups and vertical jump, the fourth day the 50 m race and on the fifth day those participants who could not take part on the previous days were assessed. Anthropometric assessment was carried out in the multi-use room the week before the physical tests. Before the physical fitness tests, participants warmed up for 15 min in accordance with the tests to be done. The physical fitness tests were carried out by military personnel of the Physical Activity Department, professionals who are used to recording the data of such

**Table 1.** Descriptive analysis by course

	All course (n = 167)	1 <sup>st</sup> course (n = 69)	2 <sup>nd</sup> course (n = 44)	3 <sup>rd</sup> course (n = 27)	4 <sup>th</sup> course (n = 27)
Gender (% male)	91.7%	91.8%	86.8%	97.2%	87.9%
Age [years]	21.9 ± 0.9	18.6 ± 0.5	20.5 ± 0.5	22.3 ± 0.5	27.7 ± 3.2
Height [cm]	176.1 ± 7.4	176.2 ± 7.2	175.2 ± 7.8	178.0 ± 7.0	174.7 ± 7.9
Weight [kg]	73.4 ± 7.9	71.2 ± 8.4	72.1 ± 9.1	77.1 ± 9.3	73.5 ± 9.0
BMI [kg/m <sup>2</sup> ]	23.6 ± 2.1	22.9 ± 2.0	23.4 ± 2.2	24.3 ± 2.2	24.0 ± 2.0
1000 m race [min]	03:22.3 ± 00:15.0	03:23.3 ± 00:14.4	03:22.0 ± 00:16.5	03:17.4 ± 00:13.0	03:30.3 ± 00:15.7
50 m race [s]	7.0 ± 0.5	7.0 ± 0.5	6.9 ± 0.5	6.8 ± 0.4	7.1 ± 0.51
2 min push ups (repetitions)	42.7 ± 11.8	42.8 ± 10.8	42.5 ± 12.0	42.6 ± 11.1	42.7 ± 10.7
Vertical jump test [cm]	55.2 ± 5.8	53.5 ± 6.9	55.7 ± 7.4	58.2 ± 5.1	53.4 ± 5.7
50 m swimming [s]	37.8 ± 7.6	37.7 ± 4.9	38.3 ± 7.8	22.3 ± 0.5	39.0 ± 5.7

Data are shown as mean/% ± standard deviation; BMI – body mass index

physical fitness tests. Anthropometric assessment was carried out by specialized technicians.

A descriptive statistical analysis based on the data has been carried out using central tendency measures and deviations, as this analysis is stratified by age. To verify the data for normality, the Shapiro-Wilks test was used ( $p > 0.05$ ). To determine if the training programme had a significant effect on the anthropometric and physical fitness variables, a Student t test for paired data was used. With a view to identifying the associations between the physical fitness tests which were used for both first and second semesters, a correlational analysis was carried out. Statistical analysis was performed using IBM-SPSS v25 for Mac. The level of significance was  $p < 0.05$ .

### ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study is in accordance with the Helsinki Declaration with respect to data collection and processing (World Medical Association, 2013) and with the Spanish *Ley Orgánica de Protección de Datos de Carácter Personal*. This protocol was submitted for consideration, commenting, guidance and approval to the research ethics committee of Faculty of Sports and Education Sciences (University of Vigo) and accepted before the study began with the code number 03-719.

### RESULTS

Table 1 shows descriptive analysis and sample characteristics by age groups. The total sample was composed of 167 students between 18 and 37 years old.

Inferential analysis between the results obtained in the first and second semesters by age group shows statistical differences for the total sample in the 1000 m and 50 m race ( $p < 0.001$ ) and in the vertical jump test ( $p < 0.010$ )

(Table 2). Depending on the age group analysed, statistical differences were observed, such as in the 2 min push ups ( $p < 0.001$ ) for the 18–19 age group; whereas in the 20–21 age group no statistical differences were observed for the vertical jump test, and in the  $> 24$  age group no differences were observed for the 1000 m race.

Table 3 summarises the physical activity undertaken in the first and second semester of the academic year 2018–2019. It should be noted that the physical activity planning used at MNAM includes characteristics intended to train and develop those physical fitness aspects (upper limb strength, general stamina, velocity, lower limb strength and swimming performance) associated with the Spanish army physical fitness assessment system.

A correlational analysis between the results obtained in the physical fitness tests of the first and second semester indicates a statistical correlation between all the five tests carried out. There was a significant statistical positive correlation between the 1000 m race, 50 m race and 50 m swimming, and between the 2 min push ups and vertical jump tests, while a significant statistical negative correlation was observed between the 1000 m race, 50 m race and 50 m swimming, and the last two tests: 2 min push ups and vertical jump test ( $p < 0.001$ ). Finally, Figure 1 shows the  $VO_2$ max evolution by age group, calculated based on the results of the 1000 m race, and comparing measurements carried out in the first and second semesters.

### DISCUSSION

The objective of this study was to analyse the physical fitness of the cadets enrolled in the five years duration of the Bachelor's degree and military training. Our sample includes a real representation of gender percentages be-

**Table 2.** Inferential analysis between first and second semester physical fitness tests

		Mean of the differences					t	gl	p
		Mean	SD	Error	CI (95%)				
					Lower	Higher			
All course	1000 m race [min]	00:03.8	00:08.2	00:00.6	00:02.6	00:05.1	6.1	167	0.001
	50 m race [s]	-0.2	0.3	0.1	-0.2	-0.1	-7.9	167	0.001
	2 min push ups [reps]	-0.7	6.9	0.5	-1.7	0.4	-1.2	163	0.229
	Vertical jump test [cm]	-0.9	4.0	0.3	-1.5	-0.3	-2.9	163	0.004
	50 m swimming [s]	0.1	2.5	0.2	-0.3	0.4	0.2	163	0.827
1 <sup>st</sup> course	1000 m race [min]	00:07.6	00:06.2	00:00.7	00:06.1	00:09.0	10.3	69	0.001
	50 m race [s]	-0.1	0.3	0.1	-0.2	-0.1	-4.2	69	0.001
	2 min push ups [reps]	-1.9	6.7	0.8	-3.5	-0.3	-2.4	68	0.022
	Vertical jump test [cm]	-2.2	3.8	0.5	-3.1	-1.2	-4.7	67	0.001
	50 m swimming [s]	0.2	2.2	0.3	-0.4	0.7	0.6	69	0.561
2 <sup>nd</sup> course	1000 m race [min]	00:03.8	00:07.4	00:01.1	00:01.5	00:06.0	3.4	43	0.001
	50 m race [s]	-0.2	0.3	0.1	-0.3	-0.1	-4.3	43	0.001
	2 min push ups [reps]	-0.6	7.1	1.1	-2.9	1.6	-0.6	40	0.572
	Vertical jump test [cm]	-0.9	4.2	0.6	-2.2	0.4	-1.4	41	0.181
	50 m swimming [s]	0.4	3.3	0.5	-0.7	1.4	0.7	40	0.479
3 <sup>rd</sup> course	1000 m race [min]	00:04.3	00:07.3	00:01.4	00:07.1	00:01.4	-3.1	26	0.005
	50 m race [s]	-0.2	0.2	0.1	-0.3	-0.1	-4.1	26	0.001
	2 min push ups [reps]	-0.2	6.3	1.2	-2.7	2.3	-0.2	26	0.879
	Vertical jump test [cm]	1.6	3.5	0.7	0.2	3.0	2.3	26	0.031
	50 m swimming [s]	-0.3	1.7	0.3	-0.9	0.4	-0.8	26	0.429
4 <sup>th</sup> course	1000 m race [min]	00:02.6	00:09.1	00:01.7	00:00.9	00:06.2	1.5	26	0.142
	50 m race [s]	-0.2	0.2	0.1	-0.3	-0.1	-3.8	26	0.001
	2 min push ups [reps]	2.1	6.9	1.3	-0.7	4.8	1.6	26	0.132
	Vertical jump test [cm]	-0.2	3.5	0.7	-1.6	1.2	-0.3	26	0.747
	50 m swimming [s]	-0.5	2.4	0.5	-1.5	0.5	-0.9	25	0.343

CI – confidence interval; SD – standard deviation

tween groups in MNAM. The total sample participating in the study was 167 as mentioned in the “Results” section, but only 8.3% were women. Men and women involved in military service carry out jobs that require a high level of physical fitness irrespective of their age, rank, or role [4]. Additionally, the physical conditioning of the sample improves with age and the best results were observed in the subgroup of 22–23 years.

Scientific evidence maintains that the response of physiological systems to exercise is specific to the mode and intensity of exercise, and that the training programme undertaken must stress the physiological systems that are critical for optimal performance in the given task so as to achieve specific training adaptations. There are a variety of fitness assessment tests available for measuring performance or changes in fitness [16].

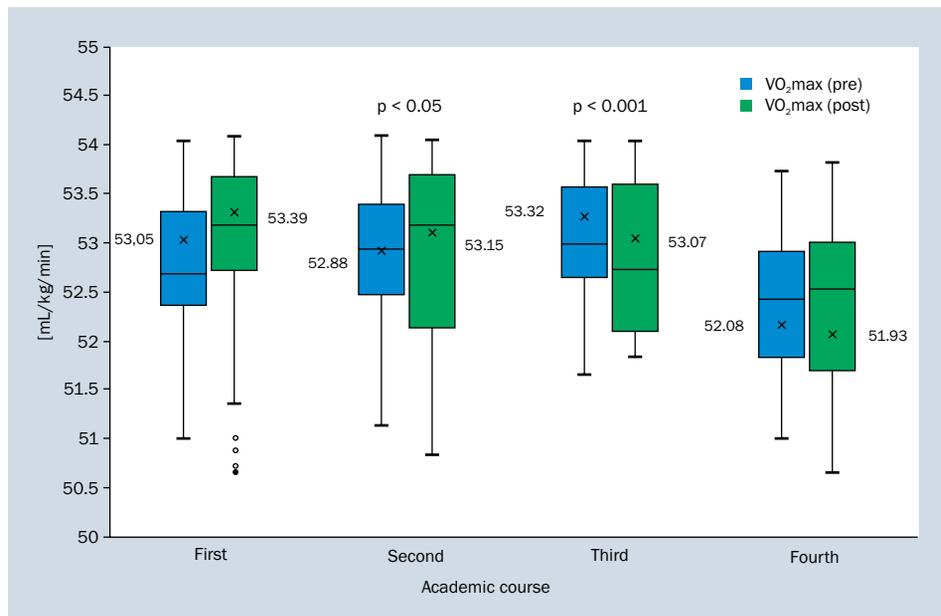
The training protocol carried out by MNAM cadets may seem timely adjusted for daily training time (50 min per day), which might lead to the idea that it might compromise obtaining the minimum marks required in the different fitness components of the test battery (minimum marks required with increment as the academic course of study progresses). Another aspect to keep in mind is that the trainings are mostly carried out in a group form, and not necessarily organized based on the homogeneity of physical condition of the cadets as well as in other armies [7].

Cuddy et al. [4] in their study conclude that candidates for entry into some Special Operations Forces in the USA who complete 30 min per day or more of physical activity have a higher likelihood of passing the physical fitness tests, or at least the run portion. Because the run portion is more

**Table 3.** Resume of the physical activity programme developed during the first and second semester of the academic course 2018–2019

Monday	Tuesday	Wednesday	Thursday	Friday
<b>1<sup>st</sup> Semester</b>				
<b>Fartlek run</b> <b>Warming:</b> 7' continuous run + running technique, high skipping, heels back, tips of toes above, extended knees <b>Main part:</b> Fartlek run: 5 series Density 1:1 Passive recovering R0 R5 15" R4 25" R3 50" R2 60" <b>Back to calm:</b> Stretching	<b>Continuous run</b> <b>Warming:</b> 5' R1 <b>Main part:</b> 25'R2 <b>Back to calm:</b> Stretching	<b>Swimming</b> <b>Warming:</b> –200 m light aerobic rhythm (100 FC+66 Ba+33 Br) (15'') <b>Main part:</b> Progressive: –200 m 66×3 Prog. 1–3 FC (30'') –100 m 33×3 Prog. 1–3 Ba (30'') –100 m 33×3 Prog. 1–3 Br (30'') Regressive: –200 m 66×3 Regr. 1–3 FC (30'') –100 m 33×3 Regr. 1–3 Ba (30'') –100 m 33×3 Regr. 1–3 Br (30'') <b>Back to calm:</b> –100–200 m smooth freestyle Total: 1100–1200 m	<b>Specific slopes</b> <b>Warming:</b> 15' continuous run, including series section once <b>Main part:</b> 2× (3×250 m in slope R3 + 2' Recovering) 4' Rec. <b>Back to calm:</b> Stretching	<b>Power circuit</b> <b>Warming:</b> 5' continuous run + rhythmic lap 250 m <b>Main part:</b> Interval training 10' 3× (30'':15'') 1'rec passive Isometric trunk flexion Oblique touching floor Abdominal scissors Circuit 2× (8' maximum repetitions) 5' rec. Passive 30 Flexions 20 Squats 10 Triceps funds 5 Shoulder flexions 250 m continuous running <b>Back to calm:</b> Stretching
<b>2<sup>nd</sup> Semester</b>				
<b>Endurance force general conditioning</b> <b>Warming:</b> Joint mobility 1' Continuous run 5'. 2× (5–10 extensions, 10–15 squats, 5–10 abdominals) <b>Main part:</b> Strength circuit: 30'' exercise 30'' passive recovering 2 rounds 1' passive recovering Stations: 1 <sup>st</sup> squats 3 s flexion 3 s isometric 3 s extensions 2 <sup>nd</sup> extensions 3 s flexion 3 s isometric 3 s extensions 3 <sup>rd</sup> oblique trunk flexion: only one side 4 <sup>th</sup> lateral stride 5 <sup>th</sup> oblique trunk flexion: both sides 6 <sup>th</sup> burpees 7 <sup>th</sup> inferior abdominals raising leg 8 <sup>th</sup> plank, touching shoulder alternatively 9 <sup>th</sup> horizontal jumps with feet together ×4, back to the initial position walking 10 <sup>th</sup> triceps funds <b>Back to calm:</b> Stretching	<b>Medium interval training</b> <b>Warming:</b> 10' continuous run 2 progressive 30 m Recovering walking back <b>Main part:</b> 2× (3× 200 m R4 2'Rec. R0) 4'Rec R0 It is sought to reach a constant brand for the repetitions. Do not do the first at maximum effort and progressively improving the following repetitions <b>Back to calm:</b> Stretching	<b>Endurance force extensions</b> <b>Warming:</b> 2' Joint mobility 5' Run with exercises each 1' ×5–10 extensions ×5–10 squats Touch floor and jump 3 times Isometric plank Trunk flexion ×10 <b>Main part:</b> 2× (De 10'' a 20'' Plank depending on the level 5''–10'' Isometric plank depending on the level while finishing arm flexion). To not let muscle fail 1' passive recovering between series 2× (from 3 to 10 extensions depending on the level, 2'' flexion, 2'' isometric, 2'' extension) 2' active recovering, continuous running R0, 4× (20'' extensions RIR +4) <b>Back to calm:</b> 2' active recovering, continuous running R0 HIIT abdominal: 20'' working 10'' recovering 3× (1 <sup>st</sup> trunk flexion, 2 <sup>nd</sup> lateral plank, 3 <sup>rd</sup> vertical scissors, 4 <sup>th</sup> lateral plank) <b>Back to calm:</b> Stretching RIR. Number of estimated repetitions before muscle fail	<b>Aerobic slopes</b> <b>Warming:</b> 10' continuous running 2 progressives 30 m Recovering walking back <b>Main part:</b> 2× (2×200 m in slope R4 3' recovering R0) 4' Recovering R0 <b>Back to calm:</b> Stretching	<b>Running technique</b> <b>Warming:</b> 5' continuous running <b>Main part:</b> Running technique exercises to 20 m and walking back 1 <sup>st</sup> tiptoe walking 2 <sup>nd</sup> heels walking 3 <sup>rd</sup> heel strike, put down the whole foot and finish with anterior foot load 4 <sup>th</sup> backward running 5 <sup>th</sup> low impact skipping 6 <sup>th</sup> backward skipping on right leg 7 <sup>th</sup> backward skipping on left leg 8 <sup>th</sup> wide strides with jump self-righting each touchdown 9 <sup>th</sup> progressive with wide strides and low frequency 10 <sup>th</sup> progressive with high frequency strides and short strides Continuous running R1 until starting to stretch. 10' <b>Back to calm:</b> Stretching

R1–R5 – continuous running rhythm from light aerobic capacity (1) to high aerobic capacity (5), FC – front crawl, Ba – backstroke, Br – breaststroke, HIIT – high intensity interval training, RIR – repetitions in reserve



**Figure 1.** VO<sub>2</sub>max level of Spanish naval cadets according to academic year (pre-post)

difficult to pass than the calisthenics portion, candidates should look to achieve 30 min per day of vigorous activity if they wish to increase their chance of passing the physical fitness test. This follows the exercise recommendations issued by the American College of Sports Medicine on improving health [4].

In the case of the physical training programme carried out at the MNAM and in response to the main objective of maintaining and training the physical and cardiovascular fitness of cadets, and preparing them for the biannual physical fitness tests, this programme is organised by giving relevance to different aspects of physical conditioning. The content of the programme focuses, in the first semester, on running training (3 out of 5 days), strength power circuit (1 day) and swimming (1 day). In the second semester, the programme focuses on running training (3 out of 5 days) and strength power circuit (2 days), without including the previous semester's specific swimming training. There does indeed seem, therefore, to be coherence between the tests used to assess physical fitness and the training programme carried out.

Emphasis in the military has traditionally been placed on the long-distance run, which is one of the simplest and cheapest forms of training that large groups can do in almost any environmental conditions, with little or no formal knowledge or understanding of the principles of physical training [7]. However, the test with the longest duration used in the current battery of tests is the 1000 m race, which is supposed to assess cadets' stamina, but this test is at the lower limit of assessing this data field. In other studies, the

VO<sub>2</sub>max is assessed based on tests that include a minimum of 1600 m [17], in some cases up to 3000 m in specific physical fitness protocols [18], and in a few cases nearly 4800 m [10], with the most commonly adopted distance being the 2400 m used by the American Navy and the British Royal Navy [3, 17]. Wilkinson et al. [19] in their study observed a direct correlation between the 2400 m race and the multistage fitness test, these representing a practical means of assessing aerobic fitness when space is limited. But in the case of the tests carried out in the MNAM, the longest distance test used is 1000 m and no multistage fitness test is included. In Dada et al. [1], as the APFT was used to assess the physical fitness of the sample, a 2 min sit ups and a 2-mile (3218.69 m) run were included in the measurements. Neither the 2 min sit ups nor the 2-mile run are included in the MNAM fitness tests; however, because the longest run included in the MNAM tests is a 1000 m race, and performance over the two different running lengths would probably be remarkably different because they involve different patterns of energy production.

In other military forces, such as the Norwegian Navy Special Operation Forces, for example, physical training is focused on aerobic endurance, through running and local muscular endurance training (bodyweight circuit training) [7, 18], a situation similar to that carried out in the MNAM. This type of training, as is more generally reflected in different public health guidelines, is characterised by prolonged periods of continuous exercise at a moderate-intensity pace [7]. Currently, however, the Norwegian Navy Special Operation Forces are taking a new approach to conform with new

demands and organizational modifications because it has been observed that an exclusive combination of mixed endurance-based training, without any individualization, does probably not provide the optimal stimulus to improve other capacities such as strength and power [18, 20]. The reason for developing a new anaerobic work capacity test for the Norwegian Navy Special Operation Forces was due to the lack of a valid, specific, and easily implemented anaerobic work capacity test for its force operators in the literature. The test simulates a scenario in which an operator must run a set distance and evacuate a person by dragging them out of the “danger zone.” This scenario was chosen because it could be easily replicated, and the movement-pattern, external load, and muscles recruited are similar to those necessary in many critical “anaerobic” combat situations [20].

Interval training could be adapted to conform to the reality in which the cadets present different levels of physical fitness and thus ensure that all members of a given unit benefit equally from the quality training time that is designed to prepare them for the demands of their missions [7]. In the case of the MNAM physical training programme, both the first and second semester include 1 day of interval training, which involves a reduced training volume and time when compared with traditional endurance training, as mentioned by Gibala et al. [7].

Considering upper train force, the Army Soldiers in Basic Combat Training and operational units of the USA Army participated in the study by Dada et al. [1] and the authors observed an average measurement for 2 min push ups of  $34.9 \pm 14.8$  repetitions for the men of age group 17–21, and  $36.3 \pm 14.8$  for the men of age group 22–26. In our study, the age groups analysed were different from those in the study by Dada et al. [1], but independently, higher values were observed, with average values of  $42.8 \pm 10.8$  and  $42.5 \pm 11.9$  recorded for age groups 18–19 and 20–21, respectively, and  $42.6 \pm 11.1$  and  $42.7 \pm 10.7$  for age groups 22–23 and > 24, respectively, though in our case, in the analysis by age group both men and women were included.

In the study by Groeller et al. [8] carried out on a sample of 51 Australian soldiers from 5 different specialities (infantry, armoured, combat engineers, artillery and transport trades) during their basic military training and initial employment training, different physical aspects were assessed, including 2 min push ups and vertical jump. In the case of the vertical jump measurement, data was taken using a portable force platform and the force applied was measured in N, this being different from the methodology employed in the current work and making data comparison impossible. However, measurement on 2 min push ups repetitions reached similar values to ours in the first assessment: 41.1 cm (37.5–44.7), but values observed after the basic military training: 49.7 cm (47.0–52.4) and

after initial employment training: 57.5 cm (54.4–60.6), were superior than those observed for our sample:  $(42.7 \pm 11.8)$ , a fact which could be explained by more focussed training on this specific ability.

Even when we considered other military naval forces, we failed to find any bibliographical evidence of other physical fitness protocols which include swimming in their tests. It is important to stress that we did not consider this factor because, in the case of the MNAM, they do not take physical performance in swimming to be critical: their physical training protocol only includes swimming once a week in the first semester; the 50 m swimming test has a cut off time to pass of over 50 s, and the average times achieved by the cadets is around 35 s.

Finally, a limitation to the internal validity of this study lies in the fact that some of the cadets do not perform in the tests at their maximum capacity because those who reach the minimum marks required for each academic year do not necessarily seek the best performance in the different tests. In addition, another limiting aspect when it comes to being able to trace and relate the physical condition of MNAM cadets is that their 1000 m test differs from other armies that focus their endurance tests on distances close to 2500 m [3, 17]. Another aspect that may compromise the external validity of our study is the fact that the protocol described for the evaluation of vertical jumping, for example, and that's still used in the Spanish Army are not currently those used in the sports and health field and it would be necessary to update the protocol and tool to be used to enable comparison with samples of similar characteristics (other military personnel, local police, firefighters, ...); however, not committing the internal validity of the same. However, it should be noted that access to the important sample of MNAM and the knowledge of its training protocol enables the initial recognition of possible adaptations necessary in both the physical condition evaluation protocol and the training protocol itself in the near future.

## CONCLUSIONS

The level of physical fitness of cadets at the MNAM appears to be at an acceptable level when compared to that of other countries' military naval corps. However, it is of importance to consider adjusting the physical training protocol so it is more in line with the fitness tests employed and the subsequent demands that such military personnel will face in garrison and deployed environments.

The authors' point is that not only is it important to assess the physical fitness of military personnel on the basis of the tests included in the Physical Fitness Testing Protocol, but also to adapt to new situations as they arise and to stop and reflect on whether the tests currently being used assess the aspects of physical fitness that they should.

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## AVAILABILITY OF DATA AND MATERIALS

The datasets generated and analysed during the current study are not publicly available as they considered to be national documents.

## CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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# Dermatological diseases in seamen's lower extremity: a prevalence study

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## ABSTRACT

**Background:** Little is known about the impact of occupational seafaring on lower limb conditions. The aim of the study was to estimate the prevalence of dermatological diseases affecting the feet and lower extremities of seafarers, as well as the possible impact of working conditions on the development of the pathologies analysed.

**Materials and methods:** A prevalence study was performed through self-completed questionnaires at the "Instituto Social de la Marina" (ISM) centres at A Coruña, Ribeira, Noya and Cádiz (Spain). Sociodemographic, anthropometric and podiatric variables, as well as the type of maritime sector, duty on board and, working footwear, were studied ( $n = 137$ ). The study has been approved by the Ethics Committee of the University of A Coruña (CE 13/2016).

**Results:** The average age of the study subjects was  $45.71 \pm 9.90$  years and the number of years sailed was  $20.31 \pm 11.64$  years. The most prevalent pathologies were mycosis (21.9%), helomas and tylomas (29.9%) and hyperhidrosis (17.5%). A statistically significant relationship was obtained between pruritus and scabies ( $p \leq 0.000$ ), xerosis ( $p \leq 0.005$ ), eczema ( $p \leq 0.000$ ), obesity ( $p \leq 0.018$ ) and psoriasis ( $p \leq 0.005$ ). A significant relationship was also found between onychocryptosis, and psoriasis ( $p \leq 0.000$ ). Frequency with which the study participants have visited the podiatrist was significantly related to the presence of helomas and tylomas ( $p \leq 0.013$ ) and hyperhidrosis ( $p \leq 0.025$ ).

**Conclusions:** A high prevalence of diverse dermatological diseases has been found, revealing the importance of podiatric assessment in sea workers prior to boarding.

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**Key words:** foot diseases, skin diseases, sea workers, dermatology, clinical research

## INTRODUCTION

It is widely known that working conditions of sea workers have a very negative effect on their health and well-being. In spite of the improvement of working conditions (protective clothing, footwear, health education), in recent decades, there are a number of risk factors associated with the job that cannot be avoided, such as working in confined spaces and on mobile platforms, exposure to harsh environmental conditions (e.g. cold weather, high humidity or extreme heat), high physical workloads, family and social isolation and distance from health care centres. The presence of

the aforementioned risk factors has led to the introduction of occupational health and safety measures to protect sea workers [1]. Nevertheless, little is known about the impact of the sea work on foot and lower limb conditions; therefore it is necessary to carry out further studies from a podiatry perspective.

This study was performed to determine the prevalence of dermatological diseases in lower extremities of sea workers, as well as the possible relationship among the analysed diseases. We have studied the potential relationship between the pathologies identified and the age of study participants,

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**Table 1.** Descriptive analysis of the sociodemographic variables

	Mean $\pm$ SD	Median	Maximum	Minimum
Age [years]	45.71 $\pm$ 9.90	47	66	22
Weight [kg]	81.13 $\pm$ 14.78	80	126	55
Size [m]	1.72 $\pm$ 0.07	1.73	1.90	1.48
BMI [kg/m <sup>2</sup> ]	27.15 $\pm$ 4.33	26.23	42.59	18.95
Sailing years	20.31 $\pm$ 11.64	20	47	1

BMI – body mass index; SD – standard deviation

their body mass index (BMI), years of service, type of ship, the number of pathologies and whether or not they have received treatment.

## MATERIALS AND METHODS

A descriptive study of prevalence was carried out.

Data collection was performed through self-completed questionnaires delivered to workers in “Instituto Social de la Marina” (ISM) centres at A Coruña, Noya, Ribeira and Cádiz, which are representative concerning seafarers’ population in Spain. The data were collected in April and May 2017 and were then analysed before the end of 2017.

The study included only those workers who passed the medical check-up previous embarkment in the selected centres and provided written informed consent prior to data collection (they agreed to participate in the study voluntarily), were all adults (> 18 years) and were working at sea at the time of study performance (either in the fishing or merchant sector).

The questionnaire was delivered by the doctor when workers were going to do the medical test. This medical test was performed prior to shipment. When participants returned to the doctor to know the results of the medical check-up, they could submit the completed questionnaires. The participants were informed that they could only cover in the questionnaire the diseases that had been previously diagnosed by a health professional.

The variables studied included: sociodemographic variables (age and gender), anthropometric variables (weight in kilograms, height in centimetres and BMI [2]), maritime sector in which the study participants worked (fishing or merchant fleet), duty on board (officer, deck, etc.), working footwear, pathology (location, treatment and progression) and the frequency with which they visit a podiatrist.

Dermatological conditions studied have been selected in line with the tenth revision of the International Statistical Classification of Diseases and Morbid States criteria and the International Classification of Diseases [3, 4].

