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Crew and passenger deaths from vessel accidents in United Kingdom passenger ships since 1900

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ABSTRACT

Background: *There is very limited systematic analysis of the causes and consequences of maritime accidents across the whole passenger sector during the twentieth century either in United Kingdom (UK) or in other maritime nations, but some of the larger events have been the subject of detailed investigations that led to improved safety measures. In recent years, there has been increased attention to the analysis of passenger ship accidents, especially in relation to the two now dominant markets: vehicle/passenger ferries and cruise ships.*

Materials and methods: *Long-term trends since 1900 in passenger and crew deaths on UK seagoing passenger ships that have sustained a maritime accident, as defined by Lloyds Register, have been collated and analysed.*

Results: *Over the course of the 20th century, there has been a continuous fall in the number of incidents and in their severity. This may be a reflection of improved vessel safety, however the scale and nature of UK passenger shipping has also changed markedly over the period.*

Conclusions: *In addition to the reducing frequency of deaths it is apparent that the majority of fatalities in both crew and passengers came from a very small number of major events during the study period. Although there has been no major disaster involving a UK passenger ship in the last 30 years, major casualties with heavy loss of life continue in the world passenger fleet, in recent years involving flags such as Greece, Indonesia, Italy, Panama and The Philippines.*

(Int Marit Health 2019; 70, 1: 1–10)

Key words: passenger ships, deaths, United Kingdom, maritime casualties, fire, collision, foundering, grounding

INTRODUCTION

Major incidents involving United Kingdom (UK) passenger ships and resulting in deaths of crew members and passengers are now rare. When they occur, as with the *Herald of Free Enterprise* in 1987, they are a cause of great public concern. The loss of *R.M.S. Titanic* in 1912 was a major international news story at the time and remains a source of fascination to this day. This investigation will look in more depth at UK passenger ship incidents resulting in deaths since 1900. Fortunately, there have been none since 2000, but this is in part a consequence of the modest decline in the number of passenger ships registered in the UK as well as improvements in ship design and aids to navigation.

Case notes on all UK passenger ships involved in incidents that led to deaths among crew and/or passengers have been collated. These indicate that, in peacetime, the main causes of such incidents are foundering (including capsize and disappearance), wrecking and stranding, collisions and fires or explosions. The toll of casualties from these causes is examined and time trends evaluated.

The war years 1915–1918 and 1939–1945 are excluded from this analysis because of the very different pattern of ship loss during these periods. However, at least one major incident after 1945 has been attributed to uncleared mines and one to terrorist action.

Four study periods have been used: 1910–1914, 1919–1939, 1946–1969, 1970–1999. The first two have

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been selected to cover peacetime before the first war and then the inter-war years. The break at 1970 enables the last years when ships dominated passenger transport to be separated from the more recent period when relatively few people used sea transport as a necessity, beyond short sea ferry routes, and the majority of passengers were aboard cruise ships.

This study analyses a long run of data collected in a systematic way about a single country's fleet. Thus it bridges the gap between reports on individual incidents, popular texts about passenger ship disasters and a number of more rigorous investigations of risks to life aboard passenger ships that have been published in this century. Insights from these sources will be reviewed in the discussion section of this article. The authors have published two previous studies on other maritime sectors and time periods that use similar search strategies and analyses [1, 2].

MATERIALS AND METHODS

A database of major passenger ship incidents resulting in fatalities was created as a sub-file of a wide collection of information on such incidents in all maritime sectors. The records relate to vessels designated as seagoing passenger ships registered in the UK. Coastal passenger ships and commercial river craft are excluded. The sources of information used were firstly reports from marine accident investigations, conducted by the Marine Accident Investigation Branch since 1989 and in previous years variously by the Board of Trade, the Ministry of Transport, the Department of Trade and Industry etc. [3]. Other information sources used were annual Lloyd's Register quarterly and annual casualty reports and data [4, 5], Lloyd's Maritime Information Services casualty information [6]. Extensive searches of the British Newspapers Archive [7], Welsh Newspapers Online [8], the wrecksite.eu website [9], and the Ships Nostalgia website [10], death enquiry and death registration files held at the Registry of Shipping and Seamen and various other searches.

A total of 90 incidents were identified in the study period. The following information was obtained from the information sources; the date of the incident, the ship name, ship type, its gross tonnage and age. The following information was sought on the fatal incident: crew and passenger numbers lost, nature and circumstances of incident, location, routing, type of cargo, weather conditions, numbers of passengers and crew saved. Not all of this information was available for every incident.

RESULTS

Figure 1 shows total fatalities (passengers and crew) by year. It can be seen that the pattern is erratic as some years are dominated by a single major incident, while for others there were no reported events. Predictably large numbers of both passenger and crew deaths occur in years when a major incident(s) has occurred. A long run reduction in incidents and fatalities can be seen. The reasons for this will be discussed later after an analysis of the causes of incidents and their consequences.

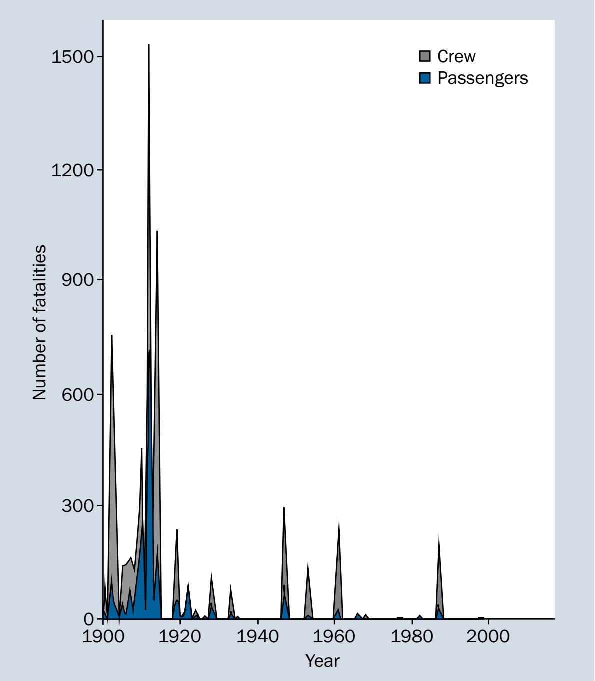


Figure 1. Trends in fatalities among crew and passengers that arose from ship accidents in United Kingdom passenger shipping since 1900

Table 1 summarises information on incidents by time period and primary cause, as reported. A major decline in the frequency of events can be seen between the 1900–1914 period and 1919–1939. Fires and explosions featured in a greater proportion of events in the periods after 1919, while collisions, wrecks/strandings and founderings all became rare after 1946. This may be a consequence of improvements in navigational aids with the widespread use of radar and location beacons.

Adverse weather conditions were recorded in 34 of the incidents that did not involve fires or explosions, although weather conditions could not be established from the information sources in a few cases. Fog was particularly linked to collisions and close to shore wrecks and strandings. Storms or gales were commonly linked to founderings.

Fires and explosions resulted in 174 crew deaths, and at least 408 passenger fatalities. Since 1946 few of these incidents have led to passenger fatalities as they arose mainly in engine rooms and other crew spaces and were contained without impairing the seaworthiness of the ship (Table 2).