In relation to the ethical-legal aspects, the Ethics Committee of the University of A Coruña approved the study project (EC 13/2016). At a local level, the Provincial Direc-

torate of ISM at A Coruña, was requested to distribute the questionnaires to the ISM centres in the cities of A Coruña, Noya and Ferrol, and to the provincial directorate of the ISM of Villagarcía for the centre of Ribeira; ISM at Cadiz was also asked to collaborate.

Although the questionnaires were anonymous, the participants were asked for informed consent, which stated that all data would be used for research purposes only and in accordance with the Valid Data Protection Act [5].

Regarding the sample size, 137 subjects have been studied, which allowed us to estimate the parameters of interest with a confidence interval of 95%, a precision of  $\pm$  4% and a risk  $\alpha$  = 0.05.

## STATISTICAL ANALYSIS

A descriptive analysis of the variables included in the study has been carried out. To relate the different variables to each other, the  $\chi^2$  or t Student test has been used. P-value of less than 0.05 was considered statistically significant. Data analysis was performed using the IBM SPSS 21 statistical package for Windows.

## RESULTS

Description of the sociodemographic variables analysed in the study is shown in Table 1. A total of 137 workers have been studied, of which 92% were men and 8% were women.

The average age of the study participants was 45.71  $\pm$  9.90 years with the minimum age of 22 years and the maximum age of 66 years.

Following the criteria of the Spanish Society for the Study of Obesity (SEEDO) [2], we have estimated that 34.1% of subjects had normal body weight, 42.0% were overweight and 23.9% had obesity.

In relation terms of the type of vessel on which they were employed, 25.5% of individuals worked in Merchant Navy, 40.1% in high fishing, 26.3% in coastal fishing and 8% served on various types of vessels throughout their working life.

Wearing special working footwear was declared by 92.7% of the workers. Regarding the type of footwear used, 51% used half-leg rubber boots and 41.6% used safety boots.

**Table 2.** Descriptive analysis of dermal and unguinal diseases of the foot studied

	Yes		No	
	N	%	N	%
Contact dermatitis	1	0.7%	136	99.3%
Allergic dermatitis	3	2.2%	134	97.8%
Eczema	4	3%	137	97%
Pruritus	14	11%	123	89.8%
Mycosis	30	21.9%	107	78.1%
Scabies	2	1.5%	135	98.5%
Moluscum contagiosum	0	0%	137	100%
Onychomycosis	9	6.5%	128	92.8%
Warts	7	5.1%	130	94.9%
Plantar warts	5	3.6%	137	96.4%
Cellulitis	3	2.2%	134	97.8%
Boil	5	3.6%	132	96.4%
Onychopathy	12	8.8%	125	91.2%
Onychocryptosis	6	4.4%	131	95.6%
Helomas and tylomas	41	29.9%	96	70.1%
Xerosis	22	16%	115	83.9%
Moles	3	2.2%	134	97.8%
Varicose ulcers	8	5.8%	129	94.2%
Hyperhidrosis	24	17.5%	113	81.9%
Pink pityriasis	1	0.7%	136	98.6%
Stings	10	7.2%	127	92%
Others	6	4.3%	131	96.2%

As regards the question on the frequency of podiatry consultation, only 6 (4.4%) workers reported that they have often consulted a podiatrist, 26 (19%) subjects sometimes consulted a podiatrist and the vast majority – 105 (76%) subjects have never had a podiatric consultation.

Table 2 shows the descriptive analysis of the dermal and unguinal conditions of the foot which have been studied.

As can be seen in the Table 2, the most frequent pathologies have been helomas and tylomas, 41 (29.9%) cases, mycosis, 30 (21.9%) cases, and hyperhidrosis, 24 (17.5%) cases. Note that no cases of molluscum contagiosum have been identified.

The location of the pathologies discussed in the study can be seen in Table 3. One of the significant findings was that scabies often involved the feet and legs, which leads to a conclusion that the lesions have not been treated.

Table 4 shows the number of individuals who have or have not received podiatric treatment (including those

who might have received treatment but failed to report the fact).

It must be underlined that despite a high prevalence of helomas and tylomas, mycosis and hyperhidrosis, the results show that only 34.2% of workers with helomas and tylomas, 37.5% of those with hyperhidrosis and 63.4% with mycosis, have been treated. In contrast, rare pathologies such as cellulite have been treated in 100% of cases. If the total number of workers is considered, regardless the pathology they suffered, it was found that only 16% have been treated or were being treated.

On the other hand, when the relationship between non-dermatological and dermatological variables is studied, the results are as follows:

- sailing years vs. the presence of varicose ulcers ( $p < 0.021$ ) and hyperhidrosis ( $p \leq 0.040$ );
- type of ship vs. eczema ( $p \leq 0.001$ ) and onychocryptosis ( $p \leq 0.001$ );

**Table 3.** Location of disease

	Location	N	%
Contact dermatitis	Legs	1	0.7%
Allergic dermatitis	Legs	1	0.7%
	Ambos	2	1.5%
Eczema	Legs	2	1.5%
	Ambos	2	1.5%
Pruritus	Legs	3	2.2%
	Feet	6	4.4%
	Legs and feet	5	3.6%
Mycosis	Legs	3	2.2%
	Feet	27	19.7%
Scabies	Legs and feet	2	1.5%
Onychomycosis	Feet	9	6.6%
Warts	Legs	7	5.1%
Plantar warts	Feet	5	3.6%
Cellulitis	Legs	2	1.5%
	Legs and feet	1	0.7%
Boil	Legs	5	3.6%
Onychopathy	Feet	12	8.7%
Onychocryptosis	Feet	6	4.4%
Helomas and tylomas	Feet	41	29.9%
Xerosis	Legs	4	2.9%
	Feet	5	3.6%
	Legs and feet	13	9.5%
Moles	Feet	1	0.7%
	Legs	2	1.5%
Varicose ulcers	Legs	8	5.8%
Hyperhidrosis	Feet	24	17.5%
Pink pityriasis	Legs and feet	1	0.7%
Stings	Legs	6	4.4%
	Legs and feet	4	2.9%
Others	Hidradenitis	1	0.7%
	Psoriasis	4	2.9%
	Varicose veins	1	0.7%

- increased incidence of helomas and tylomas vs. rare podiatrist consultations ( $p = 0.013$ );
- hyperhidrosis vs. rare podiatrist consultations ( $p \leq 0.025$ );
- boils vs. obesity ( $p \leq 0.011$ );
- obesity vs. pruritus ( $p \leq 0.018$ ).

According to the available literature, there is a statistically significant relationship among some of the pathologies studied. The same relationships have been identified in the current study; we have found the following:

- the presence of pruritus is significantly associated with scabies ( $p \leq 0.000$ ), xerosis ( $p = 0.005$ ), eczema ( $p \leq 0.000$ ), and psoriasis ( $p \leq 0.005$ );
- the presence of psoriasis is significantly associated with

onychocryptosis ( $p = 0.000$ ), xerosis ( $p \leq 0.047$ ), and eczema ( $p \leq 0.000$ );

- BMI falling within the obesity range is significantly related with the presence of boils ( $p \leq 0.011$ ) and mycosis ( $p \leq 0.18$ ) [5].

Regarding the number of pathologies affecting individual subjects throughout their working life (sample size 137 subjects), 45 (32.6%) have not reported any of the pathologies raised in this study. However, 93 (67.8%) subjects have experienced some type of pathology affecting the lower limb; 57 (61.2%) have experienced at least two pathologies compared to the remaining 38.8% (36 people) who only manifest at the time of the study or manifested in the past a pathology.

It is worth mentioning that one seaman who has had 8 different pathologies throughout his working life.

Finally, note that of the 93 people who reported the presence of the lower limb pathologies, 58 (62.3%) still have the medical condition they have reported, and only 29 (37.6%) have been successfully treated.

## DISCUSSION

This study is one of a few on the subject carried out in the maritime sector at a national level; therefore, little information and limited bibliography is available.

The discussion part of the article evaluates concordance of the results we have obtained with study findings by other researchers on the same subject.

- **Contact dermatitis** [6–8]: Contact dermatitis affects 1.3% of the population of the United States. The present study has found the prevalence of contact dermatitis to be 0.7%; this lower rate could be associated with the mandatory use of protective measures at work [9–11], leaving other body parts not included in the present investigation more exposed.
- **Allergic dermatitis**: Recent studies have shown that the prevalence of allergic dermatitis in different regions of Europe is around 1% [12]. This study has demonstrated the prevalence of 2.2%, possibly due to more common exposure to irritants, limited use of appropriate prevention measures and, in some cases, contact with marine animals [13].
- **Eczema**: The present study found that the prevalence of eczema was 3%, and we have not found any other similar studies into the prevalence of eczema in adults [14]. We have identified a direct relationship between the presence of eczema and pruritus ( $p \leq 0.000$ ) (pruritus is considered one of the symptoms of eczema [14, 15]) as well as psoriasis ( $p \leq 0.000$ ). Our findings are similar to the results of several other studies in this respect.
- **Pruritus**: Pruritus can be attributed to several dermatological causes, such as atopic dermatitis, contact

**Table 4.** Diseases and treatment

	Diagnosis (n)	No treated (n)	Treated (n)	Treatment	Do not know, no answer (n)
Contact dermatitis	1	1			
Allergic dermatitis	3	1	1	Corticoid	1
Eczema	4	3			1
Pruritus	14	12			2
Mycosis	30	11	9	Antifungal	10
Scabies	2		1	Antiparasitic	1
Onychomycosis	9	6			3
Warts	7	4	2	Surgery, cryotherapy	1
Plantar warts	5	1			4
Cellulitis	3		2	Antibiotic	1
Boil	5	1	2	Antibiotic	3
Onychopathy	12	9	1	Chiropody	2
Onychocryptosis	6	2	1	Chiropody	3
Hyperkeratosis and helomas	41	27	9	Chiropody, plantar orthosis and surgery	5
Xerosis	22	9	11	Emollient	2
Moles	3		3	Surgery, cryotherapy	
Varicose ulcers	8	5	1	Surgery	2
Hyperhidrosis	24	15	4	Antifungal, astringent	5
Pink pityriasis	1	1			
Stings	10	7	2	Corticoid	1
Others	6	3			3

dermatitis, xerosis, eczema or scabies [16]. A significant relationship was found between the presence of pruritus and scabies ( $p \leq 0.000$ ), xerosis ( $p \leq 0.005$ ), eczema ( $p \leq 0.000$ ), as was demonstrated in the Herade and Urbina study [16]. In addition, pruritus may be a sign of dermatological diseases such as atopic dermatitis and psoriasis; the present study has found a relationship between pruritus and psoriasis ( $p < 0.005$ ).

- **Mycosis:** The use of non-breathable footwear, extended working hours, and exposure to excess humidity at sea result in a high incidence of tinea pedis in individuals wearing occlusive footwear [17–19]; exogenous transmission of mycosis in susceptible individuals is common under the above-listed conditions [20, 21].
- The World Health Organization (WHO) states that the overall prevalence of superficial mycoses is very high, affecting between 20% and 25% of the general population, the condition is more frequent in humid climates [22]. A total of 21.9% of the subjects involved in this study reported either past or present history of mycosis, which is consistent with the WHO data.

- **Scabies:** Scabies, like mycosis, can be spread by direct or indirect contact through the use of common objects [23]. Although the study did not find a high prevalence of scabies among the participants (1.5%), it should be noted that some authors have attributed a higher prevalence of scabies to high humidity (air humidity is naturally higher at sea) and warm climates (some shipping routes pass through hot climate regions).

- **Onychopathies:**

- **Onychocryptosis:** According to the consulted bibliography, onychocryptosis is significantly associated with hyperhidrosis [24]; this relationship, however, has not been confirmed by the results of this study. No significant association was found between the occurrence of onychocryptosis and the use of safety footwear, although we have identified a relationship between this pathology and psoriasis ( $p \leq 0.000$ ).
- **Onychomycosis:** The present study found that the prevalence of onychomycosis was 6.5%. The findings in this respect are incompatible with the available literature [25, 26].

- **Warts and plantar warts:** There is no available literature on the prevalence of plantar warts in adults which could serve as the basis for comparison (the prevalence of cutaneous warts in adolescents has been estimated at 0.8–22%). According to the literature consulted [27–29], low prevalence of warts and plantar warts might be attributable to stronger immunity in adults.
  - **Cellulite:** There are no updated studies on the prevalence of cellulite in the working population [30]. The prevalence of cellulite in our study was found to be 2.2%.
  - **Bound:** Several studies [31] have suggested that obesity is associated with the increase in the prevalence of this pathology; our study findings are similar in this respect ( $p \leq 0.011$ ).
  - **Helomas and tylomas:** The current study showed the prevalence of helomas and tylomas at 29.9%. In older individuals [32], the prevalence was found to be 20.8%; however, because of significant differences between the two populations, the comparison is not useful. The high incidence of the pathologies can be due to the use of wrong footwear and difficult working conditions, for example, standing on mobile platforms for long hours, which causes changes in foot biomechanics and static foot posture, which in turn can cause overload in different areas of the foot.
  - **Xerosis [33]:** Xerosis was found to be one of the most prevalent diseases among the study subjects, affecting 16% of the sample. Interestingly, 40.9% of the affected workers who suffer from it are not following any treatment. The prevalence of xerosis in the elderly population is 66.7% [32], but this population group cannot be compared to our study sample because work-related xerosis could be caused by exogenous factors, whereas in the elderly it is normally age-related.
  - **Premalignant and malignant moles:** According to the American Cancer Society [34], melanomas represent 1% of all skin cancers. In the current study, the prevalence of premalignant and malignant moles was 2.2%, which is higher than in the previously mentioned study. This higher prevalence may be due to more frequent exposure to sun radiation in this group of workers.
  - **Varicose ulcer:** The prevalence of venous ulcers in people over 65 years is estimated at 5.6% [35]. In the current study it was found to be 5.8%, of which 62.5% cases were left untreated. The explanation for a higher prevalence of varicose ulcer in the study sample may be the working conditions, i.e. working in a standing position for long hours.
  - **Hyperhidrosis:** In the literature reviewed, we have found that the condition is present in 2.8% of the population in the United States population [36]. In comparison, we found that hyperhidrosis affected 24 of the study subjects (17.5%), which is particularly alarming.
  - **Pityriasis rosea:** In the literature, the prevalence of pityriasis rosea is estimated at 0.36% [37, 38] in dermatological patients [39, 40]. In the present study, only one person manifested this pathology, which represents 0.7% of the sample (a higher percentage than in the referenced studies), possibly due to the age range of the workers involved in the current study.
  - **Psoriasis:** This pathology cannot be associated with working conditions but rather with the development of other diseases, or the occurrence of certain precipitating factors such as traumas, which are quite frequent among sea workers [41]. It affects between 0.1% and 3% of general the population [42] but our study showed a prevalence of 3%, which is consistent with the data found in the literature consulted.
- As for the treatment of pathologies, the results of the study show that not all cases of the more frequent pathologies, such as mycosis, helomas, tylomas and hyperhidrosis, have been treated, unlike cellulitis. This may be due to the fact that the diseases mentioned in the first place are not incapacitating and do not prevent embarking, while in the case of cellulitis, due to its seriousness, a worker would be declared unfit for boarding.
- In spite of this, other pathologies should not be downplayed, since they can also lead to more serious problems.
- Taking into account the discussion recently presented, it is possible to objectify what has been similarly highlighted in other investigations [43–45], which is the important relationship between working conditions at sea and health problems at the skin level [45]. For this reason, these aspects have been studied for some time, although this study focuses on the podiatric level. Although there is more research, it has been observed that there is a scarcity of epidemiological studies in Latin America in contrast to other more developed countries [44].
- On the other hand, the literature review developed by Jensen et al. [44] highlights the importance of doing studies about occupational health problems, giving special relevance to skin lesions, with the aim of developing prevention systems [44, 45].
- All these aspects and the results of our study also agree with the research carried out by Loddé et al. [46], in which they state that the maritime environment constitutes a risk factor for the development of skin conditions, causing pathologies of great relevance and severity [46].

## LIMITATIONS OF THE STUDY

Concerning the limitations of the study, it is necessary taking into account that weight and height are estimated by the worker himself, and therefore do not provide a reliable BMI. This is because there is a tendency to say that we are taller and lighter than we are.

Although the questionnaire was covered by the worker himself, the doctor who developed the medical check-up, explained them that they could only cover in the questionnaire the diseases that had been previously diagnosed by a health professional.

Regarding the healthy worker effect in our results, it is necessary to mention that only healthy seafarers can embark, so the sample studied did not present important systemic pathologies. Likewise, this study is a descriptive observational study of prevalence, in which the aim is to estimate the characteristics of the sample in relation to the objective of the study previously described.

## CONCLUSIONS

As can be seen from the article, we have found that the variety and prevalence of in the study population is higher than in the general population.

It is worrisome that a large number of workers presenting with dermatological conditions do not receive appropriate treatment. Although some of these conditions are not extremely serious, they can have a negative impact on a worker's quality of life (both the condition of their feet and their general condition).

If we add to the above that a vast majority of the sea workers have never had a podiatrist consultation and that there is no podiatric assessment protocol when performing the medical examinations prior to boarding, we consider that it would be necessary to include the podiatric consultation in the said occupational fitness assessments.

Due to an increased incidence of premalignant and malignant moles, it would be advisable to conduct awareness campaigns among sea workers to remind them of the necessity to periodically check their lower limbs for any newly appearing or changing moles.

## CONFLICT OF INTEREST AND SOURCES OF FUNDING

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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# Knowledge, attitudes and practices regarding rabies among community members: a cross-sectional study in Songan Village, Bali, Indonesia

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## ABSTRACT

**Background:** Rabies is a preventable yet endemic zoonotic disease caused by a neurotrophic virus, a member of Rhabdoviridae family. Rabies remains a public health threat in Indonesia, specifically Bali Province. The present study aimed to understand the knowledge, attitudes and practices (KAP) regarding rabies among community members in Songan Village, Bali, Indonesia.

**Materials and methods:** We conducted a cross-sectional survey using a structured questionnaire among 175 community members residing in the administrative area of public health centre of Kintamani V in Songan Village of Bangli District, from December 2019 to February 2020. Statistical analyses were performed with SPSS software, version 21.

**Results:** Of the 175 community members, 53 (30.3%) owned a dog. Majority of the respondents were Hindu (98.8%), female (56.0%), aged  $\geq 29$  years old (54.9%), with an educational background of higher secondary (28.6%), residing in Songan A and B residential village (86.9%), working as farmers (50.9%), with the level of income less than district minimum wage (71.4%). The KAP scores mean  $\pm$  standard deviation were  $6.93 \pm 1.83$  and  $8.04 \pm 1.07$  (out of 10), respectively. Multivariable logistic regression models were constructed and the KAP of the community members was found to be significantly influenced by occupation ( $p$ -value  $< 0.05$ ).

**Conclusions:** Albeit community members demonstrated some level of KAP regarding rabies, overall, this study revealed critical gaps in their fundamental knowledge of rabies, the prevention in dogs, and the local rules and regulations concerning rabies. In accordance with One Health Approach, further enforcement on the collaborative efforts for comprehensive education programmes, scheduled mass vaccination for dogs, and promotion for healthier attitudes and practices are recommended.

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**Key words:** knowledge, attitude, practice, rabies, Bali

## INTRODUCTION

Rabies, a zoonotic disease, is caused by a neurotrophic virus member of the *Lyssavirus* genus and *Rhabdoviridae* family. This disease is mostly spread through the bite of an infected dog [1]. Globally, domestic dogs contributed over 95% of approximate 59,000 human rabies deaths annually

in more than 150 countries, with the highest burden of disease in parts of Asia and Africa [2]. Regionally, in South-East Asia, over 3 billion people were affected with dog rabies and more than 30,000 deaths occur annually with a mortality rate of one per 15 minutes, and nationally, in Indonesia, only nine out of 34 provinces are rabies-free province [3, 4].

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According to the Ministry of Health of the Republic of Indonesia, within 5 years (2011–2015), the rate of dog bite cases per year was 78,413 cases with 65,534 cases receiving the anti-rabies vaccine [4]. In 2019, Bali Province ranked first for dog bite cases with 38,187 cases, followed by Nusa Tenggara Timur Province with 13,599 cases [5]. Bangli was recorded as one of Bali Province districts with high dog bite cases [6].

In Indonesia, the Ministry of Health has established rabies elimination strategy by 2020 through integrated strategy using the One Health Approach engaging multiple stakeholders with advocacy and socialisation, mass immunisation and population management towards dogs, and pre- and post-exposure prophylaxis with the anti-rabies vaccine as several of the listed strategies. This strategy is in line with the global “Zero by 30”, a global action to attain zero human deaths from dog-mediated rabies by 2030, which is supported by the World Health Organization (WHO), World Organization for Animal Health (OIE), Food and Agriculture Organization of the United Nations (FAO), and Global Alliance for Rabies Control (GARC) [7]. Following this strategy, community members serving as one of the stakeholders, further assessing rabies understanding, were pivotal, and one of the methods that can be used to evaluate is through knowledge, attitudes and practices (KAP) studies. Nevertheless, in Indonesia, only a few reports have been published and data concerning KAP in Bali were limited or not made readily accessible. To address this, we developed this research to assess knowledge, attitudes and practices towards rabies in Songan Village of Bangli District, Bali Province, Indonesia.

## PARTICIPANTS

The present study adopted a purposive cross-sectional design with the enrolment of 175 community members presenting to the public health centre (PHC) of Kintamani V from December 2019 to February 2020. The PHC of Kintamani V includes 35 *banjars* (sub-villages) and animals suspected of rabies (free-roaming dogs [FRDs], cats, monkeys, and bats) were spread throughout the *banjars*. Therefore, all the community members were a population at risk for rabies infection.

The sample size was calculated using Cochran's sample size formula for categorical data [8]. Allowing a confidence interval (CI) and a margin of error of 95% and 10%, respectively, the minimum sample size (N) of community members required for this study was 96 community members.

$$N = \frac{Z\alpha^2PQ}{d^2} = \frac{(1.96)^2(0.5)(0.5)}{(0.1)^2} = 96$$

The study's inclusion criteria were: 1) community member who resided and were recorded as community members

in PHC of Kintamani V ( $\geq 17$  years of age), 2) communicative, and 3) agreed to participate in the study, while the exclusion criteria were 1) community members who do not reside and are not recorded as community members in PHC of Kintamani V.

## MATERIALS AND METHODS

### STUDY AREA

The study was carried out in the PHC of Kintamani V in Songan Village of Bangli District, Bali Province, Indonesia. Songan Village ( $-8.230699, 115.407730$ ) is approximately 40 km north of Bangli district and 80 km North-East of Denpasar, capital of Bali Province. PHC of Kintamani V provides a range of health services to the population living in the area of Songan (Songan A and B) Village, Pinggan Village, and Belandingan Village (approximately 3,400 households with 22,000 people in 2017) and is the only centre offering post-exposure prophylaxis (PEP) for humans bitten by animals suspected of rabies in and around this area. No rabies awareness campaign or dog population control measures had been conducted recently in the past year in the area before this survey.

### QUESTIONNAIRE DESIGN

The knowledge, attitudes and practices (KAP) study were constructed to assess; 1) the awareness and knowledge about rabies, 2) the attitude and health-seeking practice regarding rabies, and 3) the attitude and practice which may have led to the village's persistence of the disease. The structured questionnaire consisted of closed questions on: 1) sociodemographic data (gender, age, religion, educational status, occupation, and income levels); 2) general questions regarding awareness about rabies, attitudes and practices towards dogs, and local rules and regulations concerning rabies; 3) knowledge of rabies (ten questions); and 4) attitudes and practices towards rabies (ten questions). The questionnaire's content validity was demonstrated since the questionnaire was developed based on expert consensus and international guidelines.

The respondents were orally informed about the study's purpose, emphasizing voluntary participation, confidentiality, and informed written consent was obtained prior to the interview. The questions were read out to the respondents in the local language (Bahasa Indonesia) by the interviewer and their answers were recorded in English.

### ETHICAL CONSIDERATIONS

The study was reviewed and approved by the Ethics Committee of the Faculty of Medicine, Pelita Harapan University (Ref: 133/K-LKJ/ETIK/III/2020). The study was cleared by the Dinas Penanaman Modal dan Pelayanan Terpadu Satu Pintu, the provincial government of Bali Province and the district government of Bangli (Ref: 070/1106/IZIN-C/DISPMPPT).

## DATA MANAGEMENT AND ANALYSIS

The data collected from the questionnaires were entered into Excel files (Microsoft Excel, Microsoft Corp. Redmond, WA, USA). Descriptive and inferential analyses were performed. Statistical analyses were performed using Statistical Package for Social Sciences (SPSS) Statistics Version 21.0 (IBM Corp., Released 2012, Armonk, NY, USA). For analytical purposes, the respondents were dichotomised into two age groups based on the median age. The educational background was categorised into three divisions: 1) no formal education, 2) less than or equal to national basic level (1–9), 3) more than national basic level ( $\geq 10$ ). Occupation was also categorised into three divisions: 1) not working, 2) blue-collar/manual labour workers (farmer, labourer, fisherman, and entrepreneur), and 3) white-collar worker/administrative workers (employee and civil servant).

The respondents were categorised as having adequate or inadequate knowledge of rabies and positive or negative attitudes and practices regarding rabies based on the median score to the responses to the questions pertaining to the questionnaire's relevant sections. Potential factors associated with knowledge, attitudes and practice scores were identified using chi-square ( $\chi^2$ ) tests of associations.

Multivariable logistic regression analyses were conducted for each outcome variable, namely knowledge, attitudes and practices regarding rabies. This was done to understand the associations of outcome variables with the respondents' characteristics. Results that were statistically significant at p-value of  $\leq 0.25$  were then offered to multivariable logistic regression models. Variables with p-value of  $< 0.05$  were retained in the final model. The Hosmer-Lemeshow test assessed the model goodness-of-fit. The design, setting, analyses, and reporting of this study adhered to the STROBE guidelines for cross-sectional studies in epidemiology (**Supplementary File 1 – see journal website**) [9].

## RESULTS

### RESPONDENT'S CHARACTERISTICS AND AWARENESS OF RABIES

A total of 175 responses were collected, including 53 (30.3%) dog owners. The sociodemographic characteristics of the respondents are summarised in Table 1. Most respondents were Hindu (98.9%), female (56.0%), aged  $\geq 29$  years old (54.9%), with an educational background of higher secondary (28.6%), residing in Songan A and B Village (86.9%), working as farmers (50.9%), with the level of income less than district minimum wage (71.4%).