Table 1. Reported major incidents involving United Kingdom seagoing passenger ships that resulted in loss of life

	Years	All incidents	Fire/explosion	Foundering/lost	Collision	Wreck/stranding	Other
All years	90	90 (1 p.a.)	24 (26%)	17 (18%)	17 (18%)	26 (28%)	6 (6%)
1900–1914	15	51 (3.6 p.a.)	8 (15%)	11 (21%)	9 (17%)	20 (39%)	3 (6%)
1919–1939	21	26 (1.5 p.a.)	9 (34%)	3 (11%)	7 (27%)	5 (19%)	2 (7%)
1946–1969	24	9 (0.4 p.a.)	6 (66%)	1	0	1	1
1970–1999	30	4 (0.1 p.a.)	1	2	1	0	0

One incident in the period 1946–1969 was attributed to uncleared or drifting mines that were a legacy from the Second World War, while for one terrorist action was suspected. 'Other' includes severe storm damage; p.a. — per annum

Table 2. Deaths resulting from major incidents involving United Kingdom seagoing passenger vessels

	All deaths: numbers, percentage of total in crew, ratios		Fire/explosion number of deaths	Foundering/ /lost number of deaths	Collision number of deaths	Wreck/ /stranding number of deaths	Other causes
All years (90)	Crew	2125 (33%)	174 (29%)	718 (30%)	980 (36%)	242 (35%)	11
	Passengers	4208+	408+	1675+	1686	436+	3
	Total	6333+	582+	2393+	2666	678+	
	Deaths per incident	70+	24+	140+	156	26+	
	Deaths per year	70+	6+	27+	30	8+	
1900–1914 (15)	Crew	1700 (34%)	64 (24%)	557 (32%)	876 (34%)	197 (21%)	6
	Passengers	3290+	195+	1187+	1658	250+	0
	Total	4990+	259+	1744+	2534	447+	
	Deaths per incident	97+	32+	158+	282	22+	
	Deaths per year	332+	17+	116+	168	30+	
1919–1939 (21)	Crew	221 (38%)	26 (64%)	58 (31%)	100 (79%)	32 (14%)	5
	Passengers	356	16	128	26	186	0
	Total	577	42	186	126	218	5
	Deaths per incident	22	5	62	18	44	
	Deaths per year	26	2	9	6	10	
1946–1969 (24)	Crew	145 (25%)	68 (24%)	64 (23%)	0	13 (100%)	0
	Passengers	421	213	205	0	0	3
	Total	566	281	269	0	13	3
	Deaths per incident	62	46	269	0	13	
	Deaths per year	23	12	11	0	0.5	
1970–1999 (30)	Crew	43 (22%)	0	39 (20%)	4	0	0
	Passengers	157	0	155	2		
	Total	200	0	194	6		
	Deaths per incident	25		77			
	Deaths per year	7		6			

Foundering and collisions caused the largest number of fatalities. A few events with large numbers of fatalities in the years 1900–1914 dominated this category, notably the *Titanic* in 1912 and *The Empress of Ireland* in 1914 accounted for 2526 deaths, almost 40% of all fatalities in the whole study period. More recently *The Herald of Free Enterprise* disaster accounted for 193 of the 200 deaths between 1970 and 1999.

The number of survivors after an incident varies greatly, but is not always reliably recorded. Table 3 presents the

Table 3. Details of ship accidents that led to 6 or more crew or passenger fatalities in United Kingdom passenger ships: ordered chronologically

Year	Name of ship	Type of ship	Gross tonnage, age of ship	Seafarers (and passengers) lost	Details of the maritime casualty
1987	Herald of Free Enterprise	MV Passenger ferry	7951, 6	38 (155)	Capsized soon after departing Zeebrugge, Belgium for Dover with the bow doors left open. 41 crew and 326 passengers rescued.
1982	European Gateway	MV Passenger ferry	4263, 6	4 (2)	Collided with the Bermudan registered passenger ferry MV Speedlink Vanguard and capsized in heavy weather in the North Sea, from Felixstowe for Rotterdam.
1968	Gothic	SS Passenger cargo liner	15 902, 20	3 (4)	Fire in the officers' smoking room which spread to passenger cabins, South Pacific Ocean after departing New Zealand for Liverpool.
1966	Anzio I	MV Passenger ship	216, 57	13 (0)	Stranded and wrecked during a gale and sleet in the North Sea off Lincolnshire, on passage from Tilbury to Inverness. No survivors.
1961	Dara	MV Passenger liner	5029, 13	25 (213)	Severe explosion amidships during unloading at Dubai, having arrived from Bombay. Thought to have been caused by a planted land mine.
1960	Capetown Castle	MV Passenger liner	27 002, 21	7 (0)	Explosion in the engine room in the North Atlantic, from Cape Town to Las Palmas.
1953	Princess Victoria	SS Passenger ferry	2694, 6	9 (124)	Capsized after the vehicles deck flooded during a severe storm, when crossing the Irish Sea from Stranraer to Larne. 43 rescued.
1947	Reina Del Pacifico	SS Passenger liner	17702, 16	28 (0)	Explosion in the engine room when undergoing sea trials in the Irish Sea off Belfast.
1947	Sir Harvey Adamson	SS Passenger cargo ship	1030, 32	64 (128)	Disappeared during a gale in the Bay of Bengal after departing Rangoon for Tavoy. Thought to have been caused by an uncleared mine.
1935	Laurentic	SS Passenger liner	18 724, 0	6 (0)	Collision in fog in the English Channel with the British liner SS Napier Star, crew accommodation damaged, having departed Plymouth for Antwerp.
1933	Antung	SS Passenger cargo ship	3508, 6	70*	Foundered during a storm in the South China Sea, from Swatow, China for Singapore. 265 rescued.
1928	Vestris	SS Passenger cargo liner	10 494, 0	43 (68)	Foundered following a cargo shift during a severe storm in the North Atlantic, on voyage from New York to Buenos Aries. 215 rescued.
1924	Cigale	SS Passenger cargo ship	310, 16	7 (16)	Fire and explosions in a hold that contained spirits in the Indian Ocean off Mauritius. 36 saved.
1922	Egypt	SS Passenger liner	7912, 24	71 (16)	Foundered after colliding with a French steamship Seine amid fog in the English Channel, from Tilbury to Bombay with a cargo of gold bullion. 251 survivors.
1921	Rowan	SS Passenger ship	1493, 11	11 (11)	Collision in fog with an America steamship West Camak in the Irish Sea, from Glasgow to Belfast. 75 rescued.
1920	Bohemian	SS Passenger cargo ship	8555, 19	6 (0)	Stranded during a storm off Sandro Island, Nova Scotia, from Boston, USA, for Liverpool. 174 rescued.
1919	Iolaire	Sail and steam yacht	634, 17	20 (185)	Wrecked during a cyclone off the Hebrides, carrying armed forces, returning from World War One. 75 saved.
1914	Belgian King	SS Passenger ship	3393, 32	0 (22)	Foundered after the cargo of cattle shifted, from Trebizonde for Constantinople in the Black Sea.
1914	Empress of Ireland	RMS Passenger liner	14 191, 8	172 (840)	Collision in dense fog with a Norwegian collier ship SS Storstad in the St. Lawrence River, from Quebec for Liverpool. Foundered, 238 crew and 317 passengers saved.
1913	Alum Chine	SS Passenger cargo	1767, 7	11 (9)	Explosions and fire on deck when loading a cargo including dynamite at Baltimore. →

Table 3 (cont.). Details of ship accidents that led to 6 or more crew or passenger fatalities in United Kingdom passenger ships: ordered chronologically