**Table 1.** Sociodemographic characteristics of the respondents (n = 175)

Variable/Category	N (%)
<b>Gender</b>	
Male	77 (44.0)
Female	98 (56.0)
<b>Age</b>	
Range (years)	17–64
Mean $\pm$ SD (years)	32.063 $\pm$ 10.681
< 29 years	79 (45.1)
$\geq 29$ years	96 (54.9)
<b>Residential village</b>	
Songan (A and B)	152 (86.9)
Belandingan	13 (7.4)
Pinggan	10 (5.7)
<b>Religion</b>	
Hinduism	173 (98.9)
Islam	2 (1.1)
<b>Educational background</b>	
No formal education	19 (10.9)
Primary (1–6)	37 (21.1)
Lower secondary (7–9)	27 (15.4)
Higher secondary (10–12)	50 (28.6)
Tertiary or higher	42 (24)
<b>Occupation</b>	
Not working	28 (16)
Farmer	89 (50.9)
Labourer	2 (1.1)
Fisherman	1 (0.6)
Entrepreneur	19 (10.9)
White-collar worker	18 (10.3)
Civil servant	18 (10.3)
<b>Level of income</b>	
< District minimum wage	125 (71.4)
$\geq$ District minimum wage	50 (28.6)

SD – standard deviation; the age groups were dichotomized at the median age, i.e., 29 years (< 29 years of age and  $\geq 29$  years of age)

### AWARENESS OF RABIES

Most respondents (90.9%) had heard of rabies through mass media (69 respondents, 43.4%), non-mass media (51 respondents, 32.1%), and a combination of both (39 respondents, 24.5%). More than half of the respondents (64.3%) had encountered rabid animals, and less than a fifth of the respondents (30 respondents, 17.1%) had a history of animal bites. Nevertheless, not all respondents (15 re-

**Table 2.** Respondents' knowledge, attitude and practice parameter of rabies

Knowledge parameter			Attitude and practice parameter		
Variable	Correct	Incorrect	Variable	Agree	Disagree
Definition of rabies	162 (92.6%)	13 (7.4%)	Thinks vaccination as the initial management after a dog bite	73 (41.7%)	102 (58.3%)
The major reservoir of rabies is a rabid dog	125 (71.4%)	50 (28.6%)	Thinks washing rabies wounds as the initial management	171 (97.7%)	4 (2.3%)
Other possible reservoirs of rabies (cat, monkey, and bats)	139 (79.4%)	36 (20.6%)	Thinks anti-septic application on the wound as the second step after wound washing	139 (79.4%)	36 (20.6%)
Pathogenesis of rabies	163 (93.1%)	12 (6.9%)	Thinks after wound washing, going to the PHC/hospital to obtain PEP	173 (98.9%)	2 (1.1%)
Sign and symptoms of rabies in a dog	157 (89.7%)	18 (10.3%)	Thinks dog need to be chained or caged to avoid rabies	160 (91.4%)	15 (8.6%)
Sign and symptoms of rabies in human	146 (83.4%)	29 (16.6%)	Thinks chained or caged dogs still require vaccination	169 (96.6%)	6 (3.4%)
Initial management of a dog bite	72 (41.1%)	103 (58.9%)	Thinks vaccinated dogs does not require special identification signage	69 (39.4%)	106 (60.6%)
Infection risk of rabies	162 (92.6%)	13 (7.4%)	Thinks FRDs should be culled	97 (55.4%)	78 (44.6%)
Prevention through vaccination of both human and dogs	23 (13.1%)	152 (86.9%)	Thinks a dog that has bitten several people has to be observed	170 (97.1%)	5 (2.9%)
Culling as a method of prevention for rabies spread	64 (36.6%)	111 (63.4%)	Thinks FRDs with abnormal behaviour should be reported to local authorities (health and livestock department)	170 (97.1%)	5 (2.9%)

FRDs – free-roaming dogs; PEP – post-exposure prophylaxis; PHC – public health centre

spondents, 8.6%) were aware of rabies infection's fatality. Lastly, only approximately one-third of the respondents (75 respondents, 32.9%) had heard of the local rules and regulations about dog and control of rabies. Of these, only 60% knew the rules and regulations.

### KNOWLEDGE, ATTITUDES AND PRACTICES REGARDING RABIES AND DOGS

The median score for correct responses towards rabies knowledge; attitudes and practices towards rabies were 7 and 8, respectively.

#### KNOWLEDGE TOWARDS RABIES

In general, the knowledge parameter of rabies was sufficient (Table 2). A large number of respondents answered correctly and identified dogs as the major host of rabies, followed by a similar proportion who knew other possible hosts of rabies (cat, monkey, and/or bat), as well as the pathogenesis of rabies, its sign and symptoms in both dog and human and infection risk of rabies. Nonetheless, their ignorance about the initial management, prevention through vaccination, and culling as a prevention method for the spread of rabies should be noted.

Statistically, the mean knowledge  $\pm$  standard deviation (range) score (out of ten) was  $6.93 \pm 1.83$  (1–10). The score was significantly higher in females aged < 29 years old with

an educational background of secondary and above who have heard of rabies, encountered animals suspected of having rabies, with no previous history of animal bites, and were aware of rabies infection's fatality. The association between sociodemographic characteristics and awareness of rabies reflected by the respondents' knowledge is presented in Table 3.

#### ATTITUDES AND PRACTICES TOWARDS RABIES

In general, a large proportion of respondents disagreed that vaccination/PEP is the initial management after a dog bite and agreed that washing rabies wounds is the initial steps of management followed by anti-septic application on the wound and going to the PHC/hospital to obtain PEP. Nearly all respondents agreed that a dog needs to be chained or caged and that vaccination is compulsory to avoid rabies. Furthermore, observation and report to the local authorities should be made for an FRD dog showing abnormal behaviour.

Statistically, the mean attitudes and practices  $\pm$  standard deviation (range) score (out of ten) was  $8.04 \pm 1.07$  (4–10). A similar result was obtained in females with an educational background of secondary and above who has heard of rabies, met rabid animals, with no previous history of animal bites, and was aware of rabies infection's fatality. In contrast, respondents aged  $\geq 29$  years old were showing more positive attitudes and practices towards rabies. The

**Table 3.** Respondents' knowledge, attitudes and practices stratified by their sociodemographic characteristic and awareness of rabies

Variable	Good knowledge (n = 78)	OR (95% CI)	P value	Positive attitudes and good practices (n = 125)	OR (95% CI)	P value
<b>Sex</b>						
Male	30 (39.0%)	1.0 [Reference]	0.186*	51 (66.2%)	1.0 [Reference]	0.178*
Female	48 (49.0%)	0.665 (0.363–1.218)		74 (75.5%)	0.636 (0.329–1.230)	
<b>Age [years]</b>						
< 29	40 (50.6%)	1.0 [Reference]	0.143*	53 (67.1%)	1.0 [Reference]	0.249*
≥ 29	38 (39.6%)	1.565 (0.858–2.857)		72 (75.0%)	0.679 (0.352–1.313)	
<b>Religion</b>						
Hinduism	77 (44.5%)	1.0 [Reference]	0.877	124 (71.7%)	1.0 [Reference]	0.500
Islam	1 (50.0%)	0.802 (0.049–13.032)		1 (50.0%)	2.531 (0.155–41.261)	
<b>Educational background</b>						
No formal education	5 (26.3%)	1.0 [Reference]		13 (68.4%)	1.0 [Reference]	
≤ National basic education	19 (29.7%)	2.425 (0.748–7.861)	0.14*	43 (67.2%)	0.664 (0.214–2.063)	0.479
> National basic education	54 (58.7%)	2.052 (0.964–4.369)	0.062*	69 (75.0%)	0.736 (0.346–1.565)	0.426
<b>Occupation</b>						
Not working	11 (39.3%)	1.0 [Reference]		19 (67.9%)	1.0 [Reference]	
Blue-collar worker	39 (35.1%)	4.033 (1.293–12.585)	0.016*	71 (64.0%)	18.830 (2.167–163.632)	0.008*
White-collar worker	28 (77.8%)	4.041 (1.519–10.750)	0.005*	35 (97.2%)	24.330 (3.058–193.574)	0.003*
<b>Income</b>						
< District minimum wage	47 (40.9%)	1.0 [Reference]	0.173*	74 (64.3%)	1.0 [Reference]	0.004*
≥ District minimum wage	31 (51.7%)	0.647 (0.345–1.212)		51 (85.0%)	0.319 (0.142–0.712)	
<b>History of hearing rabies</b>						
No	1 (6.3%)	1.0 [Reference]	0.001*	10 (62.3%)	1.0 [Reference]	0.407
Yes	77 (48.4%)	14.085 (1.817–109.195)		115 (72.3%)	1.568 (0.538–4.572)	
<b>Encounter with rabid animals</b>						
No	25 (39.1%)	1.0 [Reference]	0.266	41 (64.1%)	1.0 [Reference]	0.101*
Yes	53 (47.7%)	1.426 (0.763–2.664)		84 (75.7%)	1.745 (0.893–3.410)	
<b>History of animal bites</b>						
No	67 (46.2%)	1.0 [Reference]	0.339	99 (68.3%)	1.0 [Reference]	0.042*
Yes	11 (36.7%)	0.674 (0.299–1.517)		26 (86.7%)	3.020 (0.996–9.157)	

Table 3. cont. Respondents' knowledge, attitudes and practices stratified by their sociodemographic characteristic and awareness of rabies

Variable	Good knowledge (n = 78)	OR (95% CI)	P value	Positive attitudes and good practices (n = 125)	OR (95% CI)	P value
<b>Awareness of rabies infection fatality</b>						
No	3 (20.0%)	1.0 [Reference]	0.045*	6 (40.0%)	1.0 [Reference]	0.005*
Yes	75 (46.9%)	3.529 (0.959–12.985)		119 (74.4%)	4.354 (1.460–12.978)	
<b>Heard of the local rules and regulations</b>						
No	40 (40.0%)	1.0 [Reference]	0.160*	71 (71.0%)	1.0 [Reference]	0.885
Yes	38 (50.7%)	1.541 (0.842–2.819)		54 (72.0%)	1.050 (0.541–2.040)	
<b>Knew the local rules and regulations</b>						
No	55 (42.3%)	1.0 [Reference]	0.306	95 (73.1%)	1.0 [Reference]	0.412
Yes	23 (51.1%)	1.426 (0.722–2.815)		30 (66.7%)	0.737 (0.355–1.531)	
<b>Ownership of dog</b>						
No	35 (66.0%)	1.0 [Reference]	0.591	35 (66.0%)	1.0 [Reference]	0.298
Yes	90 (73.8%)	0.836 (0.436–1.606)		90 (73.8%)	0.691 (0.344–1.388)	

CI – confidence interval; OR – odds ratio; \* – Variables with  $p \leq 0.25$  in univariate analysis were further included in the multivariate analysis

association between sociodemographic characteristics and awareness of rabies towards the respondents' attitudes and practices is presented in Table 3.

## RESPONDENTS' ATTITUDES AND PRACTICES TOWARDS DOGS

In general, most of the respondents in this study are non-dog owners (122 respondents, 69.7%). The majority of the respondents (70.9%) believed that dogs were kept as pets and a minority (5.7%) agreed that dogs have economic value. A large proportion of the respondent (72.6%) believed that dogs should be kept in a cage or chained in their land property, while 14.9% and 9.1% believed that dogs should be allowed to roam freely in and outside their land property, respectively. Nevertheless, 6 (3.4%) respondents did not know how to pet a dog.

Out of the 53 dog owners, 46 (86.8%) respondents regularly vaccinate the pet dog, 35 (66.0%) respondents chained or built a special cage for the pet dog, yet 34 (64.2%) respondents let the pet dog roamed freely. In terms of hygiene, 47 (88.7%) respondents wash hands after contact with the pet dog. In terms of willingness to take action, the majority (88.7% and 69.8%) of the respondents were willing to observe and cull the pet dog if the pet dog bites or show abnormal behaviour, respectively.

## KNOWLEDGE, ATTITUDES AND PRACTICES REGARDING RABIES

In general, the majority of the respondent in this study have good knowledge, followed by positive attitudes and good practices regarding rabies (66 respondents, 37.7%). However, 21.7% of the respondents have poor knowledge, negative attitudes, and poor practices regarding rabies. Association between respondents' knowledge and attitudes and practices has shown to be statistically significant ( $P$ -value = 0.001) with an odds ratio (OR) (95% CI) of 3.542 (1.694–7.409).

## LOGISTIC REGRESSION ANALYSIS

The analysis between the respondents' characteristics and rabies awareness with outcome variables is presented in Table 4. The results showed that each of the factors considered in this study had a  $p$ -value  $\leq 0.25$  for at least one of the outcome variables. This study's multivariate logistic regression analysis revealed that occupation had a statistically significant association with knowledge and attitudes and practice regarding rabies, while the history of hearing about rabies had a statistically significant association with knowledge regarding rabies.

## DISCUSSION

This present study was developed and undertaken to assess the KAP of the community member in Songan Village to

**Table 4.** Multivariable logistic regression analysis of factors of knowledge, attitudes and practices regarding rabies

Variable	Adequate knowledge		Positive attitude and practices	
	OR (95% CI)	P-value	OR (95% CI)	P-value
<b>Sex</b>				
Male	1.0 [Reference]	0.459	—	—
Female	1.302 (0.647–2.619)			
<b>Age</b>				
< 29 years	1.0 [Reference]	0.235	1.0 [Reference]	0.229
≥ 29 years	0.636 (0.301–1.343)		1.636 (0.733–3.648)	
<b>Educational background</b>				
No formal education	1.0 [Reference]		1.0 [Reference]	
≤ National basic education	1.097 (0.281–4.289)	0.894	0.578 (0.159–2.103)	0.405
> National basic education	1.870 (0.827–4.227)	0.133	0.753 (0.327–1.733)	0.505
<b>Occupation</b>				
Not working	1.0 [Reference]		1.0 [Reference]	
Blue-collar worker	5.864 (1.479–23.258)	0.012	12.068 (1.253–116.199)	0.031
White-collar worker	4.053 (1.382–11.884)	0.011	20.146 (2.435–166.692)	0.005
<b>Income</b>				
< District minimum wage	1.0 [Reference]	0.422	1.0 [Reference]	0.236
≥ District minimum wage	0.716 (0.317–1.617)		1.760 (0.691–4.482)	
<b>History of hearing rabies</b>				
No	1.0 [Reference]	0.04	—	—
Yes	0.099 (0.011–0.902)			
<b>Encounter with rabid animals</b>				
No	1.0 [Reference]	0.809	1.0 [Reference]	0.293
Yes	0.914 (0.441–1.894)		0.663 (0.309–1.425)	
<b>History of animal bites</b>				
No	1.0 [Reference]	0.354	1.0 [Reference]	0.080
Yes	1.592 (0.596–4.252)		0.345 (0.105–1.134)	
<b>Awareness of rabies infection fatality</b>				
No	1.0 [Reference]	0.199	1.0 [Reference]	0.128
Yes	0.377 (0.085–1.672)		0.390 (0.116–1.313)	
<b>Heard of the local rules and regulation</b>				
No	1.0 [Reference]	0.632	1.0 [Reference]	0.636
Yes	1.189 (0.586–2.411)		1.203 (0.560–2.584)	
<b>Hosmer and Lemeshow Test</b>				
Chi-square	4.591		4.065	
Sig.	0.800		0.851	

CI – confidence interval; OR – odds ratio

understand further the challenges faced in Bali in the objective to reduce the incidence of dog-bite rabies. Although few studies have identified a lack of awareness in parts of Bali province, this is the first study that relates the KAP towards rabies of community members in Songan Village. Our findings highlight

the factors contributing to rabies' knowledge, attitudes and practices across Songan Village that could be targeted to improve health-seeking behaviour and rabies control practices.

Bali province has an area of 5,632 km<sup>2</sup> with nine districts, namely, Jembrana, Tabanan, Badung, Gianyar, Ka-

rangasem, Klungkung, Bangli, Buleleng, and Denpasar city. Rabies was first detected in Bali Province in 2008. Ever since, there was a shift from the centre of case findings in Badung District towards the peripheral, including Bangli District. From 2008 to 2018 in Bali, 174 death cases due to rabies and 1.838 rabies-positive dogs have been reported. In 2009, the first recorded case of rabies in Bangli District was reported in Bebalang Village, followed by 2010, with the highest reported positive rabies cases in Bangli District constituting 51 cases. In Bangli district from 2008 to 2015, 7 death cases due to rabies and 289 positive dog rabies have been reported [6, 10].

Of the 175 community members surveyed, the majority were female (56.0%) in contrast to studies in India and Grenada [2, 11]. The median age of the respondents was 29 years, ranging from 17 to 64 years, similar to a study in East Nusa Tenggara Province, Indonesia with a median of 34 and range from 19 to 73 years of age [12]. Our results indicated that the community members' younger population had a higher rate of good knowledge about rabies. This may be associated with the educational background among young people in whom the high level of education probably translated into higher knowledge of rabies compared to adults. This finding is in line with previous studies [13, 14]. Nevertheless, none of the associations between sex, age group classification, and educational background were statistically significant in our study.

Almost all of the respondents (98.9%) were Hindu. The relation between Hinduism, Bali and dogs is explained in a spiritual relation from the Tri Hita Karana's philosophy as well as a sociocultural study carried out in Bali [15]. From a socioeconomic perspective, Bangli District, specifically Sukawana Village, is a well-known conservation area for Kintamani dogs [16].

Our study further revealed that district minimum wage influenced attitudes and practices of rabies. A plausible explanation is related to the socioeconomic status in which the respondents with higher socioeconomic status were more likely to comply to the correct initial management, seek treatment in the PHC/hospital, vaccination among FRDs, correctly identified measures restricting FRD population, and alert the local authorities of the presence of an FRD with abnormal behaviour as seen in another study in India. As expected from other studies, better knowledge about the disease should translate into the adoption of better practices, which is supported by this study showing significant associations between respondents with good knowledge and positive attitudes and good practices regarding rabies (OR 3.542, 95% CI 1.694–7.409, and p-value = 0.001) [17, 18].

Rabies awareness assessment showed that 90.9% has heard about rabies, which is similar to a study in Morocco, India, and Ethiopia [14, 19, 20]. The majority has heard about

rabies from mass media (43.4%), consistent with a study in Sukabumi, a province in West Java, Indonesia, and more than half of the community members had met animals suspected of having rabies [21]. This suggested that the community members were aware of rabies' presence in their area, which could be attributed to the prioritising of the disease by the Provincial Government of Bali. Nevertheless, only a small proportion of the community members have heard of the local rules and regulation about dogs and rabies' control. These findings suggested advocacy for further informing about rules and regulations regarding rabies for a better comprehensive understanding of rabies in the community.

After excluding insignificant predictor factors from the analysis, the multivariate model revealed that occupation was the only independent factor of knowledge, attitudes and practices regarding rabies (Table 4). In the final model, there were increased odds of having good knowledge and positive attitudes and good practices among participants who were classified as white-collar workers compared to not working (OR 4.053 and 20.146, 95% CI 1.382–11.884 and 2.435–166.692, and p-value = 0.011 and 0.005, respectively) as well as blue-collar workers compared to not working (OR 5.864 and 12.068, 95% CI 1.479–23.258 and 1.253–116.199, and p-value = 0.012 and 0.031, respectively). Occupations were found to influence good knowledge, positive attitude and good practices significantly. A potential explanation might be related to the time allocation comparatively between white-collar workers and blue-collar workers, in which blue-collar workers have to work every day whereas white-collar workers have a holiday within the weekend. The discrepancy between the available times could lead as the main reason for less knowledge and the less translation of knowledge into positive attitudes and good practices for groups other than white-collar workers [20, 22, 23].

Most of the respondents (97.7%) correctly identified washing a wound from a suspected rabid dog as the initial step. Washing the bite wound with water and soap is a pivotal component of PEP; lack of wound washing has shown to be responsible for a five-fold increase in the risk of developing rabies [24, 25]. This fundamental result was in contrast with a study in Bali in which due to widespread local belief (prior to the rabies outbreak) that dog licks could heal wounds and this belief led to the practice of not washing wounds, including bite wounds. Almost all of the respondents (98.9%) believed that visiting a local PHC/hospital was necessary after a suspected rabid dog bite and that vaccination (PEP) should be sought, as reported in a similar study. A probable explanation is that respondents wrongly believed that in the PHC/hospital there was a medicine to treat rabies and a minority understood that vaccinations could only block the virus transmission and was not the same as medicine [15].

Majority of the respondents (63.4%) incorrectly identified culling as a prevention method for the spread of rabies followed by 55.4% who agreed that FRD should be culled. Culling is an ineffective method for controlling rabies. For instance, in response to a rabies outbreak in 1997, in Flores, Indonesia, nearly half of the dog populations were culled. Nevertheless, in 2004, although the total dog population was still considerably reduced, rabies was still endemic [26]. Similar failure reports of culling were also reported from Korea, while subsequent vaccination yielded a controlled disease [27]. In order to specifically interrupt the animal-human transmission cycle of rabies, mass vaccination of dogs is essential. According to the WHO, at least 70% vaccination coverage of the canine population should be reached in order to break this cycle. This further complemented the need of higher awareness among community members, specifically dog owners, about the importance of dog vaccination [14, 28].

In the highlight of this study, the significant difference between knowledge and attitudes and practices may be related to current public educational programmes that are mainly focused on prevention, vaccination, and initial management after exposure to an animal bite. Low media involvement of clinical manifestation of rabies in man and animal may have negatively impacted in this regard [29]. Therefore, appropriate programmes should be designed to increase the knowledge of the community in faith to subsequently improve the translation into positive attitudes and good practices regarding rabies.

The fight against rabies in Indonesia, in particular Bali, is on the right track. The Provincial Government of Bali has made several attempts to control rabies incidence through the implementation of local rules and regulations, annual mass dog vaccination, and selective dog elimination. Nevertheless, it has not been optimal because the cases of rabies are still present. Several gap analysis has been published reporting and further strengthening the One Health approach that is essential: 1) a good continuing surveillance system will benefit the approach as it can portray the real situation of the number of dogs vaccinated, FRDs, and unvaccinated dogs, 2) scheduled mass vaccination system with community engagement, risk area mapping, and case estimation, 3) educating the community members and visiting tourists of preventive measures towards every dog bite cases, 4) the importance of dog vaccination and schedule should be informed to family, schools, and communities, and 5) integrated, continuous, and collaborative measures among stakeholders should be reinforced [30].

Inevitably, there were some limitations of the present study. First, this study could not determine how all the reported practices were translated into actual practice. Second, this study only provided the primary data on KAP

regarding rabies, particularly in Songan Village and may not be generalized to other parts in Bali. Lastly, the survey did not address all the questions related to KAP. To our best knowledge, this is the first study to report KAP regarding rabies in the Songan Village, Bangli District, Bali, Indonesia.

## CONCLUSIONS

Albeit community members demonstrated some level of KAP regarding rabies, overall, this study revealed critical gaps in their fundamental knowledge of rabies, the prevention in dogs, and the local rules and regulations concerning rabies. In accordance with the One Health approach, further enforcement on the collaborative efforts for comprehensive education programmes, scheduled mass vaccination for dogs, and promotion for healthier attitudes and practices are recommended.

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## CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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# Medical assessment of fitness to dive. Part I

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## ABSTRACT

Good physical and mental health is a prerequisite for anyone planning to scuba dive. A fitness to dive certificate for those willing to enter a scuba diving course as well as for active divers, either amateur or occupational, can only be issued if there are no medical contraindications to dive. It is usually within the competence of a diving instructor, a manager of underwater work or a physician to assess a person's mental and physical health and grant them permission to stay under hyperbaric conditions. The legal requirements for issuing a fitness to dive certificate are different for recreational and occupational divers. The part I of this article discusses the issues concerning medical assessment of fitness to dive for amateurs.

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**Key words:** diving, health assessment, medical contraindications

## INTRODUCTION

In Poland, recreational scuba diving courses are normally organized by privately-owned operators or sporadically by a few state-owned sports clubs affiliated to the Section of Underwater Activities at the Polish Tourist and Sightseeing Society. The training program offered by the state-owned institutions follows the guidelines proposed by the French Confederation Mondiale des Activités Subaquatiques (CMAS) and the Polish National Defense League, whereas scuba diving courses organized by privately owned operators are usually based on the procedures formulated by international diving organizations such as Professional Association of Diving Instructors (PADI), Scuba Schools International (SSI) or International Diving Association (IDA). Scuba diving courses for commercial divers, on the other hand, are organized by a number of state owned companies (e.g. the Polish Vessel Rescue Company, the Polish Register of Shipping and other shipping companies, shipyards or port authorities), by some privately-owned companies as well as by specialist units of the Polish Armed Forces, the Polish National Police and the State Fire Service. Good physical and mental health is a prerequisite for anyone planning to become a diver.

A fitness to dive certificate for those willing to enter a scuba diving course as well as for active divers (either amateur or commercial) can only be issued if there are no medical contraindications to dive. However right before a dive, it is normally within the responsibility of a diving instructor, a manager of underwater work or a physician to assess a person's mental and physical health and grant them permission to go underwater. The legal requirements for issuing a fitness to dive certificate are different for amateur and occupational divers [1].

## MEDICAL ASSESSMENT OF FITNESS TO DIVE IN AMATEUR DIVERS

A vast majority of scuba divers are amateurs. Nowadays, recreational diving is popular with people of all ages, including children and the elderly. Regardless of their age, all candidates for scuba diving are obliged to obtain a medical certificate confirming their good physical health and fitness to dive. In the past, entities authorized to issue such medical certificates were health care providers affiliated to sports medicine clinics, the Institute of Maritime and Tropical Medicine in Gdynia as well as military physicians. New

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legal regulations regarding scuba diving requirements (the Regulation of the Minister of Sport of August 17, 2006 on safety rules for practicing scuba diving, Journal of Laws of the Republic of Poland of 2006, item 1103) substantially simplified the procedure for obtaining certificates confirming lack of contraindications to diving [2]. Currently, a person who wants to dive should obtain an appropriate medical certificate, and in accordance with the applicable regulations, such a certificate may be issued by any physician. However, not many physicians are experts in the field of diving medicine; qualifying a person for a scuba diving course by a random and often incompetent physician carries a high risk of diving related accidents. In theory, every potential diver should undergo a fitness to dive assessment by a medical practitioner before they enter a course. However, in order to promote the sport and increase its accessibility, many clubs and operators no longer require a fitness to dive examination or a certificate. Thus, the complete responsibility for any potential problems or accidents which may occur underwater lies with a diver alone. A physical examination by a medical doctor has been replaced by a self-completed medical questionnaire, which is then analyzed by a diving instructor [3]. On the basis of the information provided by a candidate an instructor will decide whether or not a person can be declared fit to scuba dive [2]. This obviously places great responsibility in the hands of a scuba diving instructor. The instructor should not only be an expert in diving medicine who is fully aware of every single contraindication to scuba diving (like incidents of seizures, loss of consciousness, pulmonary edema) as well as any aspects that would temporarily disqualify a person from diving (e.g. middle ear infections, sinusitis, asthma, bronchitis and respiratory tract infections), but he must also be a skilled psychologist who has the ability to accurately assess a candidate's aptitude for diving before they start training (watch them carefully and look them deep in their eyes). The instructor must also be able to assess the risk of a potential diving accident and be able to recognize all the risk factors which might possibly lead to a diving-related incident, such as: poor physical condition or poor tolerance to exercise of a candidate, insufficient diving training, the presence of underlying health conditions that may aggravate under hypobaric conditions, the potential for a panic attack, poor planning of a diving session and a lack of enough air to complete a dive according to a pre-scheduled plan. As to date, Poland has not introduced effective legal regulations on medical requirements for recreational and sports diving [4]. Anyone interested in recreational scuba diving must rely on individual self-assessment of their health condition. The lack of legislation encourages diving associations to deal with the problems of diving fitness health assessment within their own capacities. In Poland, some diving organizations

have been organizing training sessions for medical practitioners in the field of underwater and hyperbaric medicine; such training is offered by the Polish Hyperbaric Medicine and Technology Society and the Department of Hyperbaric Medicine and Maritime Rescue – the National Center for Hyperbaric Medicine at the Medical University of Gdansk. After completing a series of training sessions, participants are certified as diving physicians or club physicians. So far, several hundred physicians have completed the training, which means that anybody willing to start their adventure with scuba diving or those already practicing the sport should be able to consult with a competent diving specialist no matter which part of Poland they live in. A medical certificate stating that a person is medically unfit to dive must never be ignored. Individuals who have been declared 'unfit to dive' may apply for re-examination to the Head of the Diving and Scuba Diving Certification Board at the University Department of Maritime and Tropical Medicine in Gdynia. As a rule, commercial scuba divers are required to undergo a medical examination every 12 months but professionals taking part in scuba diving sports events should have their fitness to dive attested every 3 months [2, 5]. Since scuba diving equipment is easily available to anyone and because formal restrictions for prospective divers are now more relaxed than they used to be in the past, some people fail to get proper training before they go scuba diving and are often completely unaware of the risks associated with this form of activity. From the medical point of view, it seems obvious that each prospective diver should get some insight into certain aspects of diving medicine. This will help them self-assess their fitness to dive and will hopefully reduce the risk of diving-related injuries. Until recently, a vast majority of scuba divers were all young and physically fit individuals, mostly under the age of 30 years. This, however, has changed in recent years. Nowadays, scuba diving is popular with people of all ages. The activity is becoming increasingly popular among teenagers and some scuba diving fans decide to go diving with their children, in some cases no older than 10 years. The requirements for young people willing to engage in scuba diving are the same as for any other age group – they must be in a good physical and mental health and should be free from any contraindications to dive. As was mentioned before, the sport does not only attract the younger generation. In fact, more and more divers are either middle aged or retired people. Some older divers are in good physical health, while others will have certain preexisting conditions. Since a person's general health and level of fitness tends to decrease with age and because ageing is naturally associated with a number of degenerative processes affecting all organs and systems, older divers are recommended to undergo a careful medical examination and extensive diagnostic tests before they start

scuba training [4, 6]. It is often the case that the initial medical examination may reveal conditions of which a prospective diver has been unaware but which may be a relative or an absolute contraindication to scuba diving. As an example, undiagnosed asymptomatic cardiovascular conditions can unmask or aggravate when a person engages in strenuous physical activity (e.g. during a dive) causing a decrease in blood supply to vital organs. As was mentioned before, the age structure of individuals who practice scuba diving has changed over the past 30 years. This has had a direct influence on scuba diving fatalities statistics. The number of accidents in the 20–29 age group has decreased by a half in comparison to the period of 1987–1989 while, in the 50–59 and 60–69 age groups the percentage of diving-related accidents increased more than 5-fold. Currently, a certain proportion of divers are individuals in their 70s or even 80s; divers in this age category obviously run a much higher risk of a diving related accident or an illness in comparison to younger people. The average age of diving fatalities increased from 39 years in 1989 to over 54 in 2017. According to medical statistics the reason for 25–32% of deaths among divers are cardiovascular conditions. In light of the above, more than ever before, a fitness to dive assessment is of fundamental importance in the process of qualifying a person for recreational diving. Diving fitness health assessment in older divers as well as in divers with preexisting illnesses is a complicated issue. Its purpose is not only to declare all seemingly healthy individuals as ‘fit to dive’ and all those with preexisting conditions as ‘unfit to dive’, but rather to assess whether a patient’s underlying conditions are a real contraindication to dive and to what extent will they affect a diver’s health and safety underwater. The aim of a diving fitness health examination is also to determine safe diving limits for each diver [6, 7]. In the past, good physical fitness was considered to be an absolute prerequisite for scuba diving, more recently however, scuba diving has become popular with all groups of people, even those with physical disabilities. Currently, poor physical fitness alone should not be considered an absolute contraindication to recreational diving, provided that a diver whose level of fitness is lower than normal acts in a reasonable manner and avoids unnecessary risk while staying underwater. Therefore, even people with physical disabilities or those with underlying conditions should be permitted to engage in recreational diving unless it may aggravate their underlying conditions. For many of them scuba diving might be an excellent form of active physical therapy [1].

## RESPIRATORY DISEASES

Fitness to dive examination should primarily focus on the condition of the respiratory system since most diving related incidents and traumas are associated with pulmonary ede-

ma caused by a respiratory arrest or abnormal retention of breathing gas in a lung or its part during ascent, even from the depth as low as 1–2 m. This type of traumas may occur at any time, even during the very first dive session when a person is breathing compressed air. Any condition which is likely to increase the risk of air-trapping (i.e., abnormal retention of gas in lungs) during ascent or affect the lung volume during a dive should be considered an absolute contraindication to scuba diving. It is essential that each prospective diver should have a chest X-ray performed prior to their first dive. Amateur diving is contraindicated in patients with airway obstruction or emphysema which is visible on a chest X-ray, patients who are susceptible to spontaneous pneumothorax, patients who have recently undergone a thoracic surgery, as well as those with asthma, bronchitis or pneumonia. Because these conditions change the respiratory mechanics, their presence increases the risk of a pulmonary barotrauma during a dive in response to rapid changes in the intrapulmonary pressure [4, 8, 9]. Medical conditions which are characterized by increased mucus secretion, such as asthma, bronchitis, pneumonia, and bronchiectasis also increase the risk of air trapping. Excessive mucus secretion is also seen in heavy tobacco smokers [1].

**Asthma** is characterized by inflammation of the bronchial mucosa, paroxysmal bronchospasm and over-secretion of mucus in the respiratory tract. Inflammatory lesions cause the so-called bronchial hyper-responsiveness, which increases the risk of a bronchospasm. An asthma attack may be triggered by exposure to allergens or cold air, physical exercise, stress, over-excitement, infections or exposure to air irritants – many of these factors cannot be avoided while scuba diving. Asymptomatic asthma may be associated with persistent subclinical bronchospasm which increases the potential for a sudden asthma attack in case of exposure to any of the above mentioned irritants. Some divers might have had childhood asthma which resolved later in life, others will have allergic rhinitis or seasonal hay fever. All of them run a higher risk of an asthma attack while scuba diving.

Physical exercise alone may be the cause of about 90% of asthma attack cases but breathing dry and cold air from cylinders is also likely to trigger an asthma attack. In order to resolve any doubts, before taking the final decision concerning fitness to dive of a person suspected of bronchial hyper-reactivity, it is recommended to consult a pulmonologist and perform an exercise or a cold air challenge test. Individuals with chronic asthma may be declared fit to dive provided that they are well controlled with steroid drugs and have normal results on the spirometry test.

Owing to the fact that each year there is a growing number of asthmatic divers, British researchers under the guidance of prof. Elliott attempted to study this complex

issue and find a solution to the problem. They have concluded that certain asthmatics can be allowed to scuba dive without running the risk of being exposed to diving-related illnesses or injuries. They have found that the prevalence rate of pulmonary barotraumas in asymptomatic asthmatics was not higher than in non-asthmatics. This led them to a conclusion that asthmatic patients with normal lung function parameters, at rest and post-exercise, may scuba dive safely provided that their forced expiratory volume (FEV) in 1 second on a spirometry test is more than 75% of the predicted FEV<sub>1</sub> value – FEV<sub>1</sub> > 75%. Elliott [8] also believes that patients with chronic asthma who are well-controlled with steroid drugs may be medically cleared to dive, provided that they have normal spirometry results. In contrast, active asthma constitutes an absolute contraindication to scuba diving. An asthma attack associated with a bronchospasm and overproduction of mucus in the airways prevent normal ventilation and increase the potential for air trapping which in turn increases the risk of a pulmonary barotrauma and cerebral gas embolism.

**Bronchitis and pneumonia** are common respiratory illnesses that are characterized by increased mucus secretion and the presence of inflammatory exudates which increase the risk of air trapping. An active infection definitely disqualifies a person from scuba diving. Occasionally, severe pneumonia may result in permanent changes in the lung structure, such as pulmonary fibrosis, cavities, emphysema, and calcifications. The lesions may obturate the bronchi and impair the lung function and its flexibility. Parts of the affected lung are generally more susceptible to injuries and air trapping. After an episode of pneumonia or bronchitis, a person should not resume scuba diving for at least a month after all the symptoms have disappeared. Before they return to diving they should consult a physician and have a chest X-ray performed. Taking a break from scuba diving will be necessary to recuperate and clear the respiratory tract of the remains of mucus whose presence may increase the risk of small airways obstruction. Susceptibility to **spontaneous pneumothorax** is an absolute contraindication to scuba diving. It is a rare disease (with prevalence rate of about 5 cases per 100,000 people) that is most often seen in younger, healthy men; women are generally at a lower risk of spontaneous pneumothorax. The disease is more common in tobacco smokers. The direct cause of spontaneous pneumothorax is a rupture of pulmonary blebs and a tear in the visceral pleura and the subjacent lung structure. Blebs are usually small and not visible on chest X-ray. Recurrent episodes of spontaneous pneumothorax affect about 50% of individuals. It is well understood that if a prospective diver is susceptible to spontaneous pneumothorax under normal atmospheric conditions they will be even more vulnerable to such inci-

dents under hypobaric conditions. Individuals with a history of **thoracic surgeries**, trauma-induced chest hematoma or pneumothorax should be disqualified from scuba diving. The formation of post-operative or post-traumatic pleural adhesions changes the respiratory mechanics and may impair normal breathing. Although the symptoms may not be clearly visible, changes in the lung volume during a dive, especially when holding one's breath, can cause further damage in the affected lung [1, 4, 8, 9].

## CARDIOVASCULAR DISEASES

A routine fitness to dive assessment may reveal certain cardiovascular conditions. A physical examination, for example, can detect cardiac murmur or arrhythmias, while the electrocardiogram reading can reveal other abnormalities. If a prospective diver is diagnosed with any cardiovascular conditions, they will require further tests. In such cases, it is recommended to perform an echocardiogram, Holter electrocardiogram (a 24-hour test) and possibly a cardiac stress test. Once all the tests have been performed, a prospective diver should be referred to a cardiologist. In general, scuba diving is contraindicated in patients with a cardiovascular condition, patients with poor exercise tolerance, a positive cardiac stress test or any other abnormalities revealed by the standard cardiac tests.

**Congenital heart defects** that allow the blood to flow between the right and left chambers of the heart are an absolute contraindication to scuba diving. A person with the above mentioned conditions may only be allowed to dive provided that these defects have been corrected surgically in childhood, they report no cardiovascular symptoms and the results of cardiological and pulmonary tests show no abnormalities. Patients with asymptomatic **valvular incompetence** may be allowed to scuba dive, provided that they have normal results of electrocardiography and echocardiography. In older patients, it will be necessary to check whether valvular incompetence has not resulted from a more serious heart condition. If such a condition is confirmed by the echocardiogram the individual cannot be declared fit to dive. Any form of **valvular stenosis** disqualifies an individual from scuba diving. Individuals with asymptomatic **mitral valve prolapse** (a condition which affects approximately 5–10% of the global population) may be declared fit to dive unless they have reported symptoms such as palpitations, arrhythmias, chest pain or syncope, in such cases scuba diving will not be possible. It is important to remember that the presence of **patent foramen ovale** (PFO, a failure of the foramen ovale in the atrial septum to close) may significantly increase the risk of diving-related illnesses and affect diving safety. Although the condition is quite common and affects between 20% and 34% of the global population, prospective divers are not routinely screened for PFO and its presence

is not considered a contraindication to scuba diving. Diving with PFO carries a certain level of risk – if the right atrium pressure exceeds the left atrium pressure during a dive, especially if a diver has not followed the recommended decompression procedures, gas bubbles are released into the arterial circulation causing arterial gas embolisms.

**Abnormal electrocardiogram** does not always mean that a patient has developed a cardiovascular disease, in some individuals it can signal sinus bradycardia or right bundle branch block.

**Bradycardia**, i.e., heart rate below 60 beats per minute is a condition associated with exercise-induced adaptation of the heart muscle. In athletes, bradycardia is normal and should not be considered a contraindication to scuba diving. In older patients, especially those who are not physically active, bradycardia is rather a signs of a heart condition and/or the effect of using cardiovascular medications. Such individuals should be consulted by a cardiologist and the decision concerning their fitness to dive should be taken with caution.

**Right bundle branch block and incomplete right bundle-branch block** is commonly seen in young physically active individuals and is not normally considered a contraindication to diving. The conditions are not associated with any heart disease and cause no signs or symptoms. In some patients, the ECG may reveal a brief resolution of the block when performing the Valsalva maneuver or during exercise. Patients with complete or incomplete right bundle branch block can safely engage in diving activities, but before they are medically cleared to scuba dive they need to be referred for an exercise tolerance test. **Left bundle branch block** is common in older people. The presence of left bundle branch block is indicative of a cardiovascular condition and is associated with a higher risk of a cardiac event; therefore it is considered an absolute contraindication to scuba diving. **Wolff-Parkinson-White (WPW) syndrome** is a condition associated with episodes of paroxysmal tachycardia, i.e., supraventricular tachycardia, atrial fibrillation or atrial flutter. WPW syndrome is an absolute contraindication to diving; a tachycardia attack under water may result in a loss of consciousness which, in consequence, may lead to drowning. For the same reason, candidates for divers with a history of paroxysmal supraventricular tachycardia (regardless of its cause) cannot be declared fit to dive. Individuals under 35 years of age may be conditionally allowed to scuba dive providing they have never fainted during a tachycardia attack, they have not been taking any cardiac medications and have not had an attack in the last six months. **First-degree atrioventricular (AV) block** is quite common in professional sports people as well as in some healthy individuals. A candidate diver with first degree AV block should first consult with a cardiologist; such pa-

tients can be declared fit to dive, provided that the results of the cardiac stress test and echocardiography show no abnormalities. **Second-degree and third-degree AV block** is always a sign of a cardiac condition and therefore it is an absolute contraindication to diving.

**Ischemic heart disease (IHD)** is the leading cause of premature mortality for both men and women and of excess mortality for middle-aged men. The most dangerous consequence of IHD is myocardial infarction (MI). A history of a MI, angina or cardiac arrhythmias which have resulted from IHD are an absolute contraindication to diving. IHD is often associated with dangerous arrhythmias, which in 20% cases are responsible for the so-called 'sudden cardiac death'. IHD was found to be the largest single cause of sudden cardiac death in scuba divers. When assessing fitness to dive of individuals in their 40s or older, special attention should be given to IHD risk factors (high total cholesterol level, past history of IHD, family history of IHD, MI or sudden cardiac death in parents or siblings, arterial hypertension, diabetes, significant obesity). Prospective divers over the age of 40 with IHD risk factors or a history of a cardiac condition should have a cardiac stress test performed before they are declared fit to dive. If the test result is negative and a diver can reach a work rate of 13 metabolic equivalent level, which is approximately 45 mL O<sub>2</sub>/kg/min, they can be considered fit for recreational diving. In doubtful cases, further non-invasive cardiac evaluation will be necessary, including echocardiogram and exercise scintigraphy. The presence of cardiac symptoms, exercise intolerance, a positive result of the cardiac stress test or any abnormalities revealed by cardiac tests disqualify a person from scuba diving. Other cardiac contraindications for scuba diving include: pacemaker implantation, artificial heart valves insertion, a history of coronary angioplasty or coronary artery bypass grafting. A diver who has had a MI should not return to scuba diving for 12 months after the cardiac event. After this period, a patient will need to undergo a thorough cardiovascular evaluation to assess his exercise tolerance and long-term complications of the infarction. In general, an episode of MI decreases a diver's tolerance to exercise, stress and cold. A diver who effectively controls his blood pressure with medication and has normal exercise electrocardiography results can re-apply for a fitness to dive certificate. In some cases additional cardiac exams, such as echocardiogram or coronography will have to be performed. Complications associated with MI such as electrical conduction abnormalities may disqualify a person from scuba diving. Also pacemaker implantation is a contraindication to resuming any diving-related activities. Because they will require chronic anticoagulation treatment, patients with artificial heart valves should not be medically cleared to return to scuba diving. It must be

remembered that the diving reflex may aggravate the existing arrhythmias and conduction abnormalities. The recent advances in medicine have enabled surgical treatment of coronary arteries. Although angioplasty and coronary artery bypass grafting significantly improve tolerance to exercise and general condition in patients with coronary artery disease or after MI, clearing such persons to return to scuba diving carries a certain level of risk due to the progressive atherosclerotic process.

Approximately 45% of people aged between 45 and 64 suffer from **arterial hypertension**. In candidates for diving it will be necessary to check whether or not arterial hypertension has caused permanent damage to the heart, kidneys and the fundus of the eye. The presence of left ventricular hypertrophy or left ventricular dilation disqualifies an individual from scuba diving. Individuals whose condition is effectively controlled with anti-hypertensive medications can be declared fit for recreational diving. However, if blood pressure cannot be normalized, a patient should not be medically cleared to scuba dive. Physical effort, stress and cold water exposure during a dive may potentially cause a significant increase in blood pressure. The risk of a stroke or a heart attack is much higher in those divers who are at an older age and have been diagnosed with arterial hypertension; therefore, such candidates should be disqualified from scuba diving.

**Arterial and venous diseases** are another major contraindication to scuba diving, because they are known to limit the physical capability of a diver. The exposure to cold water causes constriction of blood vessels and a reduction in blood supply to muscles. Arterial insufficiency in the lower limbs is a condition which will have a negative effect on a diver's swimming efficiency. Varicose veins are not considered to be a contraindication to scuba diving, provided that the condition is not associated with venous insufficiency or thromboembolism. Until only a few years ago, cardiovascular conditions were considered an absolute contraindication to dive. Currently, it is not uncommon for diving specialists to consult older divers with underlying heart conditions, which have developed as a result of many years of diving. An experienced physician should be able to determine safe diving depth limits for those who begin scuba diving at an older age. A large number of prospective divers are over 40 years old, sometimes even older than 60. Divers in this age category will be more likely to have an underlying heart problem or hypertension in comparison to younger divers. Unless they have a serious cardiovascular disease, people over the age of 50 cannot be declared unfit to dive solely because of advanced age. Divers at an older age are likely to have lower physical fitness and exercise tolerance in comparison to younger divers. This, coupled with cardiovascular conditions may lead to a sudden aggravation of the underlying diseases and increase the risk

of a sudden cardiac death in water, drowning or sustaining a diving-related injury. Elderly candidates with pre-existing cardiovascular conditions must be made aware of the risk of sudden cardiac death which may occur while scuba diving and of the potential risk for their dive buddy – in emergency situations a younger diver will have to risk his own life in order to save his older partner. When assessing their fitness to dive, a physician will not only have to consider the risk of a sudden aggravation of an underlying cardiovascular disease, but also the effects of immersion itself, stress, physical effort and cold temperature on the functions of the cardiovascular system. It cannot be assumed that every elderly diver will only engage in recreational diving, i.e., swim at a slow to moderate pace at shallow depths. During any dive, difficult conditions and circumstances can arise which may require vigorous exercise. In case of an emergency, a diver may be pushed to their limits in order to save himself or help his dive buddy, for example, he may have to swim against a strong current or a tide, he may become entangled in a fishing net, come across dangerous marine animals or have to deal with a failure of scuba diving gear. All these unforeseen circumstances rapidly increase the physical and mental strain, and may potentially turn out life-threatening for an elderly diver. Each diver should have sufficient cardiovascular reserves to be able to cope with unexpected emergencies without risking complete exhaustion or loss of consciousness. It is important to note that as they grow older people become more sensitive to temperature changes. Therefore, older divers will be more susceptible to dehydration when travelling to tropical regions or hypothermia when diving in seemingly warm waters. Both dehydration and hypothermia affect the function of the cardiovascular system and may trigger a cardiac event. Additionally, the stress associated with diving increases blood pressure and can cause tachycardia, which in patients with cardiovascular risk factors may result in acute MI leading to a sudden cardiac death. According to the statistics, as much as 25–32% of diving-related deaths in divers at an older age are associated with cardiac events [1, 4, 8–13].

## DISEASES OF THE EAR AND PARANASAL SINUSES

Chronic otitis media or sinusitis, marked stenosis of the auditory canal, permanently perforated tympanic membrane or any recent surgeries of the ear constitute absolute contraindications to scuba diving. The presence of the above listed conditions will make it difficult or even impossible for a diver to equalize pressure in the ear and in the sinuses. Diving in a wet suit with perforated eardrum may lead to irritation of the labyrinth and disorientation under water. Eustachian tube dysfunction and edema within the nasopharynx are usually caused by frequent infections of the

upper respiratory tract or by otitis media. The abnormalities increase the risk of the barotrauma of the ear or paranasal sinuses. Other common risk factors for barotrauma include: allergies, tobacco smoking, overuse of nasal sprays or nasal drops, polyps or other abnormalities within the nasal cavity. All these conditions may prevent normal ventilation of paranasal sinuses. People with childhood history of acute otitis media may have difficulties in normal ventilation of the ear at an older age which will increase their potential for an ear barotrauma. Congenital defects, such as cleft palate or bifid uvula are often associated with anomalies of the Eustachian tube. Surgical correction of the defects does not necessarily restore the function of the Eustachian tube. Patients with the above defects should be tested for the patency of the Eustachian tubes before they are medically cleared to scuba dive. If a diver had suffered **perforation of the tympanic membrane** they can only be allowed to resume diving after it has reattached and the ear function has returned to normal. Diving in a dry suit protects the middle ear from flooding and because it prevents the labyrinth from exposure to thermal irritation it allows a diver to stay underwater even if the eardrum ruptures. A history of the **mastoid process or the auditory ossicles surgery** disqualifies a candidate from diving due to a high risk of damage to the inner ear. People who often develop **inner ear infections** or **Meniere's disease** which manifest with dizziness should not be allowed to undertake scuba diving. Dizziness is often accompanied by nausea and vomiting and may potentially lead to drowning. Some divers may experience **dizziness** during the ascent because of asymmetric pressure equalization in the middle ear. If dizziness occurs on each ascent, or if it is severe, recreational diving should be discontinued. A sinus X-ray and a consultation with an otolaryngologist might be useful when assessing fitness to dive in prospective divers with a history of illnesses of the ear, nose or sinuses. However, the final decision can be left to the divers themselves. If they have problems with equalizing pressure during their first diving session or develop a severe headache or an earache while diving in shallow waters they are very likely to discontinue scuba diving anyway. A fitness to dive assessment in divers who have suffered a middle ear or inner ear barotrauma should be performed by an otolaryngologist. Such patients may be allowed to return to scuba diving provided that the tympanic membrane has healed and vestibular disorders (irritation of the inner ear) have resolved. If a diver is to dive in a dry suit only, he may conditionally be allowed to return to scuba before the eardrum has healed [1, 4, 6, 14, 15].

## EYE DISEASES

Good visual acuity and normal field of vision are essential for maintaining safety and sense of direction underwater. Having good eyesight is essential to read the screen of

a dive computer, a depth gauge, a watch, a compass or decompression tables. The visibility underwater is often limited because of water pollution or because there is not enough sunlight. Color blindness should not be considered a contraindication to scuba diving, as it has no direct influence on a diver's safety. There are some ocular conditions, however, which will disqualify a candidate from scuba diving. These include any severe inflammatory conditions of the eye or its protective apparatus manifesting with pain, disturbed visual acuity, diplopia or photophobia. If such conditions occur, a prospective diver cannot be declared fit to dive until the disease is cured and all symptoms subside; such individuals will need to consult an ophthalmologist before they can be declared medically fit to dive. **Visual acuity disorders** are increasingly common nowadays. A growing number of young scuba diving candidates have some vision defects which have to be corrected by wearing prescription glasses or contact lenses. Vision defects are found in nearly all candidates over the age of 50. When consulting individuals with decreased visual acuity, it will be necessary to determine whether scuba diving will be safe in their case and decide which forms of scuba diving activities can be recommended to an individual person. There are several ways to improve visual acuity underwater. A diver might, for example, wear soft contact lenses or use a special scuba mask fitted with corrective lenses.

Since the eyeball and the fluid within are not compressible, the eye is not affected by pressure changes. An injury to the eye or rupture of the cornea may only occur with facial barotrauma, i.e., a mask squeeze which occurs if a diver fails to exhale all the inhaled air during a descent. For this reason, a history of **eye surgery** is not a contraindication to recreational scuba diving. In general, individuals who have had an eye surgery are not recommended to go scuba diving for 2–3 months after the surgery or until the cornea has healed. People who have undergone a surgery to the eyelids, conjunctiva or eye muscles should be discouraged from scuba diving for 2–3 weeks after the surgery. Divers at an older age are more likely to have serious vision problems or eye diseases, such as **cataracts** or **glaucoma**. In fact, glaucoma is quite a common condition in middle aged and elderly people. The above conditions are not normally considered to be an absolute contraindication to scuba diving, unless the loss of vision is so profound that it could threaten diving safety. Divers who have had a glaucoma or cataract surgery can be allowed to resume scuba diving 3 months after the operation. Divers who have had any visual disturbances following an episode of a decompression sickness or arterial gas embolism should be strongly discouraged from further diving [1, 4, 6].

## NEUROLOGICAL DISEASES

A history of **seizures** with a **syncope** as well as a history of **transient ischemic attack** or a **stroke** is considered to be absolute contraindications to scuba diving. The presence of the above listed conditions creates a significant risk for the safety of a diver himself as well as people around him. A typical tonic-clonic seizure which is associated with respiratory arrest creates a high risk of drowning or pulmonary barotrauma. During a pre-dive assessment particular attention should be paid to: a past history of head trauma, concussion, post-traumatic intracranial hematoma, skull fractures, loss of consciousness or memory disorders lasting more than 24 hours, severe infections presenting with seizures. In patients with a history of febrile seizures, the risk of non-febrile seizure recurrence has been estimated at 13%. Such patients will require a pre-diving assessment by a neurologist and an electroencephalography test. If the test reveals no abnormalities, a patient can be medically cleared to dive recreationally. The assessment of divers who have experienced a **head trauma** but would like to return to scuba diving is a separate issue. Whether or not a person may be cleared to resume diving will primarily depend on trauma severity and the presence of residual neurological symptoms. Post-traumatic seizures occur in approximately 90% of patients who suffered a head injury. In such cases scuba diving should be discontinued. Divers who have suffered a mild head injury which has caused a brief loss of consciousness and memory loss may return to scuba diving after a minimum of 6 weeks after the injury provided that the neurological assessment reveals no deficits, their electroencephalography is normal and they do not require anticonvulsants. If head trauma results in a loss of consciousness lasting a longer period and a memory loss of more than three weeks, a person should not resume diving for a minimum of 12 months after the injury.

Another group of patients who should not be medically cleared to scuba dive are those who are more susceptible to **syncopal episodes** triggered by exposure to stress. Such individuals are likely to experience weakness, dizziness, excessive sweating, hot flushes and hypoglycemia when confronted with a stressful situation. Because it is essential that a diver remains conscious underwater at all times, re-current episodes of stress-related syncope are considered an absolute contraindication to scuba diving. Patients with a history of a **stroke**, even if it was mild and with minor residual symptoms only, must be disqualified from recreational scuba diving. If a stroke has been the effect of a vascular disease, there will be an increased risk of a vascular, cerebral or cardiac event during a dive. In very rare cases, a patient with a past history of a stroke episode may be cleared to take up less demanding scuba diving activities (only recreationally) provided that the risk of a recurrent stroke

has been ruled out by specialist tests and that they have adapted to their functional limitations.

**Chronic radiculopathy** and **degenerative disc disease** are conditions commonly seen in the middle-aged and the elderly people. They usually present with chronic pain at multiple sites. If the conditions are not associated with any physical disability, they should not be considered a contraindication to diving. However, it must be remembered that swimming in cold water as well as lifting and carrying heavy objects, such as scuba gear, may cause recurrence of pain. In such a case, a person should discontinue diving until the symptoms have subsided. Patients who required surgical treatment of the above conditions should not resume scuba diving for a minimum of 2 to 3 months after the operation [1, 4, 6, 16, 17].

## MENTAL DISORDERS

Mental disorders which are regarded as absolute contraindications to scuba diving include: a history of **psychotic episodes**, **anxiety** or **personality disorders**, **intellectual disability**, **alcohol addiction** and **substance abuse**. Because there is no legal requirement for prospective divers to undergo a comprehensive fitness to dive assessment before they go scuba diving, some candidates may turn out to have an underlying mental disorder. In such cases, it will be up to a diving instructor to decide whether or not an individual is fit to dive. The instructor will be the only person who can judge the behavior and personality of a prospective diver and assess whether he is likely to make progress. Close supervision of candidates during their initial dives (their behavior, the way they handle equipment and react to the challenges involved in the training and unforeseen difficulties) will provide valuable information on their general diving aptitude. An experienced scuba diving instructor will usually be able to evaluate a person's diving fitness and aptitude during the very first training session. Candidates who are emotionally unstable should be discouraged from further training or any diving related activity. Those who exhibit anxiety or depression-related behaviors require close supervision during their preparatory training. If they are unable to control their fear and move to the next, more difficult stage of the training, they will be more susceptible to a panic attack while staying underwater. People with anxiety disorders often suffer from phobias, of which claustrophobia, i.e., the fear of confined spaces, is the most common. Other phobias which might be seen in prospective divers include: the fear of diving, the fear of water, the fear of depths, the fear of open spaces or of marine fauna and flora. When a diver experiences strong fear, he is more likely to lose self-control and panic. This can have grievous consequences as panic is the leading cause of death for scuba divers. On the other side of the spectrum, there is a group of natural risk-takers, people who are over-

confident, self-centered and stubborn. Such candidates are likely to underestimate the danger associated with scuba diving and disregard the diving safety procedures. As a result, they will be more likely to experience a diving-related accident than other groups of divers. In addition, candidates who are too confident tend to ignore their diving buddy or the problems they may have during a dive, which can have tragic consequences. It should not be difficult for a diving instructor to identify such a person, as they are likely to brag about their past achievements, accidents or injuries. Unfortunately, it may be more difficult to dismiss such a candidate from a dive course. Once they have decided to complete the course, it will be difficult to dissuade them from doing so. In such situations, the only thing that the instructor can do is to supervise the 'unpredictable' candidate and ensure that he follows all the scuba diving safety regulations.