Year	Name of ship	Type of ship	Gross tonnage, age of ship	Seafarers (and passengers) lost	Details of the maritime casualty
1913	Veronese	SS Passenger liner	7063, 6	5 (33)	Stranded during a gale and fog off Porto, Portugal, from Liverpool for Brazil and Argentina. 337 survived.
1913	Volturno	SS Passenger liner	3602, 6	30 (106)	Fire in a hold spread through the ship during a North Atlantic gale, from Rotterdam to New York with a general cargo, 521 rescued. Ship later scuttled.
1912	Oceana	SS Passenger liner	6610, 23	2 (7)	Collision with a German barque Pisagua in the English Channel off Newhaven, from Tilbury to Bombay with a cargo of gold and silver ingots. 241 rescued.
1912	Titanic	RMS Passenger liner	46 328, 0	696 (818)	Foundered after striking an iceberg in the North Atlantic, on her maiden voyage from Southampton to New York. 212 crew and 498 passengers survived.
1911	Fifeshire	SS Passenger liner	5812, 12	14 (10)	Wrecked during a gale in the Gulf of Aden, on voyage from Melbourne to London.
1910	Loodiana	SS Passenger cargo ship	3264, 24	93 (83)	Disappeared during a cyclone in the Indian Ocean when travelling from Mauritius to Colombo.
1910	Abbona	SS Passenger liner	4066, 0	129 (101)	Foundered with all on board in during a severe storm in the Bay of Biscay, on her maiden voyage from Glasgow to Colombo.
1910	Axim	SS Passenger liner	2804, 15	32 (4)	Disappeared in a storm in the Bay of Biscay, from London for the Canary Islands. All on board lost.
1910	Lima	SS Passenger cargo ship	4943, 2	6 (0)	Wrecked in fog off Guamblin Island, Chile, from Liverpool on voyage to Callao.
1909	Ellan Vannin	PS Passenger ship	339, 48	21 (15)	Foundered with all on board during a severe storm in the River Mersey estuary, having departed Ramsey, Isle of Man, for Liverpool.
1909	Republic	RMS Passenger liner	15 378, 5	3 (3)	Collision in fog with the American ship SS Florida off Massachusetts, New York for Genoa. Sank next day. > 1500 rescued.
1909	Umhlali	SS Passenger ship	3388, 3	0 (11)	Wrecked off Las Palmas, Canary Islands, in dense fog when bound from London for Natal. 109 rescued.
1909	Waratah	SS Passenger liner	9339, 0	119 (92)	Disappeared on her second voyage during a gale in the Cape of Good Hope, bound from Australia to London. Wreckage found later.
1909	Powan	SS Passenger ferry	15, 9	0 (26)	Wrecked during a storm in the South China Sea off Hong Kong, on voyage from Canton for Hong Kong.
1908	Sardinia	SS Passenger cargo ship	2474, 19	16 (83)	Fire in a hold containing nitrate in the Mediterranean Sea, from Malta for Alexandria. 104 survivors.
1907	Berlin	SS Passenger ship	1745, 12	48 (85)	Wrecked during a storm off the Hook of Holland, from Harwich. 4 crew and 11 passengers rescued.
1906	Courier II	SS Passenger cargo ship	152, 22	0 (10)	Wrecked off Jethou, Guernsey, after departing Sark for Guernsey. 29 rescued.
1906	Hankow	PS Passenger ship	3073, 32	8 (122)	Gutted by a fire from a deck cargo of straw, when berthed in Hong Kong harbour (estimate on pro-rata basis: declared total 130).
1905	Damara	SS Passenger ship	1779, 21	15 (0)	Wrecked in a snow blizzard off Sable Island, Nova Scotia, London to Halifax, Nova Scotia. 19 saved.
1905	Hilda	SS Passenger	848, 22	27 (98)	Wrecked amid dense fog in the English Channel off Pierres des Portes, from Southampton for St Malo. One crew member and 5 passengers rescued.
1904	Secundra	SS Passenger cargo ship	2160, 19	7 (0)	Wrecked soon after departing Galle, Sri Lanka for New York. 142 rescued.

→

Table 3 (cont.). Details of ship accidents that led to 6 or more crew or passenger fatalities in United Kingdom passenger ships: ordered chronologically

Year	Name of ship	Type of ship	Gross tonnage, age of ship	Seafarers (and passengers) lost	Details of the maritime casualty
1903	Arequipa	SS Passenger cargo ship	2953, 13	11 (52)	Foundered during a severe gale when loading cargo including gold at Valparaiso. 32 rescued.
1903	Orion	SS Passenger cargo ship	684, 28	3 (3)	Gutted by a fire from the passengers' saloon in the Barents Sea off Makkaur, Norway.
1903	Upupa	SS Passenger cargo ship	948, 31	21 (2)	Disappeared during a gale in the Irish Sea off Ballycotton after departing Cardiff for Cork.
1902	Camorta	Sail and steam passenger	2119, 20	89 (650)	Foundered during a cyclone in the Bay of Bengal, after departing Madras for Rangoon. No survivors.
1900	Charkieh	SS Passenger cargo ship	1533, 34	21 (18)	Wrecked in a gale in Karystos Bay, Greece, on route for Piraeus from Alexandria. 60 rescued.
1900	City of Monticello	PS Passenger cargo ship	1034, 33	28 (35)	Sank during a storm in the Bay of Fundy, St. John's, Newfoundland to Yarmouth, Nova Scotia. 3 saved.
1900	Rossgull	SS Passenger cargo ship	238, 15	10 (0)	Wrecked during a storm off Jersey, having arrived from Plymouth. 3 crew and 8 passengers rescued.

*Total fatalities among crew and passengers aggregated; SS — steamship; PS — paddle steamer; RMS — Royal Mail ship; MV — motor vessel; RMMV — Royal Mail motor vessel; RoRo — roll on roll off

available information on all of those incidents where there are 6 or more fatalities. The number of survivors is noted on the table when it has been recorded. Some incidents, such as deep-sea founderings, have few if any survivors. For wrecks and collisions near to the coast the number of survivors is usually greater. The incidents that are reported include fires, where there is a threat to the integrity of the vessel but in many situations the fire is contained. Here evacuation is unlikely and numbers of fatalities are often small.

There have been few incidents involving loss of life in the most recent decades. Since 1980, the only cases refer to a collision involving a Harwich passenger ferry in the North Sea in 1982 (4 crew and passenger lost), the capsize of the Dover ferry *Herald of Free Enterprise* off Zeebrugge in 1987 (38 and 155 lost) and an explosion in the engine room of a Portsmouth ferry in 1998 (one crew fatality) (Fig. 2).

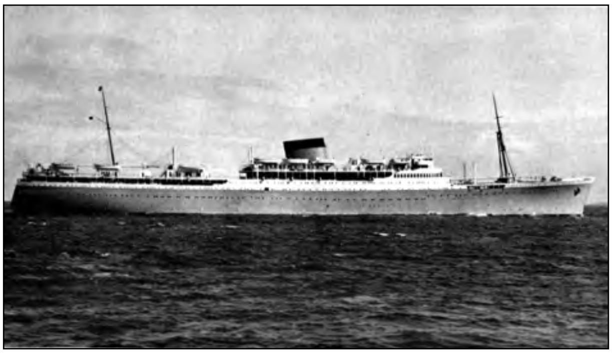
DISCUSSION

Like any other case series collected over a long period, there will be underlying trends that are not included in the data set, but which influence the findings. The British merchant marine and especially passenger shipping changed greatly over the 20th century. Between 1900 and 1914 the UK fleet was dominant in world trade, including passenger transport. Between 1919 and 1939 this dominance declined, but passenger liners owned and crewed in UK provided a large proportion of services worldwide. Passenger shipping on major routes became increasingly separated from freight transport. In the years 1946–1969 there was a decline in the tonnage of passenger shipping, especially towards the end of the period when aircraft became the main means of intercontinental passenger transport. After 1970, UK shipping continued to provide ferry services and most deep sea passenger ships moved to the leisure market of cruising. Some of the reductions in incidents and fatalities is likely to be a consequence of these changes.