Most patients with **psychosis (schizophrenia, bipolar disorder)** experience periods of symptoms exacerbation and remission. During the period of remission they manifest no worrying symptoms and are likely to conceal their illness from other people. A detailed medical interview focusing on medications taken regularly, the family situation and work environment might be helpful in such cases. Patients on psychotropic medications cannot be medically cleared to scuba dive because the drugs impair a diver's performance underwater and exacerbate the symptoms of nitrogen narcosis. Quite a large number of recreational scuba divers report a regular use of medications; the most common include tranquilizers and anti-anxiety drugs. It must be emphasized that abuse of alcohol or of any antipsychotic medications is an absolute contraindication to scuba diving. Alcohol impairs judgment, delays reaction time and affects a diver's motor coordination. Diving under the influence puts a diver at a significant risk of having an accident or sustaining an injury; it also increases the risk of a barotrauma. Therefore, it is important that divers avoid alcohol not only immediately before a dive and in between the diving sessions but also the night before they go scuba diving (e.g. at team-building parties organized before a diving session). Similarly, drug addiction is considered an absolute contraindication to diving. The use of narcotic drugs endangers the safety of a diver and people around [1, 4, 6, 18, 19].

## DENTAL PROBLEMS

A prospective diver needs to have all his front teeth to able to hold the scuba mouthpiece. Having a dental bridge or a dental prosthesis is not a contraindication to scuba diving, provided that they are firmly attached because a loose denture creates a risk of airway obstruction in case of an emergency. All prospective divers are recommended to visit a dental practitioner to have all their teeth fixed and filled before they start diving. Root canal treatment and loose

fillings increase the risk of dental barotrauma. Multiple missing teeth and advanced caries lesions are considered a contraindication to scuba diving [1].

## GASTROINTESTINAL DISEASES

Gastrointestinal system is the area of the body where gas can easily get 'air trapped'. Vomiting is a common symptom of some digestive tract disorders or illnesses; gastrointestinal conditions which are associated with an increased risk of vomiting and air trapping are an absolute contraindication to scuba diving. Vomiting underwater may potentially lead to drowning and the expanding gas trapped in the intestines may cause barotrauma.

Scuba diving, especially in a head-down position, promotes air swallowing, while the state of apparent "weightlessness" underwater has a negative effect on peristalsis, and may aggravate underlying gastrointestinal conditions. **Gastroesophageal reflux disease** is a significant contraindication to scuba diving because it puts a diver at risk of aspiration of the gastric contents. In mild cases, a patient may be conditionally cleared to scuba dive but he must be aware of the fact that scuba diving may cause aggravation of symptoms. **Hiatal hernias** which are asymptomatic do not disqualify a person from scuba diving. A major sliding hiatal hernia is considered an absolute contraindication to scuba diving as it increases the risk of distention and injury to the part of stomach displaced to the mediastinum (during ascent). Conditions associated with spasm of the cardia or pylori create a similar risk and therefore disqualify a candidate from diving. All factors which prevent gas being released from the stomach during ascent may cause gastric distention and rupture. For the same reason, obstruction of the small or large intestine is another contraindication to scuba diving. Patients with **gastritis, gastric or duodenal ulcers or cholecystitis** cannot be medically cleared to scuba dive until their condition has been successfully managed and all symptoms have resolved. **Cholelithiasis** is not a contraindication to dive. All hernias of the abdominal wall disqualify a candidate from diving until they are managed surgically. Lifting and carrying heavy objects, such as scuba gear increases the risk of hernia expansion and strangulation. Additionally, the presence of a hernia increases the risk of air trapping, with well-known consequences to the loop of the intestine filling the hernial sac. Patients who have had a hernia repair surgery can safely return to scuba diving after the post-operative wound has healed completely [1, 4, 6, 20].

## OTHER CONTRAINDICATIONS

A number of active or prospective divers might have **diabetes**. The clinical course and the severity of the illness vary between individual patients. The main risk associated

with diabetes is a sudden loss of consciousness due to hypoglycemia. Diabetic patients who manage their condition with diet and medication and have not reported any past episodes of hypoglycemia may be permitted to scuba dive. Patients who receive insulin therapy or those treated with oral medications but with a history of hypoglycemia must not be cleared to scuba dive.

**Pregnancy and obesity** are considered relative contraindications to recreational scuba diving. In general, pregnant women should be temporarily discouraged from any diving-related activity. Women who have had a natural birth are not recommended to go scuba diving for at least 4 weeks after they have given birth, while women who have had a Cesarean section should not scuba dive for 8–12 weeks after the delivery. Obesity does not only decrease general physical fitness but it may also increase the risk of a decompression sickness due to a high content of total nitrogen in the body (nitrogen is more soluble in fat than in other tissues). Candidates for scuba diving with any chronic conditions are recommended to have a fitness to dive examination before each dive. A candidate's fitness to dive will depend on the severity of their condition and how well it is controlled [3, 21].

In recent years, scuba diving has been increasing in popularity with people in their 50s. This is undoubtedly associated with a rapid growth in tourism globally, especially scuba diving tourism. Older people should be strongly recommended to undergo a careful medical examination and a fitness to dive assessment before they go diving. Candidates for recreational scuba diving must be made aware that the responsibility for their life and safety lies with themselves. It would be particularly dangerous if they tried to withhold any important information relating to their past or present medical history. It is the role of a physician, a specialist in diving medicine, to inform a patient of the conditions which are relative or absolute contraindications to scuba diving and of the potential health risk factors associated with this sport. Exposure to extreme environmental conditions (cold stress, underwater conditions, increased hydrostatic pressure, increased volume of respiratory gases) causes physiological and systemic changes which may unmask or aggravate certain pre-existing conditions [4, 9–13, 22, 23].

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# Rescue of a saturation diver, unconscious due to an explosion underwater

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## ABSTRACT

*Evolution of “safe diving practices” introduced by the diving industry and regulatory authorities in the North Sea over the past 3 or 4 decades has improved the safety records of oilfield commercial diving considerably. However, accidents still occur. In an accident occurring underwater, the outcome is often fatal. For a diving doctor providing emergency medical advice to the industry, when a diving superintendent calls to say “I have a problem” indicates an emergency and a life and death situation for a diver in water. Making a quick decision after comprehending the situations is important to tackle the problem.*

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**Key words: saturation diving, oxy-arc cutting, underwater explosion, hypothermia**

## INTRODUCTION

During diving nitrogen from compressed air dissolves in blood. While surfacing this dissolved nitrogen is expelled out of the blood during expiration at decompression stop. Any violation in this would result in decompression sickness to the diver. Beyond a depth of 30-40 m, nitrogen produces a narcotic effect and for deeper dives, nitrogen is replaced by helium, another inert gas. Quantity of inert gas dissolving in blood is a depth-time relationship and beyond a certain time no more gas can be dissolved in blood, i.e. blood is fully saturated. Under this condition, time under compression can increase indefinitely but the time for decompression remains constant. This technique known as saturation diving is used extensively in offshore oilfield diving operations for carrying out inspection, maintenance, repair of underwater structures which is carried out from specially constructed vessels. Depending on the size of the vessel, 12-24 divers remain under elevated atmospheric pressure in habitats. Depending on the depth of the oil field, divers are at different storage depths so that the entire length of offshore structure can be attended to. From each depth, limits of upward or downward excursion that can be safely carried out is stipulated. Divers breathe helium oxygen mixture maintaining oxygen partial pressure at

0.4 bars. Temperature is maintained around 26-28°C with a humidity of 70%. Carbon dioxide generated is removed chemically using scrubbers similar to closed circuit anaesthesia machine. These vessels have a built-in open to sea area inside the hull called “moon pool” through which the bell is lowered in water (Fig. 1). They descend down into the sea in a diving bell for carrying out necessary tasks. Divers



**Figure 1.** Diving bell being lowered from Monopole



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work in pairs. A diver goes out of the bell and works for 4–6 h and returns to the bell. Then the second diver goes out and continues working. Diver remaining in the bell is referred to as bell man who is expected to render assistance to the diver in water in an emergency situation. After working, the bell is lifted back to the diving vessel and the divers enter the habitat for rest. They are replaced by another pair of divers in the bell and the work continues. After 4–6 weeks of remaining under pressure in the habitat, divers are slowly decompressed back to surface at a thumb rule rate of 1 h/m, i.e. if the habitat pressure was equivalent to 60 m of sea water (msw), decompression would take 60 h. This is called saturation diving.

In offshore, diving to first 20–25 m of depth is carried out using air and for depths below that saturation diving.

## INCIDENT REPORT

Multipurpose support vessels (MSV) are used for supporting work in an oil field. They are capable of air and saturation diving, firefighting, oil pollution control etc. Such a MSV operating in Mumbai offshore oil fields was engaged in removal of old anodes fitted on a platform. The depth of dive was 53 msw. The MSV had a “cross haul” bell launching system, i.e. although the bell was launched from the “moon pool” in the middle of the ship, it travelled laterally and then went down as if lowered from the ships’ side. It was a three-man bell having 4.5 m<sup>3</sup> volume, but in practice, two divers in saturation were used. Divers were breathing a 10% oxy-helium mixture (10% O<sub>2</sub> and 90% He). Bell was launched to 46 msw and the diver locked out to work as per plan and reached the work location on the leg of the platform. The required cutting gear was lowered from the vessel to the depth and the diver set up the cutting gear on the job to commence work. Cutting produces a very bright flash which blinds the diving supervisor on his monitor screen. Supervisors therefore often switch off the diver’s camera. Audio monitoring is continuous and breathing sound of the diver is an indication that everything is okay.

The anode was fitted with three stubs on the leg. The diver cut two top stubs and informed the diving supervisor accordingly. He relocated for final cut on bottom stub. At that position, visibility was poor and halfway through cutting he needed to change the burning rod. He did not notice a small “gas pocket” on the stub due to poor visibility. After changing the rod and striking it for the final cut, the gas pocket exploded with a big noise. Hearing the sound, the diving supervisor switched “on” the diver’s camera. All he could see was the hand of the diver. He tried calling the diver repeatedly but there was no response.

When the gas pocket exploded, the diver fell down from his perch and soon went into a state of shock and lost consciousness. While falling down he managed to operate

the valve on the helmet, changing his gas supply from on demand to a continuous flow. In the process he also managed to get a grip on a grout pipe on the platform leg at 66 msw. Due to the continuous supply of gas to the helmet, there was a static rattle on the communication radio; the diving supervisor could not ascertain whether the diver was breathing.

The diving supervisor immediately asked the second diver, referred to as bell man, to get out of the bell and rescue the stricken diver as is the normal rescue procedure. The bell man after hearing the explosion had also heard the frantic calling of the supervisor and was aware of emergency situation at hand. He dressed up and informed the supervisor that he was not getting adequate gas supply in his helmet and could not get out of the bell to swim towards the diver in distress.

The diving superintendent called the author at around 20:00 h and apprised him of the situation. At that time “air diving” was taking place on the same leg of the platform. A decision was taken to launch the “stand by” air diver who was geared for any emergency situation for air diving. Because of cross haul diving bell system, the air diver could follow the bell umbilical and descend in water. The plan was to follow the unconscious diver’s umbilical from the bell and reach him. Air diver’s umbilical was short and he could not reach the unconscious diver but could enter the bell. Once inside the bell, he discarded his air diving gear and donned the helmet from the bell. He was now breathing helium oxygen (heliox) mixture instead of air and a change in voice quality confirmed it.

The rescue diver soon managed to reach the unconscious diver. He reported that the free flow gas valve was open and breathing gas was flowing out of the diver’s helmet and that there was no water in the helmet. He also reported that the diver was not responding. He pulled the unconscious diver to the bell and both were helped to enter the bell by the bell man. When his helmet was removed inside the bell, he was still unconscious.

As they splashed fresh water on his face he opened his eyes momentarily. The bell man reported to the supervisor that the diver was alive. The bell was secured as quickly as possible and hoisted back on the MSV. Once in the living chamber, the diver was connected to higher partial pressure (1.6 bar PpO<sub>2</sub>) heliox through built in breathing system (BIBS) called “treatment mix”. Three sessions were used breathing this mix for 20 min followed by a 5 min break breathing habitat mix and he recovered his consciousness immediately.

There was a strong possibility that the rescue diver would go into hypothermia as he was not wearing a hot water suit. Hot water is circulated through the suit of the diver. This is a must for heliox dive. Helium has a high thermal conductivity. Even on surface, if a person breaths

80% helium and 20% oxygen mixture (80/20 heliox mix), he starts feeling cold in a very short time. Diver breathing heliox mixture underwater loses body heat very quickly due to breathing cold and dry inspired gas. Some heat loss also occurs from body surface in cold water. Air divers' "wet suit" is not as thick as that worn by a saturation diver more so in tropical water. Air diver had breathed heliox mixture for almost half an hour without thermal support. There was no shivering. Rectal temperature was 36.4°C. He was made to wear thermal clothing and covered with a duvet; environment control unit temperature was raised to 32°C and hot water bottles placed near his body. He was given plenty of sweet hot chocolate to drink. He recovered in a short span of time.

After a 24 h hold, saturation decompression was carried out and the diver was sent ashore for a thorough medical evaluation. Chest X-ray was reported as normal. Both ear drums were intact. Gas diffusion studies and high resolution computed tomography of the chest were normal. He was declared fit for diving and after resuming work as a diver for a while is now a saturation diving supervisor.

## DISCUSSION

Cause of accident was explosion of a pocket of oxygen hydrogen mixture produced during cutting operations.

Oxy-arc cutting involves the use of large quantities of oxygen and generates hydrogen during the process. When the proportion of hydrogen to oxygen reaches a certain level, an explosive mixture is formed, which ignites when the arc, or a spark, reaches it. Gas pockets are formed when the shape of a structure being cut is such that bubbles of gas are trapped on their way to the surface and allowed to accumulate in sufficient quantity. Such spontaneous explosions of varying intensity occur at the cutting point. Ruptured tympanic membranes in ears, lung injuries and death have been recorded. Research has shown that there is enough hydrogen produced, during the time between making the rod 'hot' and striking the arc, to cause an explosion. An interval of 4 s was shown to be long enough to produce

sufficient hydrogen to cause a serious explosion. Additional explosive or flammable substances on the surface or inside the object being cut e.g. hydrocarbons inside a pipe, paint or bituminous coatings, and some light alloy materials also contribute to the mechanism of blow back [1].

Safety of the rescue diver was the biggest risk taken in the operation. Initially it was planned that he would rescue the unconscious diver and then surface with requisite decompression stops in water or enter the bell and change over to breathing heliox mixture. But the rescue plan changed altogether when he changed over to breathing heliox from bell with new risks. He was dressed up as an air diver and then changed over to breathing heliox mixture using bell man's diving helmet. He was not wearing a "hot water" suit and was in an imminent danger of going into hypothermia. After rescue, a 24 h hold was considered necessary to stabilise the rescue and affected diver before commencing decompression.

Immobilisation of the bell man is explained by a polyvagal theory of adaptive reaction of the autonomic nervous system wherein when faced with an extreme situation, a person goes into "fight/flight/fright" situation. Either he develops immense strength to face the situation and concur it (fight), run away from scene (flight) or develops severe bradycardia leading to immobilization and unconsciousness (fright) [2].

## CONCLUSIONS

The accident occurred in spite of following safety procedures as laid down by the industry [3]. A potential fatality was averted by quick action.

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# Objective and subjective measures to assess stress among seafarers

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## ABSTRACT

**Background:** Working and living on board merchant vessels often constitute high psychophysical stress for the crews. In this study, the current stress of seafarers is examined by using observation-based and subjective measures.

**Materials and methods:** The workplaces of 70 crew members on board 11 container ships were analysed and evaluated using the objective instrument for the situational screening of mental workload (SMW-S). In addition, standardised interviews were carried out with 198 seafarers about their subjectively experienced stress.

**Results:** According to SMW-S, nautical and technical officers experience psychological strain due to their limited decision latitude, risky work situations and the physical and psychosocial working conditions. Among the ratings, psychological distress is more likely due to the limited decision latitude, physical and psychosocial working conditions and low qualification requirements (and, for the engine room ratings, given the low complexity and variability in their work). The interview results show that the irregular work is stressful for 79% of seafarers, the long working periods for 77%, the long working hours per day for 69% and working under time pressure for 62%. Additional psychosocial burdens are present for 95% of seafarers due to family separation and for 65% due to existing social differences in a multicultural occupation.

**Conclusions:** Considering the stressful work on board, particular attention must be paid to shipping-specific conditions such as long working times, family and socio-cultural separation and living together in a heterogeneous crew.

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**Key words:** maritime, strain, stress, situational screening of mental workload

## INTRODUCTION

An essential feature of employment in the maritime sector are the relatively long assignments of up to 12 months on board ships and thus a long period of separation from the family and social relationships at home [1–3]. There are many different job requirements for the multicultural crews on board, with a high proportion of East Asian crew members among ratings. A 24-hour ship's operation with the corresponding watch system – primarily for nautical officers – unpredictable work demands, malfunctions, and cargo handling in the ports (often around the clock) require

the virtually constant availability of crew members [4]. Thus, life on board is primarily determined by work, and there is no clear demarcation between work and leisure [5]. The shipboard 24-hour rhythm on 7 days a week leads to the disintegration of the traditional structure of the day, week, month and year [6].

Especially the activities in ship operation with the quite different demands on the nautical and technical ship's officers as well as the crew-members of deck and engine can lead to psychological strain. The workplaces for officers and crew ratings essentially comprise activities in ship



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operation, cargo handling and load securing, operation and monitoring of the propulsion system, plus cleaning, maintenance and repair work on deck and in the engine room (STCW 2020) [7].

In subjective stress analyses on the psychological stress at work performed using questionnaires, the employees' subjective view often influences the results. In many studies, no distinction is made between actual and perceived mental stress. The Health and Safety Executive (HSE) Management Standards is one of a variety of currently available work analysis tools and is frequently used [8]. The HSE represents a common scientific approach to determine how to tackle work-related stress [9]. It is also a guide for employers on creating management standards at work and features a questionnaire-based procedure with 6 key areas of work, designed for interviewing employees. However, a questionnaire-based survey of seafarers on their work stress has limited informative value due to the specific conditions in seafaring. The perceptions of their work situation can differ considerably among the multicultural shipboard crew and also lead to distorting tendencies, such as social desirability [10]. In addition, the understanding of the English language varies. Thus, for scientific work analysis on mental stress, it is advantageous to have a procedure with an independent expert who observes the specific working conditions. According to Morgeson and Dierdorff [11], such work analysis is of high quality and represents a very important innovation of recent years.

Therefore, a subjective approach based on a questionnaire and an objective approach through an independent expert system should be used when recording mental stress at the workplace. In the subjective person-dependent approach, the person is the feature carrier; in the objective person-independent approach, it is the work situation in which the stress analysis is carried out by an independent expert using a screening procedure.

The studies available so far estimating the stress situation of seafarers on board have often used either subjective or objective methods [12–15]. Particularly an observation-based standardised assessment of the current working situation on board by an expert has rarely been carried out to date. For the first time, this study aims to capture both the objective workload and the subjective stress level of seafarers. According to Schmidtke [16], this combination of objective work analysis and employee survey as the subjective method is the most suitable procedure for measuring job-related stress.

## MATERIALS AND METHODS

Mental stress of seafarers on board container ships was assessed with the objective instrument for situational screening of mental workload (SMW-S) [17, 18] and

a standardised interview [19]. The observation of a total of 70 workplaces on board 11 container ships according to the SMW-S and the interviews with 198 crew members were carried out by a trained psychologist with experience in seafaring.

The SMW-S is a time-saving standardised instrument based on the scientific transactional stress concept of Lazarus and Folkman [20] as well as the order handling concepts of the action regulation theory of Hacker [21]. It is preferably used as part of the hazard analysis in the production and service sectors. Its objective is the analysis and assessment of work-related mental stress. The procedure captures the essential characteristics of the work situation in a workplace. In the psychological sense, it is an objective approach for recording the workload through external observation.

In the preparation of the SMW-S application on board, job and requirements profiles for nautical and technical officers as well as deck and engine room ratings were created based on the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers [7], International Safety Code [22], International Ship and Port Security Code [23] and on job descriptions of individual shipping companies. During the evaluation, the external observer analysed and evaluated the workplaces objectively for possible mental stress with regard to the scales of decision latitude, complexity/variability, qualification requirements, risky work situations, and physical/psychosocial working condition. Only negative assessments were calculated, added and weighted by 0.5, 1.0 or 2.0 when a critical value was reached or exceeded.

In the case of decision latitude, the critical value for the sum of the negative judgments is  $\geq 3$ , for complexity/variability  $\geq 5$ , and for physical and psychosocial working conditions  $\geq 5$ . These critical values are each weighted by 1.0. For the qualification requirements, the critical value is  $\geq 1$  and is multiplied by 0.5, and for the risky work situations, the critical value of  $\geq 4$  is weighted by 2.0. The weighted values of the five scales in each occupational group are added together. With a sum of  $\geq 4$ , mental stress is considered; between 1.5 and 3, mental stress is probable.

A prerequisite for the observing expert is sufficient knowledge of the workplaces, of the exposure at the various workplaces and of the environmental factors. In addition to the expert procedure, an individual reflection of the stressful work and job-specific conditions in the sense of a subjective personal assessment by the job holders should take place in the form of questions. This subjective assessment of mental stress of crew members on seagoing vessels was based on a standardised interview [24, 25]. This qualitative method was tested in several pilot studies and used in a specific maritime context [19].

**Table 1.** Scales of mental stress according to situational screening of mental workload, depending on different occupational groups

Scales	Weighted value	Raised critical values (sum of negative assessments)			
		Nautical officers (n = 25)	Deck ratings (n = 17)	Technical officers (n = 20)	Engine room ratings (n = 8)
Decision latitude	1.0	1 (4)	1 (4)	1 (4)	1 (6)
Complexity/variability	1.0	0 (2)	0 (0)	0 (1)	1 (5)
Qualification requirements	0.5	0 (0)	0.5 (1)	0 (0)	0.5 (1)
Risky work situations	2.0	2 (4)	0 (3)	2 (4)	0 (3)
Physical and psychosocial working conditions	1.0	1 (8)	1 (8)	1 (7)	1 (7)
Total		4.0	2.5	4.0	3.5

## ETHICAL APPROVAL AND INFORMED CONSENT

The study was approved by the Ethics Committee of the Hamburg Medical Association (no. PV4395).

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

## RESULTS

### SITUATIONAL SCREENING OF MENTAL WORKLOAD (SMW-S)

The average seafaring time was relatively high with 13.6 years in the investigated group, especially among nautical and technical officers (16.5 and 18.6 years, respectively) compared to the deck ratings and engine room ratings (11.4 and 11.2 years, respectively) ( $p = 0.002$ ).

The sum of the weighted values for the jobs of the nautical and technical officers is 4. These results mean mental stress for these two occupational groups (Table 1). They include a limited scope for decision latitude, a risky work situation and stressful physical and psychosocial working conditions. For the ratings of the deck department and in the engine room, the sum of the weighted values is 2.5 and 3.5, respectively. They refer to a limited scope for decision latitude, low qualification requirements and physical/psychosocial working conditions. A limited complexity and variability in the activity is also evident in the engine room ratings. Thus, according to SMW-S, mental stress is likely at the ratings' workplaces.

On the whole, the workplaces of all four occupational groups have limited decision latitude and stressful physical and psychosocial working conditions. According to the SMW-S item list, the decision latitude is, for example, limited when work content as well as communication and cooperation are predominantly restricted by technical and organisational requirements in addition to legal requirements. This is relevant for the maritime context. In SMW-S, stressful physical and psychosocial working conditions are assumed, for example, in the case of irregular working hours, work

compaction, unpredictable disruption, no error correction, difficult environmental conditions and lack of support from supervisors or employees.

### SUBJECTIVE ASSESSMENT OF THE STRESS ON BOARD

Using a maritime-based interview guide on the subjective stress of seafarers [15], this study reveals that low opportunities for shore leave (85%), irregular working hours (79% with 89% among officers and 73% among ratings), long assignments on board (77%), long working hours per day (69%), working under time pressure (62%) and an increase in job-related dangers due, for example, to accidents or piracy (59%) are the main stressors on board.

The assessment of management behaviour on board shows that 44% of the seafarers find it burdensome not to be able to address their superiors openly about mistakes. A lack of understanding on the part of superiors and shipping companies of the situation and problems of the crew on board as well as a lack of fair treatment by the shipping company were stressors for almost 30% of the seafarers surveyed.

Concerning psychosocial stressors, almost all of the seafarers interviewed (95%) found that separation from family and social relations at home was a stressor, especially when it was not possible to directly influence family problems and difficulties (80%). Social differences in living together with multicultural crews were experienced by 65% of the crew members surveyed. For 35%, these differences lead to problems in such an occupational structure. Psychosocial stress on board can also result from language comprehension difficulties (31%).

## DISCUSSION

This study reveals that the stressful physical and psychosocial working conditions, the limited decision latitude and the risky work situation are the main causes of mental stress among nautical and technical officers. Also accor-

ding to the Job Demand-Control or the Job Strain model of Karasek [26] or Karasek and Thoerell [27], having limited or no scope for decision-making is an important aspect of psychological distress and disability. Essential features of decision latitude are the implementation, scope, time and duration of the activity as well as the lack of possibility to make decisions on one's own responsibility. Limited autonomy for the ship's master and officers results from strict adherence to a schedule with fixed arrival and departure times in the ports and within the watch system, the consideration of numerous national and international regulations and laws (e.g., ISM Code [22], ISPS [23], SOLAS [28]), and stronger control by the shipping company. The work of the officers often places high demands on the reliability of action, exact compliance with regulations, time constraints, transmission of information, and assessment of hazardous actions as essential characteristics of a risky work situation.

The ratings play a subordinate role in the on-board hierarchy and are thus only involved to a very limited degree in the organisation of their professional activities, which are characterised by a high level of routine and partly (legally) prescribed procedures. This limited decision latitude obviously causes stress in ratings. This applies in particular to the engine room ratings, who have to adhere to regular maintenance and cleaning intervals and therefore also experience low complexity and variability in their work situation. Different working methods and procedures, various work requirements and varied communication and cooperation relationships are criteria for complexity and variability in an activity. Hence, there seems to be a need for more variety, especially for the ratings, which could be compensated for through a more varied range of leisure activities during the usually several months of assignment on board.

Deck ratings also usually perform consistent or repetitive work tasks, such as monitoring, cleaning, preservation and maintenance work. Normally, only one learning and training period is required for these activities. The fact that new or relearning training is not required in heavily regulated ship operations can, in the long term, be a stressor that could be relieved through increased job rotation or by taking on new responsibilities (e.g., in community activities to be organised during leisure time on the high seas).

When evaluating the objective working situation with SMW-S, the occupation-specific conditions of seafaring must be taken into account. They should include the lack of shore leave, long working assignments on board and thus the separation from family and friends [29]. Corresponding to the results in the observation-based approach of the SMW-S (stressful physical/psychosocial working conditions and low decision latitude), the subjective assessments of

the seafarers surveyed also show high stress in the work situation. This is, above all, due to the irregular and long working hours, work under time pressure, increased risk but also the specific situation of the long assignments and low shore options [30]. But the managerial behaviour of superiors, such as a lack of openness, inadequate or lacking understanding, is also rated negatively by several sailors and experienced as a stressful work situation [31, 32].

The extent to which stressors in the work process trigger stress reactions and the experience of stress in seafarers also depend on their primary and secondary coping strategies. Primary coping encompasses a variety of different actions, such as seeking support, expressing one's emotions or regulating one's emotions, and provides an important sense of control over environmental circumstances. Secondary coping includes such mental actions as distraction, cognitive restructuring and rethinking about the stressors or problems in such a way as to facilitate acceptance. This adaptation of oneself to the environment represents a more internally focused coping strategy that is generally applied when stressors cannot easily be counteracted directly [33].

According to Oldenburg and Jensen (2019) [34], visits to shore-based leisure facilities provide opportunities to compensate on-board stress. A variety of contacts and social activities, e.g., in seafarers' missions, enables seafarers to distance themselves and recover from stressful situations on board. Seafarers' missions also allow seafarers to satisfy their religious needs; this is particularly important for Filipino seafarers, who are quite religious and form the largest group worldwide. Furthermore, stressful experiences can be reduced through improved telephone contacts with the family at home [35, 36].