The greatest decline in fatalities took place between the period 1900–1914 and 1919–1939. This cannot be explained by changes in passenger transport as this came later. The reforms in passenger ship safety that followed the loss of *Titanic,* such as increases in the number of lifeboats and rafts may have increased the proportion of survivors, in addition to progressive improvements in ship design. Maritime radio communications became widely available and this may have contributed both by the provision of weather forecasting and by improving ship to ship communications, thus reducing collision risks and hastening the response to any serious incident on board. The introduction of radar and other electronic navigation aids from the 1940s onwards almost certainly contributed to improvements in safety during this period.

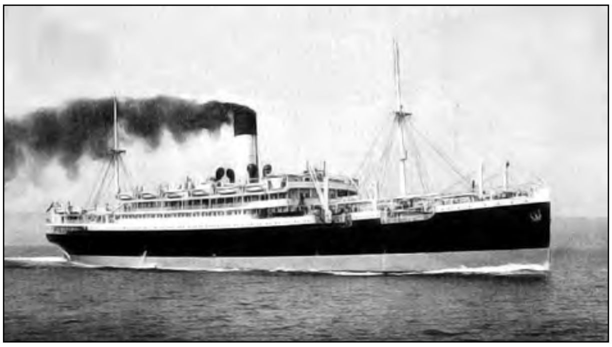
Systematic studies of world passenger shipping risks or of those in national fleets for the twentieth century are rare. This is different from the nineteenth century, at least in the UK, where state enquiries into loss of life at sea were regularly undertaken because of public and political concern about crew and passenger deaths [11]. There are a number of publications that describe some of the more sensational ship losses but do not routinely include detailed information on fatalities [12–14]. Major disasters are, however, the subject of detailed individual reports commissioned by governments or within the maritime sector.

MV Herald of Free Enterprise (1987; 7951 tons)

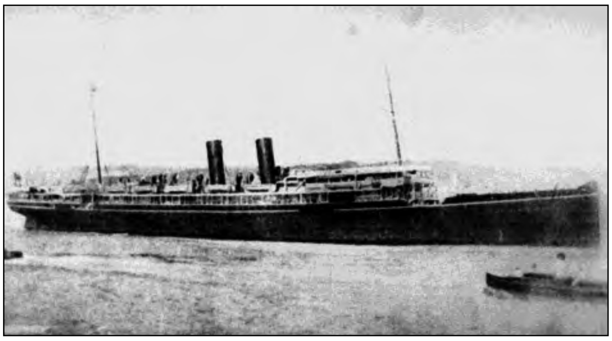


MV Capetown Castle (1960; 27,002 tons)

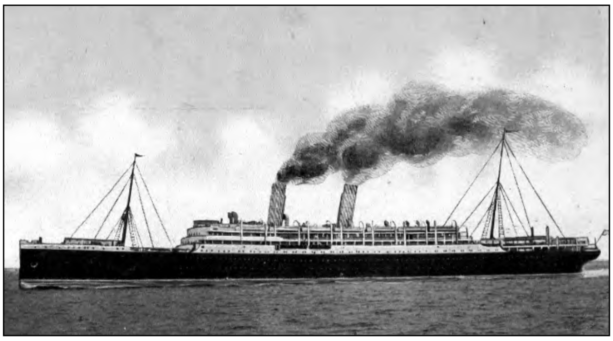
SS Princess Victoria (1953; 2694 tons)



SS Vestris (1928; 10,494 tons)

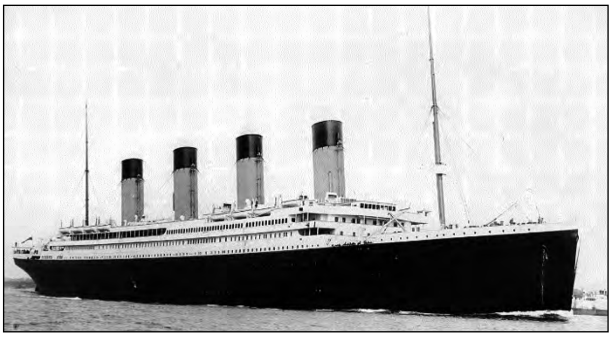


SS Egypt (1921; 7921 tons)



RMS Empress of Ireland (1914; 14,191 tons)

SS Volturno (1913; 3586 tons)



RMS Titanic (1912; 46,238 tons)

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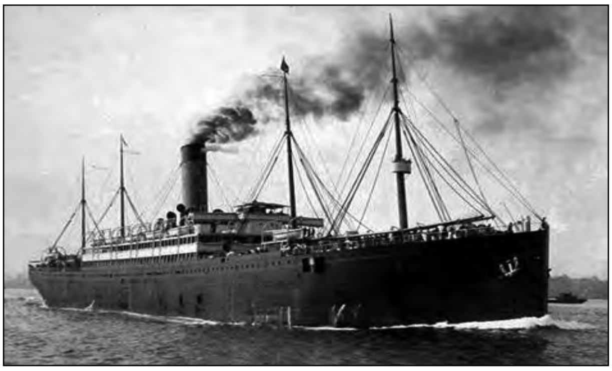
Figure 2. Photographs of United Kingdom passenger ships that were lost or had fatal (> 6 crew or passenger fatalities) ship accidents, ordered chronologically (with year of casualty and gross tonnage in brackets)

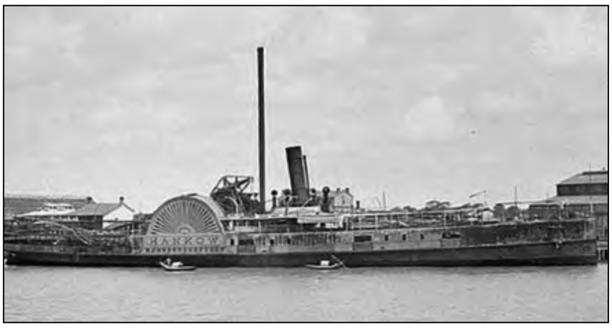


RMS Republic (1909; 15,378 tons)

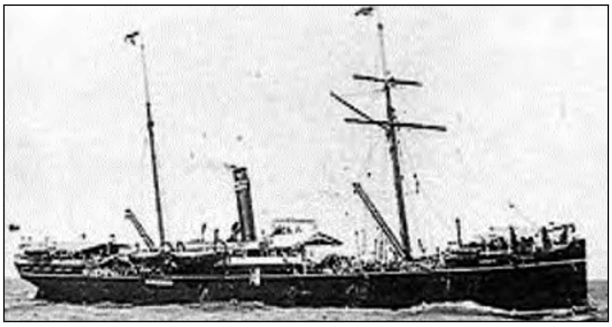
PS Ellan Vannin (1909; 339 tons)

SS Waratah (1909; 9339 tons)

SS Berlin (1907; 1745 tons)



PS Hankow (1906; 3073 tons)



SS Camorta (1902; 2119 tons)

Figure 2 (cont.). Photographs of United Kingdom passenger ships that were lost or had fatal (> 6 crew or passenger fatalities) ship accidents, ordered chronologically (with year of casualty and gross tonnage in brackets)

Watson [12] provides some summary information on the international passenger ship losses that he describes for the period 1900–1986, his is a selective list of the largest vessels lost, not all of which result in fatalities. Notable findings are the high proportion of losses that are to UK ships, 68 out of his total of 199, with the next countries being France at 23 and Italy at 17. This reflects the relative size of the three countries' passenger fleets in this period [15]. The trend information he presents broadly aligns with our study, but uses different time periods.