Job-related stressors can cause major psychophysical stress, especially for seafarers who are deployed on board for months at a time, and can pose a health risk [37]. Generally, it must be taken into account that stress can also have positive effects, provided that those affected have sufficient resources, such as primary and secondary coping strategies. As the available coping strategies of the ships' crews can only be insufficiently assessed by expert observation, they are not the subject of the present study.

## CONCLUSIONS

Overall, this study shows that working conditions on board are at least likely to increase mental stress on board. Therefore, intervention measures on ships are urgently needed. However, since the operation of a ship requires strongly regulated, in some cases legally prescribed procedures, one focus of the intervention will lie in an optimised design of needs-oriented leisure opportunities during stays on the ships for several months.

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## CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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# Effect of daily social media exposure on anxiety and depression disorders among cargo seafarers: a cross-sectional study

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## ABSTRACT

**Background:** Several studies have linked social media use to increased risks for anxiety and depression. Cargo seafaring is one occupation prone to constant mental health instability due to workload, social isolation, and harsh working conditions. We examined the effect of daily social media exposure, occupational experience, and socioeconomic factors on anxiety and depression disorders among cargo seafarers.

**Materials and methods:** We assessed the anxiety and depression disorders of 153 cargo seafarers using Generalised Anxiety Disorder-7 and Patient Health Questionnaire-9 scales. We fitted generalised linear models to estimate associations between depression and anxiety disorders and daily social media exposure, occupational experience, and socioeconomic factors.

**Results:** Approximately 30% and 37% of the seafarers had mild, moderate, or severe anxiety and depression disorders. The prevalence of anxiety was 2.68 times higher (adjusted prevalence ratio [aPR] 2.68, 95% confidence interval [95% CI] 1.30–5.50) and 2.27 times higher (aPR 2.27; 95% CI 1.12–4.62) among seafarers who spend > 2 to 4 hours and > 4 hours each day, respectively, on social media compared to seafarers who spend only up to 2 hours. In addition, seafarers who were on social media daily for > 2 to 4 hours (aPR 1.49; 95% CI 0.86–2.60) and > 4 hours (aPR 1.34; 95% CI 0.75–2.40) had a higher prevalence of depression compared to seafarers who were on social media daily for only up to 2 hours. Non-Catholics or seafarers with ≤ 10 years of occupational experience had a higher prevalence for anxiety and depression disorders than Catholics or seafarers with > 10 years of occupational experience.

**Conclusions:** Daily social media exposure for > 2 hours, working for ≤ 10 years, or being a non-Catholic may contribute to the increase in the seafarers' susceptibility to depression and anxiety disorders. The establishment of support groups for cargo seafarers is warranted to promote mental health awareness and well-being.

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**Key words:** anxiety disorder, Catholic, depression disorder, Generalised Anxiety Disorder-7, occupational experience, Patient Health Questionnaire-9, seafarers, social media

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## INTRODUCTION

Social media has been integrated into the daily lives of many of its users. In 2016, roughly 2.31 billion users globally used one or another form of social media [1]. As the number of users increases, social media has extended its reach into many facets of our everyday lives, from work to politics to communicating with friends and strangers and how we get and share information [2]. This widespread use of social media has led to many research studies examining social media's utilisation and its effects on our health and life. Various studies have been reported to assess its association with psychosocial health and overall well-being; however, results have been conflicting. In one review, internet usage may help increase self-esteem, perceived social support, and increased social capital while contributing to increased exposure to harm, social isolation, cyberbullying, and depression [3]. In another review, the effect of social media use on depression and anxiety is similarly inconclusive [4].

Depression and anxiety are the two most common mental health disorders worldwide. Depression affected approximately 4.4%, or 322 million, of the world's population in 2015. Moreover, depression is also considered the single largest contributor to non-fatal health loss accounting for 7.5% (50 million) of all years lived with disability globally. In addition, 3.6% of the population are diagnosed with an anxiety disorder [5]. Anxiety and depression are the most common mental health disorders among adolescents [6]. The prevalence of anxiety and depression has increased by 70% in the past 25 years [7]. Furthermore, these two disorders are comorbid conditions [8] while also with other morbidities. Depression and anxiety have adverse consequences, including impaired social relationships and increased risk of substance abuse, mental health problems, and suicide, one of the top 20 leading causes of death in the United States [9–11]. Aside from the direct costs from these illnesses to the individuals, costs from comorbid conditions account for a larger part of its economic burden [12]. These two conditions have also negatively impacted work performance and decreased economic productivity in the workforce [13, 14].

Many factors contribute to the development of depression and anxiety, such as genetics and environmental factors [15, 16]. Due to the harsh environmental conditions in seafaring, mental health issues among crew members are not surprising. Seafaring is considered one of the most hazardous jobs globally [17]. Besides being exposed to occupational health hazards, seafarers are also prone to experiencing social isolation, given their extended deployment at sea and away from home [18, 19]. In addition, the exact prevalence of anxiety, and depression, is not entirely known among the maritime population, with some studies offering inconsistent conclusions.

Furthermore, evidence from previous studies supports generally stable mental health among seafarers, including a low rate of medical repatriation due to psychological reasons and a decline in suicide rates in recent decades [20, 21]. However, these findings do not guarantee a good mental health status among seafarers. Some studies report suicidal ideation among seafarers reported by their colleagues and increased prevalence of stress and fatigue [18]. With the advent of the internet and social media comes a more accessible avenue for communication. Social media encompasses web-based and mobile-based applications that allow users to exchange generated content and build virtual networks that are ubiquitously available. Aside from social networking sites such as Twitter and Facebook, it also includes really simple syndication feeds, news, blogs, and all unstructured text available on the internet [22]. Understanding how the use and access to social media affect their mental health will help inform policies that may influence their lives at sea. Moreover, the literature also indicated an increased use of social media due to the increased symptoms of depression and anxiety. The relationship between social media use and symptoms of depression and anxiety is complex due to the bidirectional effects [23].

The impact of social media exposure and mental illness on workers' occupational health cannot be overstated. Several factors have been linked to increased adverse mental health effects due to social media exposure. In addition, various mechanisms could account for the association between social media use and mental health disorder. People who engage in high levels of social media use may experience more inadequate quality sleep, which may be a mediator on the pathway to depression or anxiety [24]. Time spent on social media may also increase the risk of experiencing cyberbullying, which may lead to an increased risk for depression, particularly in teenagers and young adults [25]. Aside from age and time spent on social media, another factor that may affect the mental illness includes religious beliefs or spirituality. A study suggested that religious beliefs and practices were consistently associated with greater life satisfaction and psychological well-being. This association led to less anxiety and fear, increased hope and optimism, and decreased depression [26].

In this study, we focused on estimating the prevalence of depression and anxiety among cargo merchant seafarers and examining the effects of daily social media exposure, occupational experience, and socioeconomic factors on anxiety and depression.

## MATERIALS AND METHODS

### STUDY POPULATION

This cross-sectional study involved 153 international seafarers who were enrolled from March 2019 to June 2019. Participants' recruitment was face-to-face at the

Antwerp Seafarer Centre in Antwerp, Belgium, and through some online social media platforms. Seafarers with electronic devices who agreed to participate in the study were given a link to access the web-based self-administered questionnaire in English. Eligible study participants were 18–65 years old, male, currently deployed on a merchant cargo ship, and worked on board for at least 2 months. Excluded from the study were female seafarers, given the expectedly low number of respondents. In addition, the web-based questionnaire included the demographic profile of the seafarer, their employment history, nationality, religion, daily social media use, and screening tools for the assessment of anxiety and depression disorders. Prior to answering the questionnaire, each participant was asked to consent before proceeding with the survey questionnaire. This study obtained institutional ethics approval from an independent research ethics committee.

### EXPOSURE ASSESSMENT OF DAILY SOCIAL MEDIA USAGE

Daily social media use was assessed by adding the participants' self-reported hours on social media during and after their work shift. The total was used to group the daily social media exposure of seafarers into three categories: 0 to 2 hours, > 2 hours to 4 hours, and more than 4 hours.

### HEALTH OUTCOME ASSESSMENT OF ANXIETY AND DEPRESSION

The severity of the seafarers' anxiety was assessed using the 7-item Generalised Anxiety Disorder-7 (GAD-7), a standard tool for anxiety disorder assessment. Respondents were asked, "Over the last two weeks, how often have you been bothered by the following problems?" The response anxiety scale options for the 7-item questions were "not at all," "several days," "more than half the days," and "nearly every day," and each scale option was scored as 0, 1, 2, and 3, respectively. The seafarers were grouped into four outcome categories based on their total GAD-7 score using a diagnostic algorithm for anxiety disorders: 0 to 4—no/minimal anxiety; 5 to 9—mild anxiety; 10 to 14—moderate anxiety; and 15 to 21—severe anxiety [27].

Patient Health Questionnaire-9 (PHQ-9), a 9-item tool representing the nine Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) criteria of depressive disorder, was used to assess the severity of the seafarers' depression. Response depression scale options were identical to the GAD-7 questionnaire used for anxiety disorder assessment. Seafarers, based on their total PHQ-9 score, were grouped into no/minimal depression (0 to 4), mild (5 to 9), moderate (10 to 14), moderately severe (15 to 19), and severe (20 to 27) using a diagnostic algorithm for major depressive or other depressive disorders [28]. Both the PHQ-9 and GAD-7 as-

essment tools have strong internal validity, test-retest reliability, and construct and factor structure validity [29].

### STATISTICAL ANALYSIS

We calculated the descriptive statistics for the demographic profile, daily social media use, and the anxiety and depression disorder health outcomes. The correlation coefficients were also calculated to evaluate the relationship between anxiety, depression, covariates, and daily social media use.

Associations between depression and anxiety disorders and daily social media use were estimated using generalised linear models with Poisson distribution and log link function and with a robust variance estimator, a more appropriate approach to analyse cross-sectional data with common health outcomes [30–33]. In addition, seafarers were classified into two groups according to their total PHQ-9 score (no/minimal depression: score  $\leq 4$ ; with mild to severe depression: score  $> 4$ ) and GAD-7 score (no/minimal anxiety: score  $\leq 4$ ; with mild to severe anxiety: score  $> 4$ ). Furthermore, generalised linear models were fitted to account for the heterogeneity in the seafarer's overall anxiety and depression disorders.

In all the models, we controlled for age (young adult; adult), relationship status (in a relationship; single/no relationship), educational attainment (college graduate; a college-level student or less), religion (Catholic; non-Catholic), nationality (Filipino; non-Filipino), years working as a seafarer ( $\leq 10$  years;  $> 10$  years), months on the current contract ( $\leq 6$  months;  $> 6$  months), and employment status (officer; staff). The sociodemographic characteristics and occupational experience used were chosen *a priori* as potentially important predictors of anxiety and depression disorders [34, 35].

Effect size estimates were reported as adjusted prevalence ratio (aPR) with a 95% confidence interval (95% CI) for the effect of daily social media use and other factors on depression and anxiety disorders. STATA 12 was used in the statistical analyses ([www.stata.com/stata12/](http://www.stata.com/stata12/)). P-values of  $\leq 0.05$  were considered to be statistically significant.

### RESULTS

One-hundred fifty-three (153) eligible participants were included in the study. Participants had a mean ( $\pm$  standard deviation) age of  $31.0 \pm 8.3$  years, with 87.6% being Filipinos. Most of them were Catholic (75.2%), at least a college graduate (84.3%), and with 10 years or less work experience (79.1%), while only about 37.2% were in a relationship. Participants' self-reported hours on social media during and after their work shift, 1/3 of them spent 0 to 2 hours on social media, approximately 3 out of 10 spent  $> 2$  to 4 hours, and about 3 out of 10 spent  $> 4$  hours, respectively. The survey on depression disorders revealed that most of them had no/minimal depression (62.7%), while

**Table 1.** Study characteristics of the seafarer participants (n = 153)

Characteristics	N	Values
Age [years]	152	31.0 ± 8.3
Young adult (21–25 years old)	41	26.8
Adult (> 25 years old)	111	72.5
No data/missing	1	0.7
In a relationship	57	37.2
At least a college graduate	129	84.3
Catholic	115	75.2
Filipino	134	87.6
≤ 10 years of work experience	121	79.1
> 6 months on the current contract	59	38.6
Officer of the vessel	54	35.3
Hours spent on social media:		
0 to 2 hours	51	33.3
> 2 to 4 hours	47	30.7
> 4 hours	48	31.4
No data/missing	7	4.6
PHQ-9 score distribution:		
No/minimal	96	62.7
Mild	37	24.2
Moderate	11	7.2
Moderate severe	7	4.6
Severe	2	1.3
GAD-7 score distribution:		
No/Minimal	107	69.9
Mild	29	18.9
Moderate	16	10.5
Severe	1	0.7

Data are shown as mean ± standard deviation or per cent. GAD-7 – Generalised Anxiety Disorder-7; PHQ-9 – Patient Health Questionnaire-9

almost one-fourth of the participants had mild depression. In addition, the survey collected on anxiety disorders also showed that nearly 7 out of 10 had no/minimal anxiety, while almost one-fifth had mild anxiety. Furthermore, only about 1.3% and 0.7% had severe depression and anxiety, respectively. Table 1 summarises the study characteristics of the seafarers in detail.

### EFFECT OF DAILY SOCIAL MEDIA USE ON ANXIETY AND DEPRESSION DISORDERS

Figure 1 shows the estimated effect of daily social media use for various hourly exposure on depression (Fig. 1A) and anxiety (Fig. 1B) disorders. The linear models showed that seafarers' exposure to daily social media use was associated with an increased prevalence for both anxiety and depression. The prevalence of anxiety was 2.68 times higher (aPR 2.68, 95% CI 1.30–5.50,  $p < 0.01$ ) and 2.27 times higher (aPR 2.27, 95% CI 1.12–4.62,  $p = 0.02$ ) among sea-

farers who spend > 2 to 4 hours daily and > 4 hours daily, respectively, on social media compared to seafarers who spend only up to 2 hours daily on social media. Additionally, seafarers who were on social media daily for > 2 to 4 hours and > 4 hours had a higher prevalence of depression (aPR 1.49; 95% CI 0.86–2.60;  $p = 0.16$  and aPR 1.34, 95% CI 0.75–2.40;  $p = 0.32$ , respectively) compared to seafarers who were on social media daily for only up to 2 hours.

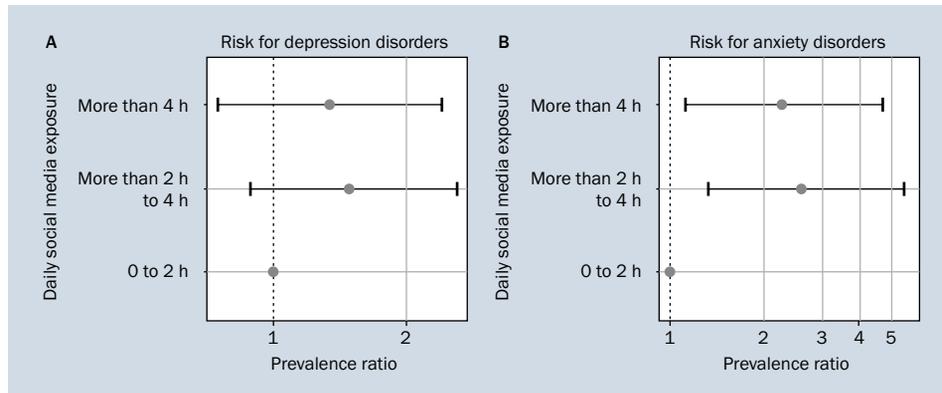
### EFFECT OF OCCUPATIONAL EXPERIENCE AND SOCIO-ECONOMIC FACTORS ON ANXIETY AND DEPRESSION DISORDERS

Figure 2 shows the occupational experience and socio-economic factors associated with anxiety and depression disorders for the seafarer participants. Participants with ≤ 10 years of work experience had approximately 3 times and 2 times higher prevalence of depression (aPR 3.11; 95% CI 1.16–8.36) and anxiety (aPR 2.02; 95% CI 0.73–5.61), respectively, compared to participants with > 10 years of work experience. Moreover, the prevalence of anxiety was 69% higher for seafarers in the 21 to 25 years old age group compared to seafarers in the > 25 years old age group (aPR 1.69; 95% CI 1.05–2.72). Furthermore, non-Catholic seafarers had both a higher prevalence of anxiety (aPR 1.86; 95% CI 1.15–3.00) and depression (aPR 1.62; 95% CI 1.06–2.48) compared to Catholic seafarers (Table 2).

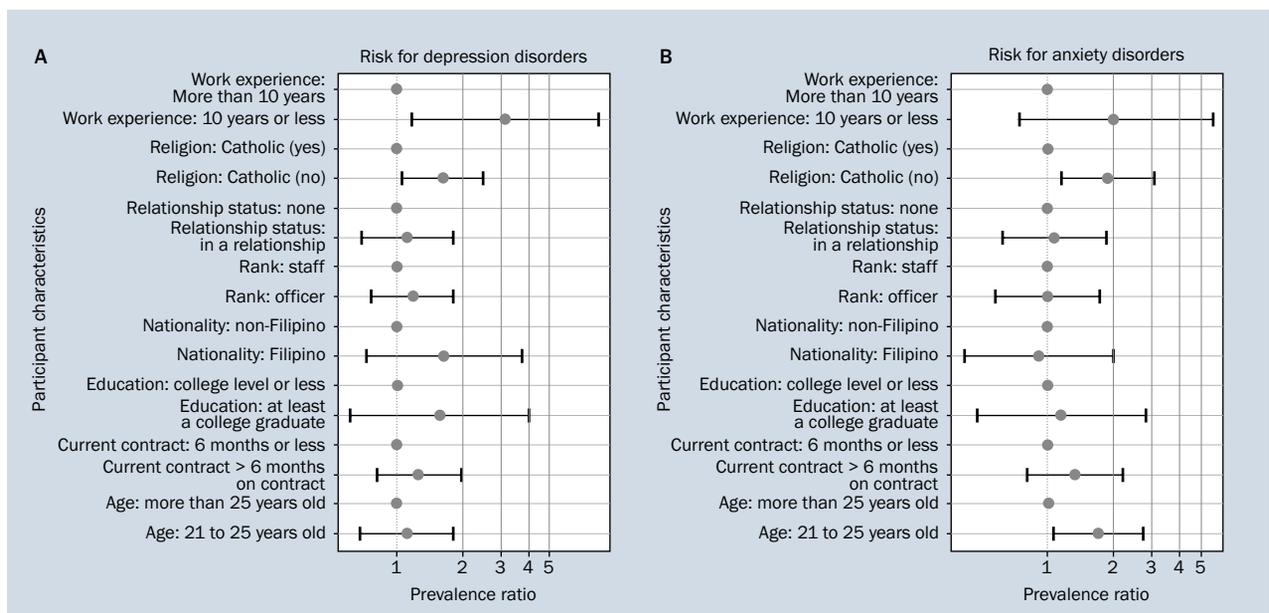
### DISCUSSION

Globally, there is increasing recognition of the effect of mental health conditions on working populations. Seafarers are among the occupational workers at most risk for adverse mental health outcomes [36]. Generally, the seafarers' mental health and health-related quality of life are poor [37]. In addition, mental health issues such as depression and anxiety are recognised as health problems [38]. Currently, there is limited research on occupational exposures and mental health among international seafarers [39]. Different factors, including months or years away from home, and loneliness, may trigger anxiety and depression, and for some seafarers, even suicide [19].

Our study showed that approximately 37% and 30% of the cargo seafarers had mild, moderate, or severe depression and anxiety. Using the same screening tools to assess depression and anxiety, one study reported about 25% and 17% had scores suggesting depression and anxiety, respectively, among international seafarers [39]. In another study on Chinese seafarers, almost half had mild to severe depression [40]. Our research also provided further understanding of the psychosocial health risks among international seafarers, including Filipinos, who are among the world's top seafarers. Nevertheless, with the different reported prevalence of anxiety and depression



**Figure 1.** Adjusted prevalence ratio for the effect of daily social media use on depression (A) and anxiety (B) disorders. All models were adjusted for age (young adult [21–25 years old], adult > 25 years old]; in a relationship status (yes, no); education (at least a college graduate, college level or less); Nationality (Filipino, non-Filipino); religion (Catholic, non-Catholic); work experience (> 10 years, 10 years or less); on current contract (> 6 months, 6 months or less); and officer of the ship (yes, no). Error bars indicate 95% confidence interval



**Figure 2.** Adjusted prevalence ratio for the effect of occupational experience and socio-economic factors on depression (A) and anxiety (B) disorders. All models were adjusted for age (young adult [21–25 years old], adult > 25 years old]; in a relationship status (yes, no); education (at least a college graduate, college level or less); Nationality (Filipino, non-Filipino); religion (Catholic, non-Catholic); work experience (> 10 years, 10 years or less); on current contract (> 6 months, 6 months or less); and officer of the ship (yes, no). Error bars indicate 95% confidence interval

among seafarers, more studies are warranted to validate our research findings.

Understanding social media’s effect on well-being has become necessary due to a simultaneous increase in mental health problems, including depression and anxiety [41]. Our study’s result that suggests a positive association between daily social media use and depression and anxiety is in agreement with several previous studies that reported the associations between the increased use of social media and heightened levels of depression and anxiety [42–46].

However, other studies have also reported mixed or no relationship [47].

We also observed evidence that anxiety is significantly associated with > 2 to 4 hours and more than 4 hours of daily exposure to social media than those who usually spent 0 to 2 hours on social media. Similarly, a study of adults published that people who were addicted to social media reported more anxiety [48]. One explanation could be that social media sites may be a source of stress that could contribute to elevated anxiety disorders and related

**Table 2.** Adjusted prevalence ratio (PR) with 95% confidence interval (95% CI) for the effects of daily social media use, occupational experience, and socio-economic factors on depression and anxiety disorders

Characteristics	PR for depression (95% CI)	PR for anxiety (95% CI)
Daily social media use:		
0 to 2 hours	1.0	1.0
> 2 to 4 hours	1.49 (0.86, 2.60)	2.68 (1.30, 5.50)
> 4 hours	1.34 (0.75, 2.40)	2.27 (1.12, 4.62)
Age:		
> 25 years old	1.0	1.0
21 to 25 years old	1.11 (0.68, 1.80)	1.69 (1.05, 2.72)
Relationship status:		
No relationship	1.0	1.0
In a relationship	1.11 (0.69, 1.79)	1.07 (0.62, 1.85)
Education:		
College level or less	1.0	1.0
At least a college graduate	1.57 (0.61, 4.00)	1.15 (0.48, 2.78)
Religion:		
Catholic	1.0	1.0
Non-Catholic	1.62 (1.06, 2.48)	1.86 (1.15, 3.00)
Nationality:		
Non-Filipino	1.0	1.0
Filipino	1.64 (0.72, 3.74)	0.92 (0.42, 2.01)
Work experience:		
> 10 years	1.0	1.0
≤ 10 years	3.11 (1.16, 8.36)	2.02 (0.73, 5.61)
Months in current contract:		
6 months or less	1.0	1.0
> 6 months	1.26 (0.81, 1.96)	1.33 (0.80, 2.20)
Employment status:		
Staff	1.0	1.0
Officer	1.18 (0.76, 1.83)	1.00 (0.58, 1.73)

impairments [49]. Another hypothesis is that exposure to social media triggers unhelpful social comparisons, such as believing that others are happier and have better lives [50]. One research among adults in the United States reported participants spent an average of 6.63 hours on social media, and a higher daily social media use was significantly associated with more significant dispositional anxiety disorders [51]. The previous studies' results are consistent with our findings of a higher risk of anxiety from increased social media use.

Our study also suggests that increased daily social media use is associated with the risk of depression. Our findings are supported by previous studies that show evidence of a greater risk of depression for spending more time than spending less time on social media [52, 53]. One study of 1730 adults who used the same tool to assess depression reported participants who highly used social media in terms of time spent, frequency, multiple platforms, and intensity increased the odds of having elevated depression by 2 times

[52]. In comparison, another study of young adults had found that social media use was significantly associated with increased depression by 2 times [53]. These studies confirmed the results of our research, which also observed similar positive effect estimates. Several studies have related social media use with declines in subjective mood, sense of well-being, life satisfaction, and an increase in depression [50, 54, 55]. One probable explanation may be that constant exposure to idealized representations of people on social media provokes thoughts of envy and the distorted belief that others lead happier lives, and these envious feelings may lead to depression over time [56, 57]. Moreover, the significant increase in the amount of time one spends on social media has led to recognising a specific psychiatric condition called "internet addiction" closely associated with depression [58]. To further understand the effect of social media on seafarers' overall mental well-being, future studies are needed to focus on studies assessing the links of psychological well-being, social media usage, and

various neutral outcomes such as general job satisfaction, resilience, and subjective happiness among seafarers.

Our study suggested that working for 10 years or less as a cargo seafarer will likely increase the risks of developing depression or anxiety, which may be attributed to not being accustomed to the work routines, or being away from their family. However, continuous long years of separation, time pressure, and long working days with few opportunities for communication and the feelings of social isolation were reported in previous studies to contribute to the detrimental impact and dilapidation on seafarers' mental health, including anxiety and depression [19, 59–63]. Nonetheless, more studies are needed to support the findings of our research.

In addition, our observed association between being a Catholic and a lower risk of anxiety and depression were in agreement with past studies. In a prospective study, Catholic adults with high personal importance of religion or spirituality had about one-fourth the risk of having depression or anxiety episodes than adults who did not value spirituality that much [64]. The protective effect of religion or spirituality against the risk for depression or anxiety among high-risk groups was found to exist primarily against recurrence rather than onset [65]. Spiritual practice may be associated with physiological and morphological changes in the brain, including increases in serotonin, leading to decreased risk for depression or anxiety [66].

To our knowledge, this is the first study conducted with Filipino seafarers that assessed the association between their daily social media usage and their risk for depression and anxiety disorders. Furthermore, an electronic survey questionnaire tool ensures efficient and timely data collection and limits the number of missing data from the respondents. In addition, the use of generalised linear models with Poisson distribution and log link function to analyse cross-sectional data with common health outcomes reduces overestimation of effect estimates, provides narrower confidence interval(s), and are relatively robust to omitted (residual) factors compared to logistic regression models [30, 33].

### LIMITATIONS OF THE STUDY

One of our study's limitations is the use of a cross-sectional study design; contrasts were mainly between participants from a one-time point, and a temporal association between the exposure variables and anxiety and depression cannot be measured. Additionally, our study did not assess the bidirectional relations between mental health and social media use, which should not be dismissed. The interactions of religion and age with social media use should be addressed in future studies. The younger generation has been identified as less religious, and their use of social media

continues to rise. Consequently, confounding factor bias would be more than in a longitudinal study design, which can account for the contrasts for both between and within-subjects. Moreover, unmeasured or residual confounding factor bias should not be omitted. Because the study population consists of all male merchant seafarers who are mostly Filipino, our study's findings may not be generalisable to other occupational groups, women, teenagers, children, or other ethnic or racial groups. Daily social media use on the risk of depression and anxiety in these populations should be explored in future research.

### CONCLUSIONS

This study documents that daily social media exposure for > 2 hours may increase the risk of anxiety and depression among cargo seafarers. In addition, susceptibility to increased risk of depression and anxiety is more likely to occur among cargo seafarers with ten years or less experience. However, being a Catholic cargo seafarer may suggest being protected from the risk of anxiety and depression. This study also showed that different levels of anxiety and depression are expected among cargo seafarers. Lastly, our results provided information that can be useful for support groups for seafarers. Considering the amount of time spent by most seafarers on social media, this can also serve as a potential avenue to disseminate health information and promote mental well-being.

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# Visualisation and bibliometric analysis of worldwide research trend of stress among seafarer: an extensive publication analysis

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## ABSTRACT

Stress is the most predominant and worldwide psychological human condition that undoubtedly impedes the state of mind of the individuals. During the last few years, a tremendous change and growth in the global publishing trend for human stress have been observed. Like other professionals (doctors, bankers, teachers, and businessmen), the mariners or seafarers are also being the most common victims of this human psychological disorder (stress) these days. The keywords “seafarer” and “stress” have been exposed to mine the research trend of the articles exploring the stress among the seafarers. From 2001 to 2020, more than six thousand (6211) human stress-based articles have been reported in Scopus indexing database. However, the number of articles related to the stress among seafarer is 136 only i.e. 2.18% of the human-stress based articles. The research related to the psychological disorder (stress) among seafarer has been increased during the last two decades. Germany, United Kingdom and Italy found to be the topmost countries for exploring the stress among the seafarer. The study concluded that the human psychological conditions like bulimia, anorexia nervosa, obsessive-compulsive disorder, schizophrenia, generalised anxiety disorder, cyclothymia, mood, conduct, and personality disorders along with stress still need to be extensively mined to diagnose the state of mind of seafarers.