One of the notable features of our casualty data is the predominance of a few major incidents as the major causes of loss of life during each of the periods studied. The effect of this on the frequency of fatalities can be seen in Figure 1. Such major incidents have featured prominently in the public perceptions of risk at sea and have continued to do so following more recent incidents affecting ships of other flags such as the foundering of the Estonian Ro-Ro ferry *Estonia* during a crossing of the Baltic Sea in 1994, which led to over 800 deaths. The grounding of the cruise ship *Costa Concordia* in 2012, with 32 deaths led to even greater public interest as it was visible to all, had overtones of navigational failure and affected the sort of cruise liner that many people had holidayed on.

While there have been no major disasters involving UK passenger ships over the last 30 years, other major casualties with heavy loss of life have continued in the world passenger fleet [4, 5, 7]. These also include the Greek ferry *Express Samina* which struck a rock off Paros Island in the Aegean Sea in 2000 with 81 deaths and the Panamanian RoRo ferry *Al-Salam Boccaccio 98* which foundered in the Red Sea with more than 1000 lives lost in 2006. Additionally, since 2000, casualties involving 4 Philippine (*Maria Carmela, Princess of the Stars, Superferry 14 and St. Thomas Aquinas*) and 4 Indonesian passenger ships (*Digul, Dumai Express 10, Senopati Nusantara* and *Tristar 1*) alone have led to more than 1700 fatalities, while another 1863 crew and passengers were lost through the foundering of the Senegal ferry *Le Joola* during storms off Dakar in 2002.

To cover the long time period studied we have used the standard classification of maritime disasters that has long been used by Lloyds Register [4]. This attempts to define a single, usually proximate, cause for an incident. In recent years there has been a growing literature that has looked in more detail at risk assessment and risk management of vessels, including those carrying passengers [16–18]. Such analysis has the potential to provide more detailed insights about causation, in particular the contributions of human factors [19, 20], and technical aspects of ship design [21]. Risk management and risk mitigation are usually analysed separately, with a particular focus on passenger evacuation procedures as a major contributor to survival after an incident [22]. A number of recent publications use historic data as the basis for predictive models and these can be a valuable source of more detailed information on incidents and on the realities of risk management and mitigation in passenger shipping [23–25].

Maritime incidents are only one contributor to death and morbidity in passenger shipping [25, 27]. Both passengers and crew members can sustain injuries and, in the case of crew these are frequently work-related [28–30]. Both groups can develop illness while at sea. Such risks can be reduced by good safety practices, fitness criteria for crewmembers and sometimes for passengers and the provision of facilities for medical care on board. There is conflicting evidence about changes in the relative importance of major incidents, occupational and other accidents and illness to deaths and morbidity at sea [31].

Passenger travel by sea has become far safer than it was in 1900. It is not, however, possible to analyse the causation of incidents in the same detail for most historic events as can be done in the immediate aftermath of major incidents, although this has been attempted for some of the best documented major incidents, for instance by comparing the loss of *RMS Titanic* with that of *Costa Concordia* [32, 33].

Because of their drama, visibility and issues such as liability and potential for multiple fatalities among passengers, it is the major incidents that have commanded most attention and concern. This has not abated, despite the long term reductions in risk. As the numbers of passengers and crewmembers on a single vessel increases so does the worst case scenario of total loss with few or no survivors. The very low probability of such an incident does little to downgrade the levels of concern and even sensationalism.

The expectations of travellers have more than kept pace with improvements in safety, as well as being influenced by comparisons of the safety cultures and their effects on risk in different modes of passenger transport, such as rail, road and air. The change from shipping as a necessity, because it was the sole means of intercontinental travel, to a luxury as a capital intensive part of the leisure sector has also influenced attitudes and led to new approaches to risk assessment and mitigation.

The relative level of concern about passenger risk compared with that of crewmembers has been one of the drivers for higher standards in passenger shipping than in cargo transport [34–36]. It does have to be remembered that passenger and crew fatalities correlate with each other [37]. Some 30% of fatalities throughout the period studied have been in crew members and, given their greater exposure to risk of personal accidents as well as accidents to their ship throughout the whole of their careers, rather than just when on an occasional voyage, their lifetime risk remains far higher than the passengers they transport, even if it has a lower public and political profile.

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ORIGINAL ARTICLE

A survey of jellyfish sting knowledge among Thai divers in Thailand

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ABSTRACT

Background: *In tropical regions, jellyfish envenomation is a persistent hazard for people who spend time in the sea. Jellyfish stings can be dangerous, and among the people who face the greatest risk are scuba divers. This study therefore sought to determine the level of knowledge divers in Thailand have about the threat of jellyfish envenomation.*

Materials and methods: *In April 2018, a total of 238 divers responded to a questionnaire, thereby providing data for further statistical analysis.*

Results: *The findings revealed that 31.91% of the study participants cited jellyfish stings as their most frequently encountered injury, with 68.09% having personal experience of the problem, or having seen others injured by jellyfish. However, 34.03% of the sample respondents believed their own level of knowledge to be "low" or "none". The mean score was 71%, which can be considered satisfactory, but the scores for items concerning the recognition of signs of envenomation and items about first aid responses (52.74% and 59.13%, respectively) were not acceptable.*

Conclusions: *Divers frequently experience jellyfish stings, and diving personnel were highly rated for their knowledge in this area. However, very few were fully confident in their first aid capabilities, and therefore it can be argued that it is necessary to improve the level of medical education and to provide training to eliminate this weakness.*

(Int Marit Health 2019; 70, 1: 11–16)

Key words: divers, jellyfish sting, knowledge, medical education

INTRODUCTION

Jellyfish are a type of marine invertebrate which can be found worldwide. Both venomous and harmless species exist, including some which pose a serious threat to humans who come into contact with them. Most jellyfish have dome-shaped bodies and are easily recognised by their tentacles which hang below. These tentacles house the cnidocytes, which are cells that can be activated by stimulation, which can take both chemical and mechanical forms. The cnidocytes contain organelles known as nematocysts, which are responsible for the delivery of venom into the target when they are triggered [1, 2]. Not only is the sting very rapid, but it can be delivered even when the tentacles are separated from the jellyfish, or when the jellyfish is already dead [3].

Different species will produce different symptoms when they envenomate their victims. Another factor affecting the severity of an attack is the amount of bare skin exposed to the jellyfish. While some cases are relatively mild and do not lead to permanent sequelae, others can be much more serious, causing constant pain, vesicular formations, urticaria, superficial necrosis [4], eye injuries [5], cardiovascular problems [6], Irukandji syndrome [7], multiple organ dysfunction [8], and sometimes death [9]. It can be difficult to find accurate data concerning the incidence of

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jellyfish envenomation because stings are rarely reported. It can be estimated that the number of cases could be as high as 150 million per year [10]. Research carried out in Italy revealed that medical services provided to jellyfish victims in Italian waters cost around €400,000 over a period of 5 years. This represents a significant burden for public health care providers [11]. In tropical or subtropical regions, jellyfish enjoy conditions which are even more conducive to growth and procreation, and the past 10 years has seen jellyfish blooms become increasingly common, especially in Thailand, possibly as a consequence of overfishing, global warming, and of activities which place excessive nutrient levels in the water, thus boosting plant growth while contributing to lower oxygen levels [12, 13].