(Int Marit Health 2021; 72, 1: 64–75)

**Key words: seafarer, psychological disorders, stress, maritime industry**

## INTRODUCTION

The bibliometric and publishing study assists in getting the complete publication and citation trend of the articles [1]. This information will assist in finding the impact and influence of research domain, articles, journals, publishers, authors, research groups and funding agencies. The details regarding universities, authors, research groups and countries who are pursuing their research work in specific areas for the welfare of the society can be easily extracted from a bibliometric analysis. The details of funding agencies that support similar kind of work can also be extracted through the research trend of this study. The ideas relating to stress, related works, and the novelty of this research work have been briefly highlighted in the rest of this section.

## STRESS

Earlier, cancer, diabetes and heart attacks were the most critical and prevalent global human disorders [2]. However, nowadays, the psychiatric disorders are the most proliferating human diseases. Stress is a predominant, persistent and global human psychiatric disorder. It is a human psychiatric disorder that inevitably revamps the state-of-mind of an individual [3, 4]. It affects the thinking, moving, walking, eating and working capacity of the victim. The late diagnosis of stress may intricate several other human critical disorders like diabetes, stroke, anxiety and depression. Therefore, it is intended to diagnose these psychiatric conditions at an early stage.

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## RELATED WORKS

Earlier, different studies have been carried out to explore the publishing and bibliometric trend for disaster health [5], public health research [6], open-access [7], clinical radiology [8], predatory journals [9], epidemiology [10], health services [11], ergonomics [12], feature selection [13], and neurological disorders [14]. However, a little attention is given to mine the research trend of stress among maritime industry workers. The maritime industry is the backbone of the world trade business and is responsible for globalization and foreign exchange.

## NOVELTY

The objective of this study is to examine and highlight the publishing trend of stress among seafarer based articles. A Scopus indexing database has been explored for the same. The period of observation was restricted to two decades i.e. 2001 to 2020. Here, an extensive research trend analysis in terms of global publications, sources (books, journals, and conferences), countries, access (open/closed), and languages have been explored. The list of productive journals, universities, and funding agencies active in this research area has also been highlighted.

The methodology used in this bibliometric analysis is presented in section "Materials and methods". The results and discussions are summarised in section "Results and discussion". Finally, the work is concluded in section "Concluding remarks and future directions".

## MATERIALS AND METHODS

### DATA SOURCES

The Scopus indexing database has been mined for this bibliometric analysis. The articles related to the human-stress and stress among seafarers published between 2001 and 2020 were extracted and explored.

### SEARCH STRATEGY

In Scopus, the search term "(TITLE-ABS-KEY ("seafarer" AND "stress") AND (LIMIT-TO (PUBYEAR,2020) OR LIMIT-TO (PUBYEAR,2019) OR LIMIT-TO (PUBYEAR,2018) OR LIMIT-TO (PUBYEAR,2017) OR LIMIT-TO (PUBYEAR,2016) OR LIMIT-TO (PUBYEAR,2015) OR LIMIT-TO (PUBYEAR,2014) OR LIMIT-TO (PUBYEAR,2013) OR LIMIT-TO (PUBYEAR,2012) OR LIMIT-TO (PUBYEAR,2011) OR LIMIT-TO (PUBYEAR,2010) OR LIMIT-TO (PUBYEAR,2009) OR LIMIT-TO (PUBYEAR,2008) OR LIMIT-TO (PUBYEAR,2007) OR LIMIT-TO (PUBYEAR,2006) OR LIMIT-TO (PUBYEAR,2005) OR LIMIT-TO (PUBYEAR,2004) OR LIMIT-TO (PUBYEAR,2003) OR LIMIT-TO (PUBYEAR,2002) OR LIMIT-TO (PUBYEAR,2001))" has been mined for analysis of this study. Both subscription and open-access based articles, conference papers, reviews, book chapters, letters, notes, editorials, and books have been considered for this investigation.

The data extracted from Scopus have been mined for the countries, research categories, universities, and languages.

Moreover, the publication trend for some major psychiatric conditions like bulimia, anorexia nervosa, obsessive-compulsive disorder, schizophrenia, generalised anxiety disorder, cyclothymia, mood, conduct, and personality disorders have also been assessed. This research trend analysis assists to gain clear insights regarding the variation in publication trend of stress and other human psychiatric conditions.

## RESULTS AND DISCUSSION

### STRESS AMONG SEAFARER RELATED ARTICLES IN THE WORLD

The number of the last 20 years worldwide publications relevant to the keywords used in the search strategy has been depicted in Figure 1A. In the last two decades, the number of publications per year has increased from 1 to 18 nearly. Moreover, thirty seven different countries have carried out research related to this theme. The country-wise publishing details are presented in Figure 1B. The highest number of publications are from Germany (24), followed by the United Kingdom (20) and Italy (11).

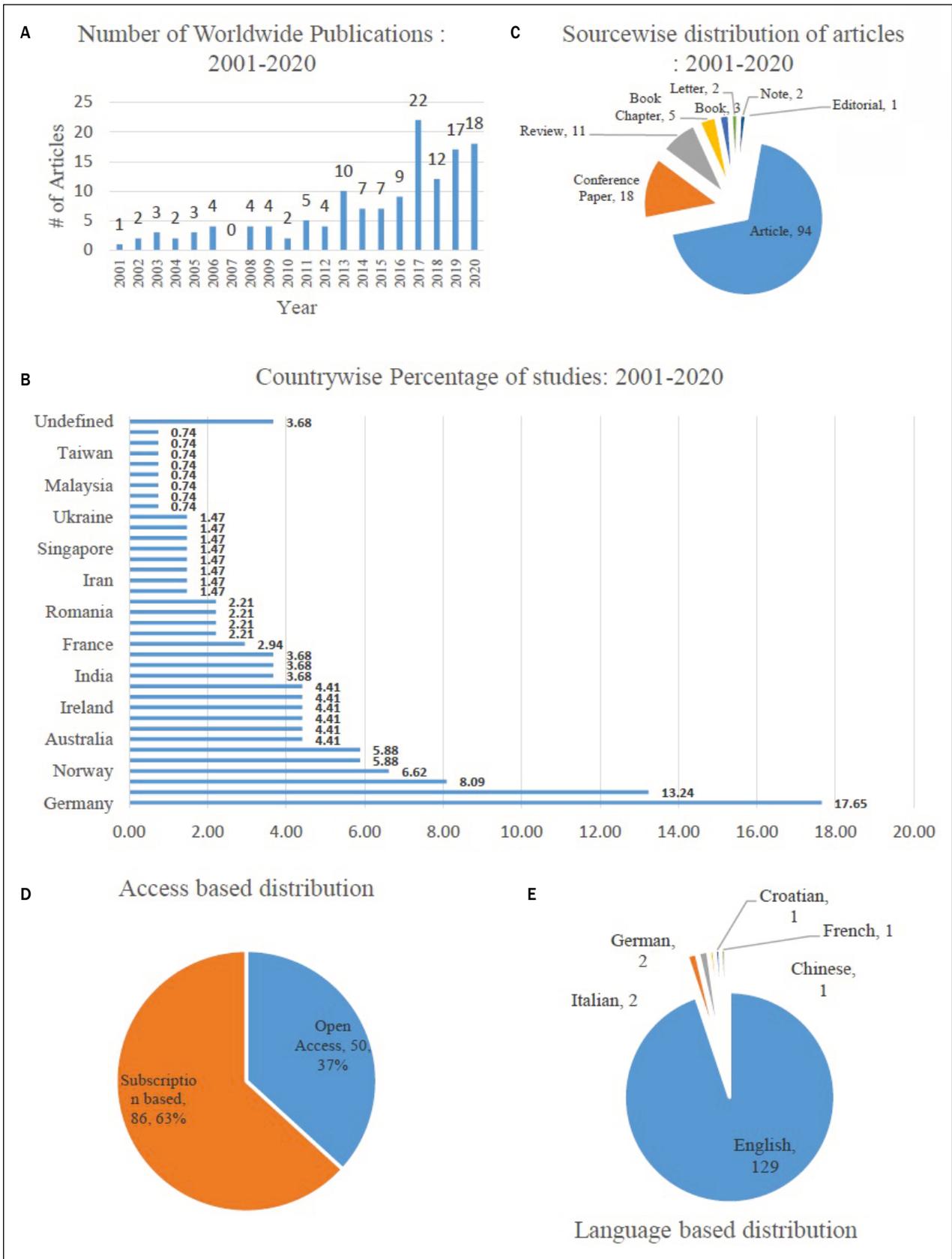
The source-wise distribution (Fig. 1C) reflects that the studies related to the theme under observation have been published in the form of research articles, notes, letters, book chapters, reviews, conference papers, books, and editorials. More editorials and short communications are required to cover the publication gaps for these studies. The contribution of subscription (63%) and open-access (37%) based articles are reported in Figure 1D. Despite English, some of the studies have also been authored in German, French, Chinese, Italians and Croatian (Fig. 1E).

### STATISTICS

In the previous 10 years (2011–2020), the number of worldwide publications related to seafarer stress has skyrocketed from 1 to 136. A positive growth trend ( $R^2 = 0.693308$ ) has been observed. The statistics report for the same is depicted in Table 1. The coefficient of determination ( $R^2$ ) indicates that 70% (approx.) of variation of several publications around the mean are completely extracted by the year of publication that means 70% of values fit the regression model.

### RESEARCH CATEGORIES

Globally, 19 distinct research categories (Agricultural, Biological Sciences, Arts, Humanities, Decision Science, Computer Science, Chemical Engineering etc.) related to stress among seafarers have been found (Fig. 2). Among these distinct categories, medicine (83, 61.02%) social sciences (34, 25%), engineering (31, 22.79%), and environmental sciences (19, 13.97%) found to be more common.



**Figure 1.** Stress among seafarer related articles; **A.** Number of Worldwide Publications: 2001–2020; **B.** Countrywise Percentage of studies: 2001–2020; **C.** Distribution of articles: 2001–2020; **D.** Access based distribution; **E.** Language-based distribution.

However, the categories like computer science, decision science, energy need to be more explored as far the stress among seafarer is concerned. A significant variation of these publication categories has been found. More conferences and symposiums related to the theme are intended to be arranged to disseminate knowledge among young professionals and to motivate them for future research works.

**CONTRIBUTION OF UNIVERSITY**

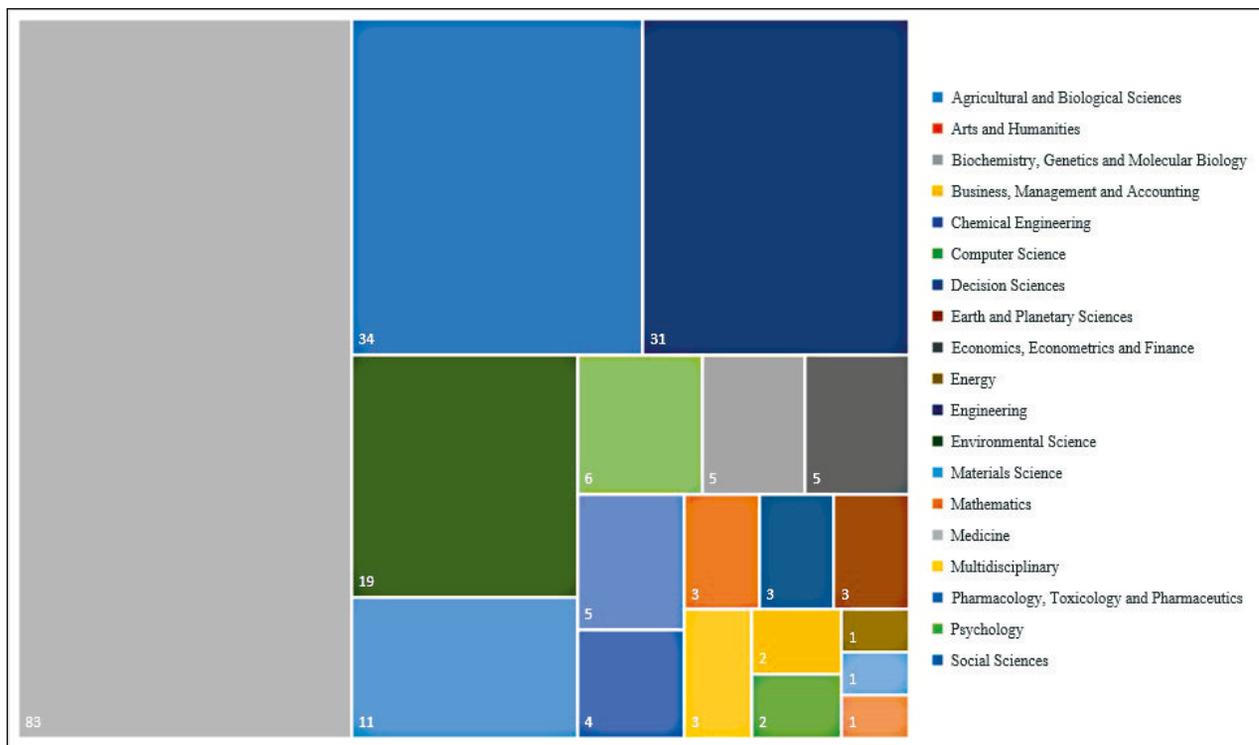
Several authors from distinct global universities are working on mining and management of stress among the seafarer. The names of the universities along with the number of articles published in the area of stress among seafarers are presented in Table 2. The Universitätsklinikum Hamburg-Eppendorf und Medizinische found to be a leader for such kind of publications.

**Table 2.** Universities contribution

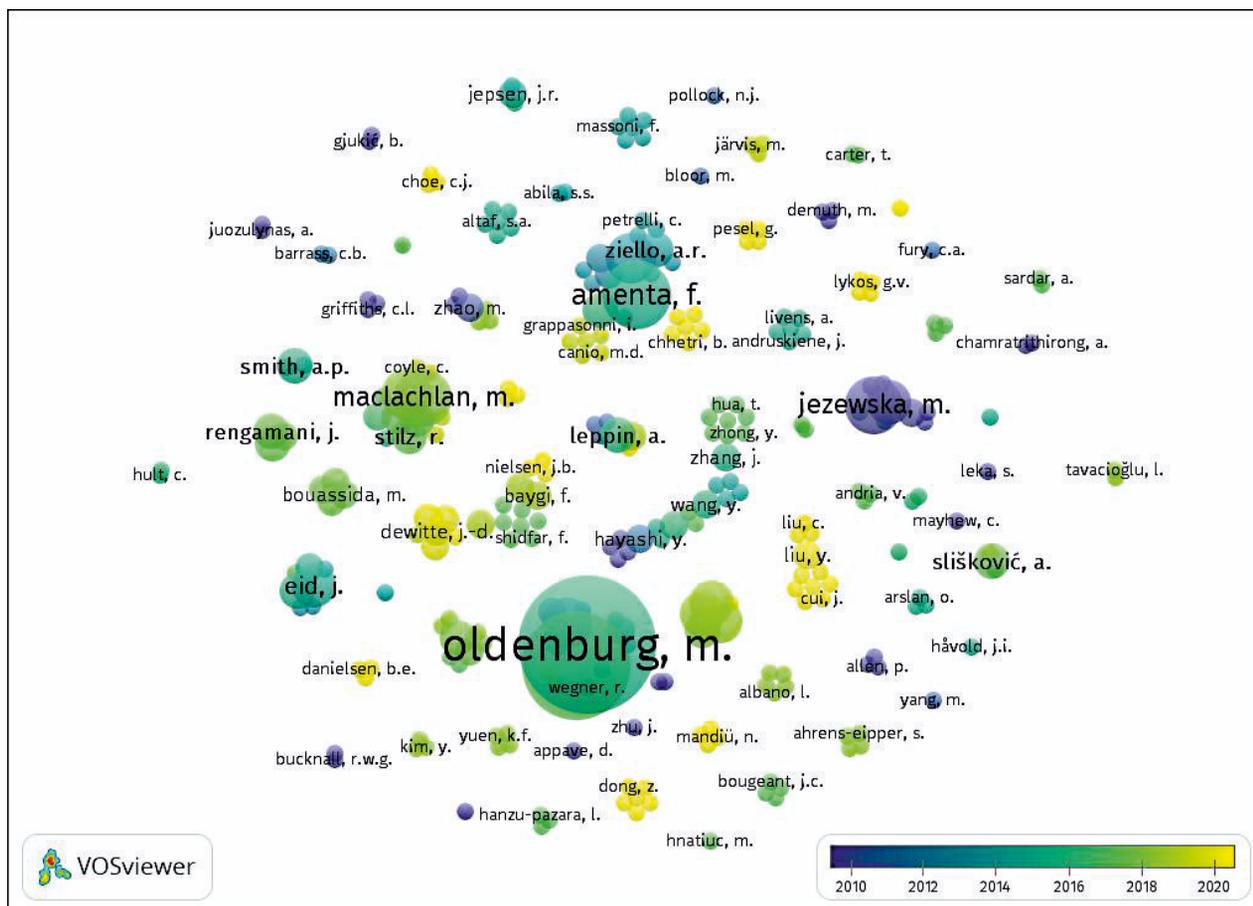
University	Article published
Universitätsklinikum Hamburg-Eppendorf und Medizinische Fakultät	20
University of Southern Denmark, Esbjerg	8
Cardiff University	8
Gdanski Uniwersytet Medyczny	7
Università degli Studi di Camerino	7
Australian Maritime College	5
Universität Hamburg	5
Stellenbosch University	4
Akademickie Centrum Medycyny Morskiej i Tropikalnej	4
Trinity College Dublin	4
University of Tasmania	4
University of Zadar	4
Fachhochschule Münster – Abteilung Steinfurt	4
AMET University	3
Univerzita Palackého v Olomouci	3
Kobe University	3
Memorial University of Newfoundland	3
Maynooth University	3
Dalian Maritime University	3
Centre for Risk, Integrity and Safety Engineering	3

**Table 1.** Statistics

Regression statistics	
Multiple R	0.832314
R square	0.692747
Adjusted R square	0.675677
Standard error	3.494022
Observations	20



**Figure 2.** Research categories for stress among the seafarer



**Figure 3.** Authors' network map

### AUTHORS' NETWORK

Several researchers are working in the area of mining and management of stress among mariners. The collaboration of the authors has been presented in Figure 3. This map assists in finding the collaboration network of the authors. This information will be useful for naïve researchers who want to do collaborative research in this domain. The authors map indicates that a total link strength of twenty and greater is observed for six different authors. The highest number of publications (23) has been recorded for the M. Oldenburg.

Table 3 depicts the country-wise international collaboration in mining and management of stress among seafarers. The link strength signifies the rate of international collaboration. The highest level of international collaboration has been asserted for the United Kingdom, followed by Ireland and the United States.

### KEYWORDS FREQUENCY

A list of high-frequency keywords (found in the explored publications) has been extracted in the form of triplet i.e. (Keyword, Frequency, Total-Link Strength). The (human, 79,

1062), (ships, 55, 682), (male, 45, 722), (adult, 41, 686), (medicine, 39, 555), (mental-stress, 36,559), (stress, 30, 492), (occupational-health, 28,426), (psychology, 24,386), (occupational-disease, 18, 286), and (mental-health, 15, 196) are some of the instances of the triplets. The keyword distribution map for the same is presented in Figure 4.

### JOURNAL AND FUNDING CONTRIBUTION

As per the search strategy, a total of 136 articles have been filtered out that recognise the use of two important keywords viz. stress and seafarer. Out of 136 articles, 94 have been published in different journals. The bifurcation publishing details are shown in Table 4. As per the search strategy (mentioned in section “Search strategy”), the International Maritime Health found to be a top contributed journal. The results witnessed that 30.85% of the articles have been published in this journal alone.

A network map for citations (organisations) has also been created (Fig. 5). The organisation having cumulative citations of less than ten has been excluded from this analysis. Globally, 59 different organisations have met this criterion. As far as organisational citations are considered

**Table 3.** International collaboration

Country	Documents	Total link strength
Germany	24	0
United Kingdom	18	13
Italy	11	5
Denmark	9	6
Norway	9	1
China	8	5
Australia	6	4
Canada	6	4
Croatia	6	0
Ireland	6	10
Poland	7	0
United States	6	9
India	5	4
South Africa	5	9
South Korea	5	3
France	4	3
Czech Republic	3	7
Japan	3	1
Romania	3	0
Sweden	3	0
Greece	2	1
Iran	2	3
Lithuania	2	0
Philippines	2	4
Singapore	2	1
Tunisia	2	0
Turkey	2	0
Ukraine	2	5
Brazil	1	1
Estonia	1	0
Malaysia	1	1
Spain	1	2
Switzerland	1	0
Taiwan	1	2
Thailand	1	1
Vietnam	1	2

the 'Institute for occupational and maritime medicine, Germany' is on the top followed by 'Statutory accident insurance institution for seafaring, Hamburg', and 'University of applied sciences, Berlin'. Surprisingly, the top three institutes are from Germany.

The work related to the mining of stress among seafarers has been funded by different agencies and universities. The list of funding agencies and the number of works supported during the last two decades have been shown in Figure 6. The maximum amount of work in the concerned area has been supported by the University of Tasmania.

### HIGHLY CITED RESEARCHERS

Citation is one of the significant research performance metrics. The list of top 20 cited researchers along with their total number of publication in the concerned area is presented in Table 5. It is found that M. Oldenburg is the top-cited researchers in this area. However, if the articles per citation are considered then X. Baur is on the top.

Likewise, the citation report of the articles explored using the search strategy (mentioned in section "Search strategy") has also been extracted. Some of the highly-cited key articles are mentioned in Table 6 [15–29].

The cumulative country-wise citations related to the theme under consideration are also presented (Table 7). It is found that the highest number of citations has been recorded for Germany followed by the United Kingdom and Canada. The countries where the cumulative citations are below ten have not been considered in this analysis.

### PSYCHOLOGICAL DISORDERS AND SEAFARERS

The existing studies recognized that the prolonged or high intensity of the stress may trigger different human psychological disorders. Like stress, other human psychological disorders among seafarers need also to be mined (Table 8). No doubt, research has been carried out to mine and manage different human psychological disorders. The number of articles published for the psychological disorder in general and particularly in context to the seafarers has been extracted using a similar search strategy. The results witnessed a high number of publications in context to a different human psychological disorder in general. However, very few articles related to the mining of human psychological disorder particularly for seafarer has been identified. A minor change can be observed by altering the search strategy. However, the facts will remain same, i.e. as compared to the stress, more effort (research work) is required to mine the state of other human psychological disorders among the seafarer.

### CONCLUDING REMARKS AND FUTURE DIRECTIONS

Here, an exhaustive bibliometric trend of international scientific articles for worldwide stress among seafarer has been examined. In the last two decades, stress among seafarer had observed a positive publishing trend. The publishing gap of distinct countries from 2001 to 2020 has



**Table 4.** Bifurcation publishing details

Journal	Number of articles
International Maritime Health	29
International Archives of Occupational and Environmental Health	6
Marine Policy	4
Safety Science	4
International Journal of Environmental Research and Public Health	3
International Journal of Mechanical Engineering and Technology	3
Journal of Occupational Medicine and Toxicology	3
Maritime Policy and Management	3
PLOS One	3
Work	3
Safety and Health at Work	2
AIDS Education and Prevention	1
Acta Biomedica	1
Advanced Engineering Informatics	1
African Journal of Marine Science	1
Archives Des Maladies Professionnelles Et De L Environnement	1
Archives of Environmental and Occupational Health	1
Arhiv Za Higijenu Rada I Toksikologiju	1
Asia Life Sciences	1
Chronobiology International	1
Entrepreneurship and Sustainability Issues	1
Frontiers in Psychology	1
Gazzetta Medica Italiana Archivio Per Le Scienze Mediche	1
IEEE Transactions on Electrical and Electronic Engineering	1
International Journal of Occupational Medicine and Environmental Health	1
International Journal of Public Health	1
Journal of Loss Prevention in The Process Industries	1
Journal of Occupational Health and Safety Australia and New Zealand	1
Journal of Pacific Rim Psychology	1
Kindheit Und Entwicklung	1
Marine Structures	1
Maritime Studies	1
Medicina Kaunas Lithuania	1
Nase More	1
Occupational Medicine	1
Psychiatria Danubina	1
Ricerca Folklorica	1
Sociology of Health And Illness	1
Transportation Research Part-A Policy and Practice	1
WMU Journal Of Maritime Affairs	1
Zentralblatt Fur Arbeitsmedizin Arbeitsschutz Und Ergonomie	1
Chinese Journal of Industrial Hygiene and Occupational Diseases	1

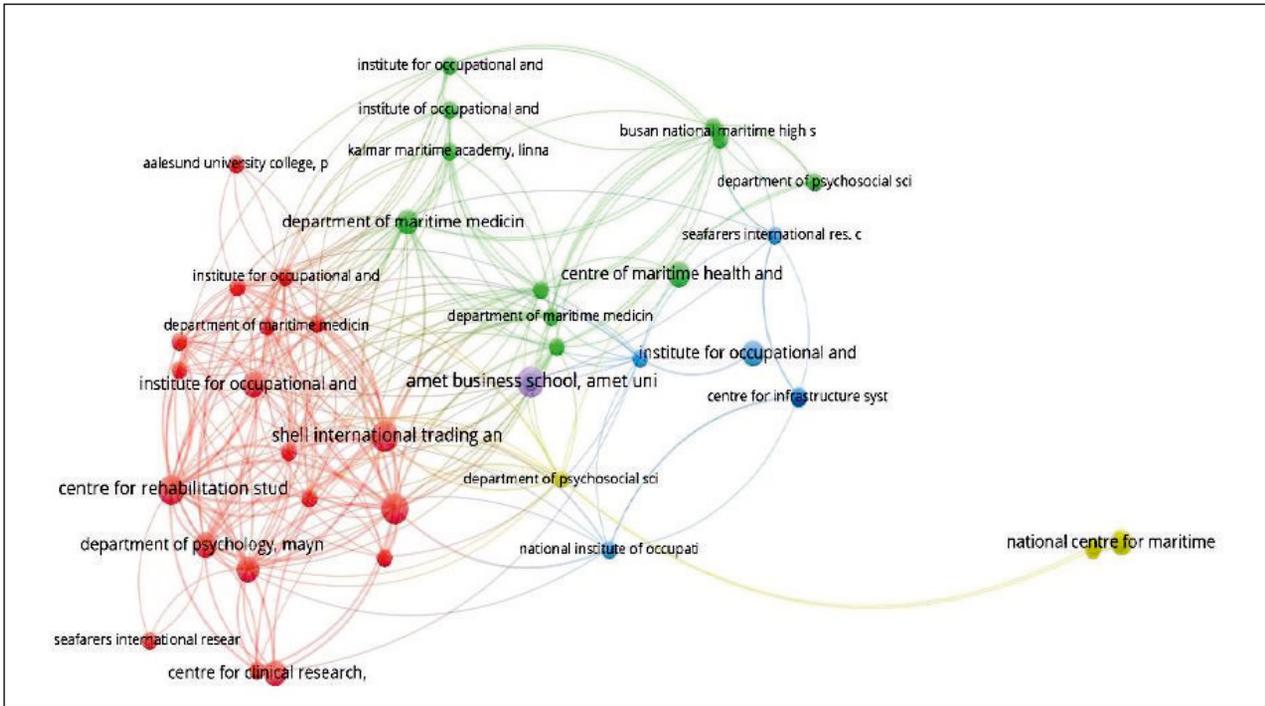


Figure 5. Citations (organisation)