In the tropical seas of the Asia-Pacific region, the major jellyfish types include *Chironex fleckeri*, *Aurelia aurita*, and *Chrysaora chinensis*. *Aurelia aurita*, also known as the moon jellyfish, can be found all over the world, and had long been considered harmless. However, toxicology tests along medical reports have since confirmed that it is in fact a species which is venomous to humans [14]. Among the other types of jellyfish known to be venomous are *Cyanea capillata* and *Chrysaora chinensis* which appear predominantly in the seas around East Asia, including Thailand, Japan, and Korea [15]. In other parts of the world, especially the North Atlantic, North Pacific, and Arctic Oceans, *Cyanea capillata*, also known as the lion's mane jellyfish poses a potential threat [15]. Meanwhile, blooms of *Cyanea nozakii* have been seen in the Yellow Sea, the Bohai Sea, and the waters around Thailand [16]. In addition, the dangers posed by box jellyfish are relatively well-known since it has a reputation as one of the world's most venomous marine creatures [9]. The most dangerous of all these species is *Chironex fleckeri*, which is capable of causing rapid cardiorespiratory depression when it strikes, with the potential to kill within minutes when the dose received is high [17]. One problem is that many doctors and nurses do not have the requisite knowledge concerning box jellyfish, and are therefore not able to offer the best possible assistance to victims of envenomation. This situation persists despite a number of box jellyfish attacks occurring in Thai waters. The symptoms caused by box jellyfish envenomation, such as Irukandji syndrome, which is linked to carybdeid stings, and other envenomation sequelae are thus rarely diagnosed by Thai physicians [9, 17].

Since these dangerous species are becoming more abundant, they pose an increasingly significant risk to divers and other tourists, especially when it is taken into account that they are almost invisible in the water. Divers are particularly threatened since they spend more time in the water in close proximity to jellyfish. In this study, the researchers therefore carried out a survey to assess the level of knowledge of Thai divers concerning jellyfish. This survey made use of a number of sub-questionnaires in order to gather the data. In this report, the findings concerning the section of the study which addressed the topic of jellyfish stings will be reported.

MATERIALS AND METHODS

STUDY DESIGN AND SAMPLING

The study involved an investigation into the levels of knowledge held by divers about health, and hence the researchers visited a number of diving schools and participated on diving trips in order to gather data during May 2017. The study used a cross-sectional design to examine the divers' knowledge on the subject of jellyfish envenomation. The study population therefore comprised Thai scuba divers who attended the diving schools or joined the diving trips. The study participants were chosen through a convenience sampling approach with the exclusion criteria ensuring that divers who had previously worked in health care environments were not selected.

COLLECTION OF DATA

To gather data, a questionnaire was used. This instrument was written in Thai and was developed in accordance with the Cochrane Systematic Review and 2014 Expert Consensus with the approval of the Chinese Society of Toxicology [18]. Certain alterations were made to fit the purposes of this study. The instrument comprised two parts: the first covered demographic data through items involving gender, age, diving experience, education, and health and medical details, while the second emphasized knowledge concerning jellyfish envenomation and included items asking about sources of this knowledge, personal experience with jellyfish stings, knowledge of emergency first response, general knowledge about recognising and treating jellyfish stings, and also knowledge about the dangers and consequences of envenomation. The questions in the knowledge component included both multiple choice items and items requiring a true/false response [18]. For the purposes of this study, the term 'jellyfish' refers to the *Chironex fleckeri*, *Aurelia aurita*, *Scyphozoans* and *Chrysaora chinensis* species. Correct responses were therefore indicative of knowledge related to first aid, venomous species and body parts, and periods of increased incidence of attack in the context of the species mentioned.

DATA ANALYSIS

The data underwent analysis using SurveyMonkey® (San Mateo, California, USA), while counts and percentages were to describe the categorical variables. Correct answers were awarded one point, and other answers received zero in the case of single-answer items. For multiple choice items which listed more than one correct answer, one point was awarded for each correct answer identified, but the selection of a single wrong answer would result in a score of zero for that item. The total scores were then presented in the form of median ± standard deviation. Scores exceeding 60% were deemed satisfactory. Univariate analyses were performed for each of the factors which influence the knowledge score in order to determine the links between the total score and the variables involved. The results from the knowledge score were not normally distributed, and hence it was necessary to employ non-parametric tests for the purpose of performing the univariate analyses.

ETHICAL CONCERNS

The researchers received ethical approval from the Ethics Committee of Walailak University, Nakhon Si Thammarat, Thailand (WUEC-18-015-01); the study was carried out following the guidelines set out by the Declaration of Helsinki, and the participants completed the questionnaire in anonymity. Confidentiality was maintained at all times for the data collected.

RESULTS

The study used data gathered from 238 Thai divers. Table 1 presents the socio-demographic data about the respondents, of whom 54.62% were male while 45.38% were female. In the age category, 86.14% were aged 18–35 years. A majority attended diving schools on the island of Koh Tao in Surat Thani province, Thailand (78.90%) and 65.22% held PADI certification (Professional Association of Diving Instructors) while 89.50% had less than 5 years' diving experience. Around 85% had attained at least a bachelor's degree level of education.

A total of 32% of the respondents (n = 75) stated that either they personally, or a diving colleague, had been stung by a jellyfish. A majority of the respondents (65.97%, n = 157) had some knowledge about jellyfish stings, while the remainder had no such knowledge. Medical education concerning jellyfish stings was typically obtained through online sources (43.27%, n = 90), while other sources of information included television (16.35%, n = 34), friends or family (12.5%, n = 26), and the diving schools (27.88%, n = 58).

In Table 2, the general knowledge levels of divers with regard to jellyfish envenomation are presented. The mean scores for knowledge were shown to be 71 ± 18%, or the equivalent of 6.4 out of 9 points.

In Table 3, participants were asked about the symptoms and consequences of jellyfish envenomation. The highest score recorded was 100%, but the mean was 0.8 ± 0.36 or around 85%.

Table 1. Participants' socio-demographic data (n = 238)

Characteristics	N (%)
Gender:	
Male	130 (54.62)
Female	108 (45.38)
Age [years]:	
18–25	77 (33.33)
26–35	122 (52.81)
36–45	26 (11.26)
< 45	6 (2.60)
Did not answer	7
Diving experience [years]:	
0	111 (46.64)
< 2	64 (26.89)
2–5	38 (15.97)
> 5	25 (10.50)
Education level:	
Lower than bachelor's degree	34 (14.72)
Bachelor's degree	166 (71.86)
Higher than bachelor's degree	31 (13.42)
Did not answer	7
Diving certificate::	
PADI	135 (65.22)
NAUI	8 (3.86)
Other	3 (1.45)
No certificate	61 (29.47)
Did not answer	31
Friends or relatives working in health care:	
Yes	45 (19.15)
No	190 (80.85)
Did not answer	2

In Table 4, the respondents' knowledge of appropriate first aid responses to jellyfish envenomation is presented. For the first item, the mean score was 0.5/1.0 ± 0.50 while for the second it was 0.8/1.0 ± 0.36.

DISCUSSION

The researchers believe this is the first research study to examine knowledge about jellyfish envenomation among a particular population. The study involved divers in Thailand, and it was found that while jellyfish injuries were common, fewer than half of the participants who had personally experienced a jellyfish attack had the necessary knowledge to intervene safely or effectively. While a majority knew something about jellyfish stings, few had sufficient knowledge of first aid

Table 2. General knowledge concerning jellyfish envenomation (n = 238)

Questions	N (%)
1. Which part of the jellyfish is responsible for envenomation?	
1. Body	25 (10.59)
2. Tentacles	200 (84.75)
3. Head	11 (4.66)
Did not answer	2
The correct response: 2	200 (84.75)
2. Which jellyfish species has a potentially fatal sting?	
1. Box jellyfish	148 (62.45)
2. Moon jellyfish	15 (6.33)
3. True jellyfish	6 (2.53)
4. Chrysaora jellyfish	68 (28.69)
Did not answer	1
The correct response: 1	148 (62.45)
3. Dismembered or dead jellyfish can still envenomate victims	
1. True	188 (80.00)
2. False	47 (20.00)
Did not answer	3
The correct response: 1	188 (80.00)
4. Jellyfish do not make unprovoked attacks on humans	
1. True	157 (67.97)
2. False	74 (32.03)
Did not answer	7
The correct response: 1	157 (67.97)
5. In which of the periods below are jellyfish stings most likely?	
1. Noon	22 (9.24)
2. Morning	16 (6.72)
3. Night	37 (15.55)
4. Rainy season	151 (63.45)
5. Winter	12 (5.04)
The correct response: 4	151 (63.45)

Table 3. Knowledge of the symptoms and consequences of envenomation (n = 238)

Questions	N (%)
1. What symptoms result from mild envenomation?	
1. Itchiness	125 (52.74)
2. Burning pain	109 (45.99)
3. Hoarseness	3 (1.27)
4. Chest pain	0 (0.0)
Did not answer	1
The correct response: 1	125 (52.74)
2. In which of the circumstances below should an envenomated patient be taken immediately to hospital?	
1. Obesity	6 (12.53)
2. Allergy or heart disease	219 (92.41)
3. Having a cold	4 (1.69)
4. Alcoholism	7 (0.42)
Did not answer	2
The correct response: 2	219 (92.41)

Table 4. Knowledge of first aid and treatment aid (n = 238)

Questions	N (%)
1. How should you treat the wound if someone is stung by a jellyfish?	
1. Leave the sea and clean the wound with sea water	125 (53.19)
2. Leave the sea and clean the wound with fresh water	110 (46.81)
Did not answer	2
The correct response: 1	125 (53.19)
2. You should pull out any remaining nematocyst from the skin with your bare hands	
1. True	36 (15.19)
2. False	201 (84.81)
Did not answer	1
The correct response: 2	201 (84.81)

to react correctly to envenomation. To address this problem, further training and medical education would be required.

GENERAL KNOWLEDGE CONCERNING JELLYFISH ENVENOMATION

Jellyfish which are dead or tentacles which have separated from the body are still able to envenomate a victim if they have not yet dried out. Therefore, divers should take care not to touch dead jellyfish with their exposed skin. Jellyfish do not actively seek to attack humans, and will only sting after the provocation of coming into close proximity with a swimmer. It is therefore important for swimmers to avoid jellyfish whenever possible. Another way to reduce the incidence of jellyfish envenomation would be for divers to avoid the sea during the rainy season when the probability of an attack is greatest. In terms of knowledge about the dangers of different species, most participants were aware that box jellyfish stings can be fatal. This is important since box jellyfish have been reported in Thai waters. The level of general knowledge shown by the respondents overall was satisfactory, while two questions were successfully answered by more than 60% of the participants. More than half of the divers knew that the rainy season in the most dangerous period in Thailand for jellyfish stings. The reason for this is that when it rains, the presence of fresh water attracts jellyfish to move towards the shore [18].

RECOGNITION OF SYMPTOMS

First aid is most effective when delivered early, accurately, and correctly. This requires immediate recognition that a problem exists. The first sign of mild envenomation is usually an itchy skin. If this is accompanied by hoarseness, burning pain, or chest pain, this is indicative of an allergic reaction to the sting. In some cases, this can quickly turn to acute pulmonary oedema and allergic shock within a period ranging from a few minutes up to six hours. Death is a potential outcome should this happen [19]. Accordingly, it is vital to be able to identify the symptoms quickly so that severe cases can be sent immediately to hospital. In particular, victims who have allergies, heart disease, a temperature exceeding 38°C, are aged above 65, or have been extensively stung across a large expanse of skin should be hospitalized as soon as possible [18]. The findings in this research suggest that a majority of divers have some knowledge of the signs of jellyfish envenomation, since more than half knew that itchiness would result in mild cases. However, 45% identified burning pain, chest pain, or hoarseness as signs of a mild case; this is potentially dangerous since any of these symptoms can be followed by allergic shock and death if immediate medical help is not sought. It would therefore be helpful if educational efforts could focus on this particular misconception so that divers will in future be aware of this potential danger.

FIRST AID KNOWLEDGE

When a jellyfish sting occurs, the victim should promptly leave the sea and have the wound cleaned in seawater. It is inadvisable to use fresh water since fresh water has low osmotic pressure which allows the remaining nematocysts to break apart and release further toxins [20]. Once the wound has been cleaned, the tentacles and any observable nematocysts should be removed carefully from the skin. It is advisable to use a seawater paste to cover the injured skin. Dry sand can also be used for this purpose. It is then possible to extract the jellyfish tentacles with tweezers or a knife. This can also be done by hand as long as protection is used to prevent the bare hands from suffering envenomation [21]. The knowledge of the divers was shown to be good in this section. However, it is a matter for concern that 47% of the respondents believed fresh water to be the better choice for cleaning the wound, since the use of fresh water would lead to a worsening of the injury. The divers were also shown to be generally well aware that they should not attempt to remove nematocysts with their bare hands.

MEDICAL EDUCATION AND FURTHER TRAINING

The respondents cited the internet as their main source of medical education about jellyfish envenomation. This suggests that there is a need for better-designed and more accessible medical training and education to raise knowledge standards. Since many divers also obtained information from television or the diving schools, it might be argued that brochures could be used effectively to deliver this education. The diving schools themselves must also seek to increase the knowledge levels in first aid practices and skills along with appropriate responses to jellyfish envenomation. One useful aid to learning about symptoms would be photographs of typical skin reactions which could be used for comparison. The validity of this particular finding could be verified through future studies involving other seaside populations, such as fishermen and tourists. It may also be helpful to design educational materials which could extend this knowledge base to the general population.

LIMITATIONS OF THE STUDY

This study has a number of limitations. The problem of selection bias may be present since the sample size was small. Furthermore, the sample might not be fully representative of the population because a convenience sampling approach was employed. In addition, recruitment of the participants solely from diving schools means that it is difficult to make generalizations from the findings which extend beyond the diving fraternity. It cannot be inferred that the general population of Thailand, for example, would be similarly knowledgeable about jellyfish envenomation. Further studies would be required to shed light in this area.

CONCLUSIONS

This study may be the first to investigate knowledge levels about jellyfish envenomation among members of a particular population who are most at risk. Within this naval unit based in northeastern Thailand, jellyfish stings are frequently encountered, yet personnel scored badly in their knowledge of risk factors, symptoms, and appropriate first aid responses to jellyfish stings. From this it can be inferred that medical education and further training might be useful in order to improve this situation, offering divers better protection from the dangers of jellyfish attacks in the future.

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REVIEW ARTICLE

Is it worth to continue to analyse the factors of cardiovascular risk among the sailors? Review of literature

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ABSTRACT

Background: *Cardiovascular diseases are still the most common cause of death from natural causes among seafarers. The aim of the study was to determine which of the cardiovascular risk factors listed in the current recommendations of the European Society of Cardiology occur among seafarers.*

Materials and methods: *The paper is a review of literature from PubMed Database.*

Results: *Based on conducted analysis of over 31 papers high prevalence of classic and other cardiovascular risk factors among seafarers was proven. The most common risk factors among off-shore workers are overweight and obesity (over 64%); moreover, these factors occur more often among seafarers than in the general population. Also hypertension, smoking, type 2 diabetes and unfavourable lipid profile were present more often in this occupational group. In the analysed studies attention was also paid to factors often overlooked in risk assessment such as mental and inflammatory illnesses, unfavourable working conditions and psychological burden.*

Conclusions: *Seafarers have a higher cardiovascular risk because, among other things, the prevalence of "old and new" risk factors among them is higher than in general population.*

(Int Marit Health 2019; 70, 1: 17–21)

Key words: cardiovascular risk, seafarers, ischaemic heart disease, hypertension, stroke

INTRODUCTION

According to the current World Health Organisation (WHO) definition, cardiovascular diseases (CVD) are a diverse group of diseases, affecting the heart, as well as large and small vessels, also including, among others, hypertension, ischaemic heart disease and stroke. According to current data, those are the leading causes of death in the general European population [1], as well as the leading natural causes of deaths of seafarers [2]. In addition, according to results of the NAT-POL Plus study [3], which concerned the Polish population and whose authors assessed the prevalence of such risk factors as hypertension, hypercholesterolaemia or diabetes — only about 11% of Poles aged 19–94 are free from risk factors for CVD. Analyses carried out earlier [4] indicate that cardiovascular risk factors are also common in the seafarer population, with mortality rates in the case of cardiovascular events at sea being much higher than on the land [5, 6]. It is also worth mentioning that episodes of chest pain were the reason for about 7% of Telemedical Maritime Assistance Service (TMAS) calls received by the TMAS physician at our centre in Gdynia from 2012 to 2017, and CVD concerned 12% of all the calls. Approximately 1/3 of the evacuations recommended by TMAS doctors on duty concerned cases of CVD (own).