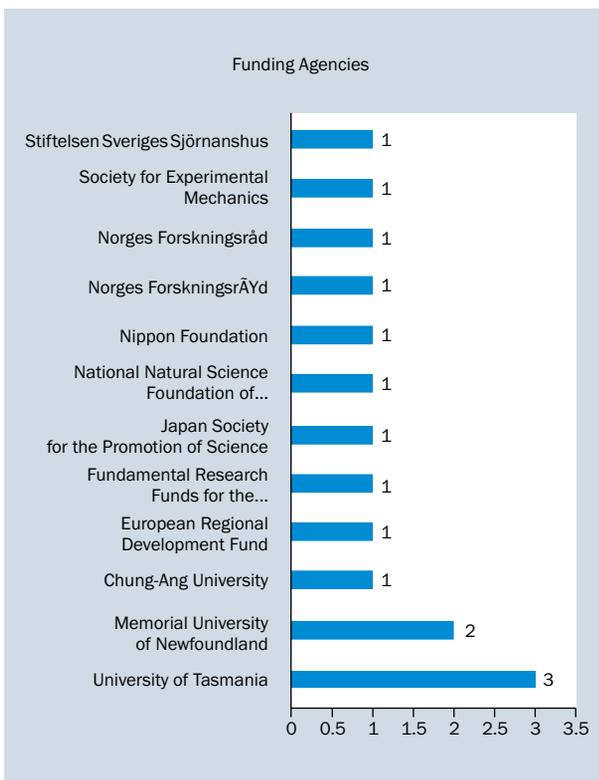


Figure 6. Funding agencies/universities

Table 5. Author's citation report

Author	Documents	Citations
Oldenburg M.	23	289
Baur X.	5	188
Jensen H.-J.	16	165
Amenta F.	8	87
Fasanaro A.M.	5	80
Abbassi R.	3	69
Garaniya V.	4	69
Islam R.	4	69
Khan F.	4	69
Eid J.	4	64
Hystad S.W.	3	44
Maclachlan M.	6	34
Leppin A.	3	31
Mcveigh J.	5	30
Cox H.	3	21
Fraser A.	3	21
Stilz R.	3	21
Jezewska M.	6	20
Sibilio F.	3	19
Šlišković A.	3	19

**Table 6.** Highly cited article

Authors	Year	Cited by	Document type	Access type
Oldenburg M. et al. [15]	2010	81	Review	Open access
Oldenburg M. et al. [16]	2009	74	Article	Subscription-based
Vickers D., Walsh V. [17]	2005	69	Article	Subscription-based
Carotenuto A. et al. [18]	2012	58	Review	Subscription-based
Thomas M. et al. [19]	2003	58	Article	Subscription-based
Watermeyer K.E. et al. [20]	2008	37	Article	Subscription-based
Oldenburg M. et al. [21]	2013	34	Review	Subscription-based
Islam R. et al. [22]	2018	29	Article	Open access
Hystad S.W., Eid J. [23]	2016	27	Article	Open access
Islam R. et al. [24]	2017	23	Article	Subscription-based
Oldenburg M. et al. [25]	2008	23	Article	Subscription-based
Haka M. et al. [26]	2011	22	Article	Subscription-based
Muraia K. et al. [27]	2009	21	Article	Subscription-based
Nielsen M.B. et al. [28]	2013	20	Article	Subscription-based
Bal E. et al. [29]	2015	19	Article	Subscription-based

**Table 7.** Countrywide citation

Country	Documents	Citations	Total link strength
Germany	24	282	118
United Kingdom	18	146	77
Canada	6	139	11
Norway	9	100	56
Australia	6	72	13
South Africa	5	64	54
Denmark	9	46	32
Italy	11	37	31
Ireland	6	34	60
China	8	30	35
South Korea	5	28	10
Croatia	6	26	28
Japan	3	23	0
Sweden	3	23	7
Poland	7	31	7
Turkey	2	20	0
United States	6	18	7
India	5	16	2
Thailand	1	16	0
Singapore	2	14	4
Czech republic	3	13	40
Estonia	1	11	0
Taiwan	1	11	6

Table 8. Publication analysis

Psychological disorders	No. of publication	
	General	Seafarer
Bulimia	17726	Nil
Anorexia nervosa	24497	Nil
Obsessive-compulsive disorder	32047	Nil
Schizophrenia	200662	01
Generalised anxiety disorder	14859	Nil
Anxiety	405383	31
Depression	738,227	35
Mood disorder	53900	Nil
Personality disorder	64510	01
Conduct disorder	11324	Nil

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# COVID-19 vaccine on board ships: current and future implications of seafarers

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The impact and effect of novel coronavirus disease 2019 (COVID-19) are expanding all over the world without boundaries. When it began in China in late 2019, it was seen to be not as scary and devastating as it has become today. However, the hope for overcoming the pandemic lies in finding an effective treatment and inventing a vaccine. If we look at the history of the spread of this contagion, within a short span of seven months it has spread all over the world. Statistics are saying that more than 104 million individuals got infected and 2.2 million deaths were currently occurred [1].

In the last few months, there has been a massive revelation in the medical domain regarding the outbreak of COVID-19 and its vaccination [2]. It has been truly amazing to see scientists and doctors come together across all over the world to share their expertise to develop vaccination in the past few months. Thanks to the collaboration between researchers and scientists are always way ahead to take up challenges and bear the torch of a bright and prosperous future as far as the COVID-19 struggle is concerned. To channelise their potential and encourage them to develop solutions by joining hand together in this pandemic time, the government has also been supportive of various initiatives and funding. Medical doctors sharing their experiences and the patients who have recovered from this near-fatal disease largely help in vaccine development. This brought a whole new perspective on how to handle the current situation the world is facing with the COVID-19 pandemic.

Seafarers are unsung heroes of this pandemic because shipping plays an important role in this serious outbreak. Unfortunately, because of the global emergency that happened in the last year, seafarers went through the depressive symptoms and faced various neuropsychological and psycho-affec-

tive alterations [3]. To slow down the rate of onboard infection, various shipping companies provided some serious guidelines such as social distancing at working places, self-hygiene, and room quarantine for any suspicious cases. For some seafarers, this situation is unbearable. Because of the novel pandemic, tens of thousands of sailors were stuck on board for more than a year now. Despite the fact of crew changes have been made conceivable in certain nations, the implementation stays exceptionally challenging. These situations demand immediate access to the vaccine for seafarers.

The speakers in the CrewConnect Global Virtual Event 2020 highlighted that, with some vaccine trials now showing promising results, sailors need to be treated as fundamental workers and be among the first to get vaccine [4]. “I think all the work we’ve done in lobbying governments now needs to be even more concerted effort about the point that seafarers are essential workers... we need to find a way to find a way to access vaccines” said Mr Stephen Cotton, general secretary of International Transport Workers Federation [4].

Some countries, such as Singapore, already started vaccination for seafarers and it becomes one of the first nations to give importance for COVID-19 vaccine to frontline workers of maritime. According to the Maritime and Port Authority of Singapore, seafarers need to undergo fewer testing before getting vaccinated. It is scheduled that at least 10,000 seafarers can be vaccinated by the end of January 2021 under air vaccination exercise [5].

COVID-19 is considered a type of pneumonia which can be effectively treated by vaccination. All national bodies have to step forward and take Singapore as an example in the provision of vaccine for frontline workers such as seafarers. On other hand, the International Maritime Or-

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ganization also urges that maritime workers and seafarers have to obtain COVID-19 vaccination on a priority basis to allow them to work freely and sustain dynamic global supply chain.

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# The need to determine recommended activity restrictions as part of the criteria for a COVID-19 alert based on the status of the municipal-level response

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Japan experienced the third wave from the second half of November, 2020 to the second half of February, 2021 in coronavirus disease 2019 (COVID-19) pandemic. A state of emergency was declared in 11 prefectures of Japan in January 2021 [NHK; <https://www3.nhk.or.jp/news/special/coronavirus/data-all> (cited 2021 February 26)], and the number of COVID-19 cases in the third wave was significantly higher than that of the first wave.

An examination by each prefecture or municipality reveals a considerable difference in the rate of infection in COVID-19.

The following parameters differ by municipality in Japan: the number of patients with severe COVID-19, the number of patients hospitalised for COVID-19, the availability of beds for patients with COVID-19, the availability of beds for patients with severe COVID-19, and the state of the medical system (which includes the state of testing). Given this situation, important indices for COVID-19 alerts issued by

government entities must be ascertained. In addition, the infection trends and the related state of the medical system in municipality should be considered. This difficult situation must be endured and SARS-CoV-2 contained (through vaccination) while adeptly balancing the prioritisation of measures to prevent infection and economic measures.

Each municipality needs to carefully determine a policy on activity restrictions based on infection trends in the region, and each municipality needs to further clarify the balance between “when to refrain from routine activities” and “when to relax those restrictions”. Moreover, each municipality needs to relieve the mental exhaustion of its residents.

COVID-19 must be dealt with by meticulously analysing its various aspects and by ascertaining its status in different regions. Municipalities, the nation as a whole, and countries around the globe must support one another to overcome the COVID-19 pandemic.



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# The realities of a new era featuring truly international lectures during the prolonged COVID-19 pandemic: international collaboration and advances in medical education

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About a year has passed since coronavirus disease 2019 (COVID-19) broke out. As of January 2021, the cumulative number of people with COVID-19 around the world exceeded 100 million and the cumulative number of the dead exceeded 2 million [1]. In the Kazakhstan, the cumulative number of the infected exceeded 180,000 and the cumulative number of the dead exceeded 2,400 [2]. In Japan, the cumulative number of the infected exceeded 350,000 and the cumulative number of the dead exceeded 5,000 [3]. COVID-19 has broken out in the Kazakhstan, Japan, and the rest of the world, and people continue to be infected and die. This situation has had a massive impact on people's lives, work, and education both at home and abroad, and it has also hampered efforts at international collaboration. Despite such circumstances, routine activities need to resume at their normal pace and approaches to those activities need to be implemented from new perspectives. Kochi University professor has been visiting Semey Medical University to deliver lectures to its medical students, graduate students, instructors, and personnel pursuant to the international exchanges between the two institutions. International lectures by Kochi University professor were delivered in a new format in 2020, so this report has summarised that approach and offered recommendations for the future, with a focus on lectures as part of education.

An online lecture by a Kochi University professor for Semey Medical University's medical students, graduate students, instructors, and personnel was scheduled for December 19, 2020. Nevertheless, the Internet connection was bad. Despite numerous attempts, a stable connection could not be estab-

lished, and the lecture had to be postponed to a later date. The later date was December 27, and the online lecture took place then [4]. Questions were asked online. This provided an experience like a lecture in person and it provided an opportunity to create an environment in which students felt comfortable asking about social matters and research details.

Prior to the onset and spread of COVID-19, there were various online meetings and online research presentations in various parts of the world. However, the spread of COVID-19 may have occasioned a transition from lectures in person to lectures online [5]. Provided that attention is paid to the Internet connection, conducting lectures online allows more effective use of time by reducing travel time. Even if lectures are primarily conducted online, lectures may need to be conducted in person at times. A combination of these two approaches may be considered normal in the future.

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# Robot-assisted rehabilitation: it is the time for utilisation in in-patient health care facilities to maintain the activity of the elderly during the COVID-19 pandemic

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The central goal of rehabilitation is to prevent, strengthen, restore or limit the deterioration in physical, mental, and social skills in elderly people [1]. Rehabilitation treatments usually consist essentially of multiple ongoing sessions where a therapist directs and supports the patient through a set of training activities [2]. The rehabilitation sessions are normally conducted in the different rehabilitation facilities, nursing homes, homes, and different in-patient health care facilities (IPHCF).

During the coronavirus disease 2019 (COVID-19) crisis, quarantines, limitations, and social distance are major barriers to sustaining long-term therapies for the elderly without paying attention to this issue. To avoid the risk of infection for both health care providers and patients, the requirement for long-term care services, including rehabilitation, has also been cancelled or avoided. The high rate of rapid transmission and thus death by COVID-19 could increase the risk of mental, psychological, and physical health problems, especially among comorbid chronic diseased elderly [3, 4].

Nowadays, it is not possible to provide rehabilitation for the elderly in the same manner as before the COVID-19 pandemic [5]. In nursing homes and IPHCF, many staff, workers, and residents still do not wash their hands properly, and thus spread the virus. To reduce the risk of infection for both healthcare providers and patients, the current global pandemic situation is raising the need for robot-assisted rehabilitation (RAR) devices.

To improve elderly care or to encourage independent living for the elderly and people with disabilities, digital innovations, including robots, are being increasingly used. With the aid of robotics, rehabilitative work and activities are

evidence-based to have a positive effect on the emotional, social and physical aspects of the elderly [6].

For two big reasons, robots are used in rehabilitation. Robots are used as a physiotherapeutic treatment device (mainly after neurological insults including stroke [7], multiple sclerosis [8], parkinsonism [9], and spinal cord injuries [10]). Also, the use of robots in rehabilitation imposes desirable benefits in people with disabilities mainly in everyday life tasks, cognitive functions, and emotional support [7].

Robot-assisted rehabilitation devices can overcome the limitations of traditional methods of manual rehabilitation. RAR devices have the ability to reliably provide intensive rehabilitation for a longer time as in stroke compared to the traditional manual therapy. RAR devices are not impacted by the abilities and exhaustion level of the rehabilitation therapists. In the long run, without the intervention and/or presence of the rehabilitation therapist, RAR devices can perform the rehabilitation sessions allowing more frequent care and potentially reducing costs in forever-disabling conditions such as stroke and spinal cord injuries that need a forever-rehabilitation.

The maximal own effort during exercise may be stimulated from the patient during RAR sessions via the experience of entertainment gained from the in-built virtual games within the RAR systems [11]. Also, the robot's friendly aspect and its ability to catch the attention of patients help to create a fun environment during the RAR programmes [2].

The robot receives thorough details about the patient. These details are used to supply feedback to control the

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architecture of the robot to adjust itself to the requirements of every patient. On the other hand, the architecture continuously sends an updated plan to continue the rehabilitation of the patient [2].

One of the main evidence-based applied aspects of RAR devices is their ability to reduce falls in the elderly via the applied help during the different hypothetical home-settled scenarios of exercise, orientation, walking training protocols. RAR devices can attract the attention of the elderly during the rehabilitation sessions by utilizing the verbal and visual motivation properties of these devices [12].

In older residents with neurological physical disabilities after stroke and parkinsonism, the need for continuous upper-and lower-extremity exercises is vital to prevent, limit, and recover limb movements and functions. In places with a suspected application of infection control measures against COVID-19 spread such as nursing homes or IPHCF, the continuation of a supervised exercise programme may be an undesirable task by many rehabilitation therapists.

This attitude may be explained due to the risk of cross-infection that may be acquired from the continuous close contact with the elderly during the application of rehabilitation sessions. In these facilities, RAR training for the limbs provides a risk-free approach in this situation.

In exercising the older patients, RAR devices may be available in two forms, the hands-on robots (unfortunately, these robots resembles the traditional manual therapy because these types of robots make direct physical contact with the patient during aiding him in performance of exercises) or non-contact (hands-off) robots that not allow any form of direct contact to the patients [13].

To lower the risk of infection by COVID-19 during the use of hands-on robots, the use of hands-off ones — either in rehabilitation or in assistance of elderly care — is very suitable in nursing homes and IPHCF in which residents live with each other in close quarters and quarantining or socially-isolating them is very difficult.

In conclusion, with the advanced invasion of technology in all aspects of life during the COVID-19 pandemic including the health-care sector, RAR devices is a fairly-new excellent therapeutic technology that is recommended to be used in rehabilitating older residents in different IPHCF to reduce their economic burden and social problems. RAR devices can face the shortage of rehabilitation therapists in remote IPHCF during times of imposed or intentional social distance. Rehabilitation therapists or even older patients in different IPHCF hope that the endless COVID-19 crisis alarms the

governments of high-income countries — or even middle- or low-income countries that seek excellence in performance in the field of health care — to find a solution to allow, manufacture, or even import the RAR devices from the countries that manufacture them, for example as Japan, not only to maintain the physical rehabilitation process or the daily activity level of elderly but also to reduce the spread of viral infection among staff workers and residents as possible.

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# Consequences of COVID-19 pandemic on global maritime trade industry

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The coronavirus disease 2019 (COVID-19) pandemic caused by the recently discovered novel coronavirus has caused confusion and hysteria around the world, leading to daily activities such as work, walking outside, or leaving home in some countries, to cease. The maritime sector is also one of the areas affected by the pandemic. This crisis has forced the shipping and marine industries to go through the toughest times in the present day, as the work in these fields has been shut down for the protection and prevention of the COVID-19 outbreak.

Though COVID-19 has placed the world in a massive humanitarian crisis, the pillars of our globalised economy have also been destroyed by it. Perhaps any country, small or large, has been infected by this virus. This pandemic has led to profound disruptions in supply and demand, thereby upsetting world commerce and causing serious economic pain. Depending on how the situation unfolds, analysts at the World Trade Organisation plan world merchandise trade volumes to decline by 13% to 32% (the decline was 12% at the height of the 2008 crisis) [1].

This global pandemic has provided a major negative impact for not just the ports that are located in China (where the outbreak is said to arise) but also the ports for the shipping and maritime industry at the global level are equally affected.

Some of the maritime and shipping industry's problems include border restrictions for airlines and port shutdown, reduced demand for freight, disputes in laytime arbitration, disputes between owners and charters of such vessels due to lack of time and resources, bankruptcy due to reduced demand and the failure to control the company's finances during this era of decreased demand for shipping and freight [2].

In pandemic, the quarantine conditions and prohibitions, for workers crossing borders in certain countries that led to crew shifts and repatriations for mariners, especially those

operating on cruise ships and yachts, are critical issues that have a negative impact on the global maritime industry [3]. The study showed a large majority who preferred shore leave previously has decreased dramatically during the pandemic. The effect on the job and well-being of seaman was exposed when only one-fifth of them voluntarily negotiated to renew the deal. In the outbreak with many parameters, this analysis reported occurrence rates around 6 months: overdue resettlements (21.44%) including crew with contract extensions (12.48%), the crew with a completed contract pending repatriation (8.96%) and crew who had crossed 12 months of continuous operation (0.82%). Compensation, if given, is insufficient and has had the most effect on ratings. The survey also revealed the deprivation of medical assistance [4].

For the global maritime shipping, the pandemic has sent shockwaves and laid the ground for a changing industry and related supply chains management. United Nations Conference on Trade and Development (UNCTAD) predicts the momentum of economic growth to return in 2021.

But because of the enormous damage triggered by COVID-19 outbreak, the overall maritime trade will fall by 4.1% in 2020 worldwide. This prediction is done by UNCTAD in its Maritime Transport Assessment 2020 [5]. Figure 1 explains all the COVID-19 pandemic factors that are interconnected with each other that have resulted in the decline of maritime trade [6].

The study warns that new pandemic waves may cause a steeper downturn, further affecting supply chains and economies. The report claims that the pandemic caused a massive hindrance across supply chains, transport networks and ports, which led to a decrease in cargo volumes and stifled the prospects for expansion [7].

"The short-term prospect for maritime trade is poor", according to the report [5]. Moreover, the long-term consequences of a pandemic along with the timing and extent of the industry's recovery are difficult to predict [5].

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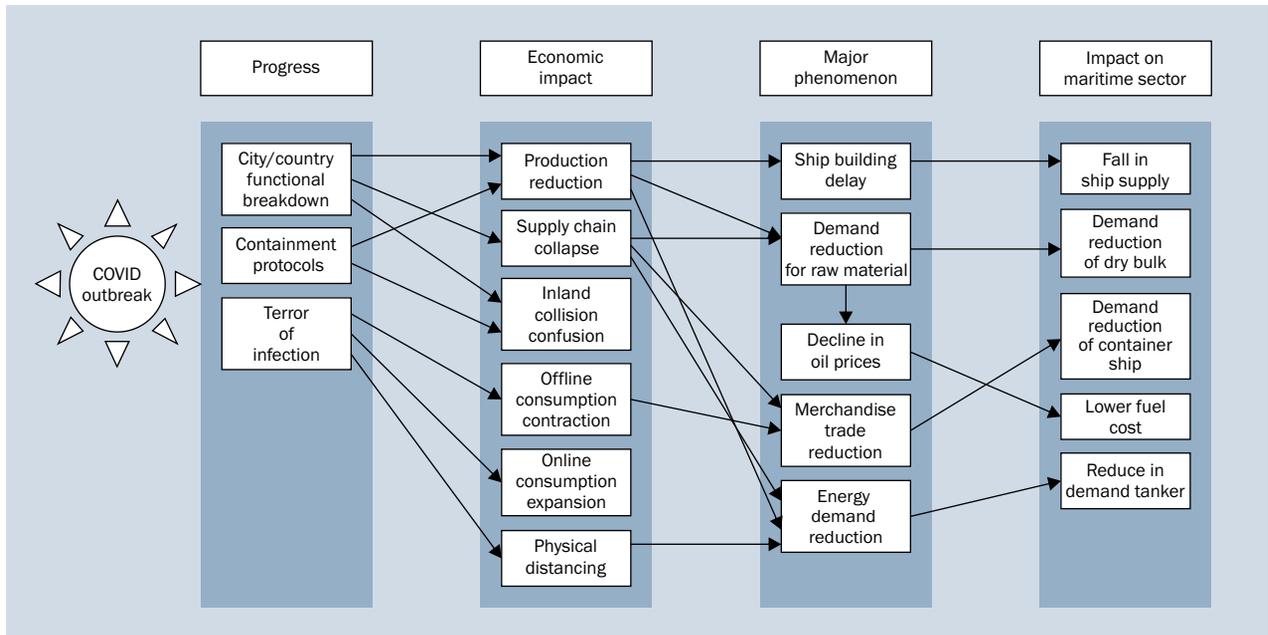


Figure 1. COVID-19 factors for decline in maritime trade [6]

“As a crucial enabler of the smooth running of international supply chains, the global shipping sector will be at the forefront of efforts for a sustainable recovery” [6]. UNCTAD Secretary-Kituyi said “The industry must be a key stakeholder to help adjust the logistics of ‘just-in-time productivity’ to ‘just-in-case’ preparedness”, UNCTAD has made the prediction that maritime trade development will recover its losses and increase by 4.8% in 2021 by assuming that global economic performance is recovering at a steady pace. However, they stress that there is a strong need to brace for transition in the maritime transport industry and be well-positioned for a changed post-pandemic environment [5].

In the near future as well, it is expected that COVID-19 will have a major impact not only in the maritime and shipping industries but also in the domain of the cruise ship industry, therefore reflecting its repercussions on world trade and tourism. It has been catastrophic in its effects on seaman worldwide, be it in the marine industries or port industries. The boundaries of collaboration have been demonstrated by government actions focused on their concerns about the welfare of people. By citing health and safety concerns, many countries have closed their naval facilities for seaman; however, seafarers are the forgotten heroes of the pandemic. The major takeaway from this scenario is

that the seafarers, who are not in sight or mind of anyone except their relatives, have to be better recognised as we are highly dependent on them for goods which are needed every day. They are the ones that make world trade possible.

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# COVID-19: rethinking seafarers' temporality to improve healthcare and prevention practices?

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Hitting the coronavirus disease 2019 (COVID-19) pandemic one year anniversary has been an opportunity, for many of us, to take stock and reflect. Ethical issues and management practices in maritime medicine have been re-examined in the light of this outbreak [1]. Throughout history, seafarers have been known to play a key role in the spread of infectious diseases, particularly amongst native American populations [2]. However, COVID-19 has not been primarily carried by ships, and many mariners and islanders have found themselves being rather isolated and spared from the outbreak.

Dr. Jezequel [3] reported this finding. He was working on a record regarding the French Southern Lands population's medical monitoring when the pandemic struck. Mariners and islanders from these circumpolar territories have been out of touch with the rest of the world, experiencing the pandemic through a different timeline, and facing considerable concerns on how to avoid the virus when travelling back to the mainland.

Temporality is a key concept in healthcare. It applies to each step of a healthcare approach: waiting for a diagnosis, for a cure, for the cure to show its effects...etc. Temporality can be asymmetrical and perceived differently depending on the person. While care-givers may often run out of time in their everyday practice, patients might be disrupted in their routine and face time differently [4].

How can this temporality concept apply to maritime medicine in the era of COVID-19? It might be a relevant

indicator in helping to comprehend how mariners or scientists have experienced this pandemic, in order to target preventive actions.

Remote marine personnel might not have the habit of following hygiene measures due to the fact that they have been isolated during a large part of pandemic. It is important to provide them with detailed information regarding their countries' national guidelines before they go back to the mainland.

Moreover, when confronted to the fact that a pandemic has been impacting their loved ones living far away, remote personnel may display distinct reactions. On the one hand, some could feel anxious because of they couldn't help their family. Indeed, feeling helpless has been shown to be a significant stress factor, leading to anxiety or mood disorders.

On the other hand, some could feel guilty of living in a COVID-19-free environment while their loved ones are exposed and threatened by the virus back in their hometown. Finally, it is worth mentioning that seafarers anticipating the fact that they have to come back to their hometown and be exposed to the pandemic may induce a particular form of post-traumatic stress disorder [5].

Some marines, on the contrary, experienced the epidemic on board, in a confined environment. They could develop anxious or post traumatic disorder after quarantine [6].

While mariners have often been described as disease carriers and spreaders throughout history, the COVID-19 pan-

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demic has developed without them, or beside them. This new time lag between mariners and their loved ones could lead to mental health challenges such as guilt, or anxiety and mood disorders. Maritime doctors should acknowledge this issue, to improve detection and refine their health prevention advices.

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# INFORMATION FOR AUTHORS

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.

Typical length of such a paper would be 2000–4000 words, not including tables, figures and references. Its construction should follow the usual pattern: abstract (structured abstract of no more than 300 words); key words; introduction; participants; materials; methods; results; discussion; and conclusions/key messages.

Case Reports will also be accepted, particularly of work-related diseases and accidents among maritime workers.

All papers will be peer-reviewed. The comments made by the reviewers will be sent to authors, and their criticism and proposed amendments should be taken into consideration by authors submitting revised texts.

Review articles on specific topics, exposures, preventive interventions, and on the national maritime health services will also be considered for publication. Their length will be from 1000 to 4000 words, including tables, figures and references.

Letters to the Editor discussing recently published articles, reporting research projects or informing about workshops will be accepted; they should not exceed 500 words of text and 5 references.

There also will be the section Chronicle, in which brief reports will be published on the international symposia and national meetings on maritime medicine and health, on tropical parasitology and epidemiology, on travel medicine and other subjects related to the health of seafarers and other maritime workers. Information will also be given on training activities in this field, and on international collaborative projects related to the above subjects.

**All articles should be submitted to IMH electronically online at [www.intmarhealth.pl](http://www.intmarhealth.pl) where detailed instruction regarding submission process will be provided.**

Only English texts will be accepted.

Manuscripts should be typed in double line spacing on numbered pages and conform to the usual requirements (Ref.: International Committee on Medical Journals Editors. Uniform Requirements for Manuscripts Submitted to Biomedical Journals, JAMA, 1997; 277: 927–934).

Only manuscripts that have not been published previously, and are not under consideration by another publisher, will be accepted.

Full texts of oral presentations at meetings (with abstracts printed in the conference materials) can be considered.

All authors must give written consent to publication of the text.

Manuscripts should present original material, the writing should be clear, study methods appropriate, the conclusions should be reasonable and supported by the data. Abbreviations, if used, should be explained.

Drugs should be referred to by their approved names (not by trade names). Scientific measurements should be given in SI units, except for blood pressure, which should be expressed in mm Hg.

Authors should give their names, addresses, and affiliations for the time they did the work. A current address of one author should be indicated for correspondence, including telephone and fax numbers, and e-mail address.

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

## REFERENCES

References should be numbered in the order in which they appear in the text. At the end of the article the full list of references should give the names and initials of all authors (unless there are more than six authors, when only the first three should be given followed by: et al.).

The authors' names are followed by the title of the article; the title of the journal abbreviated according to Medline; the year of publication, the volume number; and the first and last page numbers. **Please note:** References you should include DOI numbers of the cited papers (if applicable) – it will enable the references to be linked out directly to proper websites. (e.g. Redon J, Cifkova R, Laurent S et al. Mechanisms of hypertension in the cardiometabolic syndrome. J Hypertens. 2009; 27(3): 441–451, doi: 10.1097/HJH.0b013e32831e13e5.)

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Information from yet unpublished articles, papers reported at meetings, or personal communications should be cited only in the text, not in References.

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