MATERIALS AND METHODS

This study analyses articles concerning individual cardiovascular risk factors available in the PubMed, Via Medica — International Maritime Health and Oxford Academic databases. Searching for articles for analysis was done by searching for keywords, followed by searching for key authors. The keywords were selected based on the current Guidelines of the European Society of Cardiology (ESC) [7] on the prevention of CVD and previous publications on documented risk factors [3]; authors were selected based on

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previously analysed work. The search took into account key words in English, Polish and sometimes German languages.

RESULTS

CLASSIC RISK FACTORS

The best known risk factors for CVD, also in seafarers, include smoking, hypertension, diabetes and high total cholesterol. Analysis of Pougnet et al. [4] of previous studies from 1990 and 2000 indicates that smoking of tobacco, hypertension (for which average blood pressure > 140/90 mmHg was considered significant) and overweight (body mass index [BMI] > 25 kg/m^2) as well as high cholesterol and glycaemic disorders were common among seafarers. Between 1990 and 2000, the number of seafarers smoking tobacco decreased; however, frequency of other risk factors increased — especially the overweight/obese group of seafarers increased from 47% to 64% [4]. A later study done by Oldenburg et al. [8] in 2010, carried out on a group of 46 German seafarers confirmed the increased frequency of type 2 diabetes (8.7% vs. 2.9%) and smoking (39.1% vs. 33.8%), as well as slightly higher mean arterial pressure (132.6 vs. 131.6) relative to general population. The German study [8] also concluded that obesity, type 2 diabetes, arterial hypertension, and smoking were significantly more common in a group of seafarers working more than 15 years on the sea. Also, higher levels of low density lipoprotein cholesterol and triglycerides were found in this group, than in the groups working less than 15 years.

A higher percentage of overweight and obese people than in the general population was also found among seafarers working on Italian ships (Italians, Filipinos and Indians). A study by Natari et al. [9] conducted on a group of about 1150 seafarers was published in 2019. A higher percentage of people with BMI > 25 kg/m^2 was found particularly for Filipino and Indian seafarers (compared to average BMI values for a given population). Interestingly, in the Italian study, the number of people with hypertension and glycaemic disorders was the same as in the general population.

When talking about obesity, one should also mention the right diet — a diet lowering CVD risk is a diet low in saturated fat, with a high content of fish and fibre and with reduced sodium content [7].

Among Filipino seafarers more than 40% of respondents consumed a diet rich in fats, and another 27% diet with a high salt content, which means that about 70% made dietary mistakes [9]. What's more, almost 80% of seafarers admitted to consuming alcohol in the last month [10].

In addition, the so-called classic risk factors of CVD include also low physical activity, age, gender and psychosocial factors such as stress [11]. According to Wójcik-Stasiak [5], due to the specific working conditions at sea, discouraging physical exercise during free time (lack of space or adequate equipment for physical exercise), there is often a low level of physical exercise in leisure time among seafarers; as well as the unfavourable ratio of effort level in free time to the level of work-related effort [5]. Both of these factors are considered to be associated with higher overall mortality, especially among people with low levels of fitness [12]. The low activity of seafarers during their stay at sea was confirmed by the Norwegian study [13] in which only 39% of 577 seafarers surveyed performed physical exercises at least twice a week.

According to the European Maritime Safety Agency (EMSA) report published in July 2018, 98% of people working at sea are male [14], which is an independent, unmodifiable risk factor for CVD [7, 11]. In addition, the average age of people with a valid certificate of competency was 43, which may also be associated with an increased cardiovascular risk [7]. Furthermore, according to a study by Oldenburg and others, the incidence of CVD risk factors among seafarers increases with seniority [8].

Seafarers are also heavily exposed to stress during work resulting primarily from isolation from the family, fatigue, loneliness, sleep disorders and communication problems among the multicultural crew on the ship [15].

PREVIOUS CARDIOVASCULAR EVENTS

According to the ESC Guidelines regarding CVD prevention [7], people with a history of acute myocardial infarction, acute coronary syndrome, stroke or transient ischaemic attack have a very high risk of an acute cardiovascular event. Until 2015, a Regulation of the Minister of Health was in force in Poland, according to which seafarers diagnosed with ischaemic heart disease were considered unfit to work at sea (with the exception of those working at sea for more than 10 years under certain conditions) [16].

This probably led in some cases to suppressing ischaemic heart disease by seafarers of Polish nationality while obtaining a health certificate and thus underestimating the number of seafarers with a positive cardiovascular history [5]. In accordance with the currently valid regulations and regulations in force in Poland [17] and the International Maritime Labour Convention 2006 [18], a seafarer after a so-called cardiac event may be re-admitted after 3 months after certain conditions have been met.

For the cardiac event, the legislator recognises, apart from a myocardial infarction, an electrocardiogram record indicating the post-infarction condition, a newly diagnosed left ventricular block of the atrioventricular bundle, angina pectoris, cardiac arrest; as well as coronary artery bypass grafting and coronary angioplasty [17]. Considering the above and the fact that seafarers holding a certificate of qualifications issued in Poland constitute the second largest group among seafarers of European descent [14], one can expect a greater number of patients after a cardiac event among those working at sea.

FAMILY HISTORY

Also, a positive family history of CVD increases the average cardiovascular risk. According to the ESC guidelines [7], a positive family history is considered to be a case of heart or vascular disease (myocardial infarction, atherosclerosis, hypertension, stroke) in first degree relatives before the age of 55 years in the case of men or before the age of 65 years for women. According to a study conducted in 2010 in Hamburg by Oldenburg et al. [8] on a group of about 160 seafarers sailing under the German flag (104 seafarers were of European descent, 57 came from outside Europe) positive family history concerned about 15% of seafarers. This is a result similar to those obtained in working men of the same age from the general German population (PROCAM study) [8, 19].

CHRONIC DISEASES

When assessing the general risk of CVD, one can also not forget about chronic diseases other than those classically associated with CVD risk that may affect seafarers' populations. According to the meta-analysis of 24 studies conducted in 2008 by Aviña-Zubiet et al. [20], over 111,000 patients with rheumatic diseases and more than 22,000 acute coronary events, rheumatoid arthritis patients were 50% more likely to die from CVD compared to the general population. The increased risk concerned both the incidence of ischaemic heart disease and cerebrovascular accidents. What is more, the increase in CVD risk also applies to other rheumatic diseases: gout, lupus and other connective tissue systemic diseases [21]. In this group of patients, risk factors such as obesity/overweight, hypertension and smoking are common, and moreover, patients in this group are also exposed to cardiotoxicity of the used drugs or chronic increase of markers of inflammation [21, 22]. Until 2015, rheumatoid arthritis was a contraindication for work at sea; currently, according to the applicable regulation, a person suffering from connective tissue diseases may be allowed to work at sea after the acute symptoms of the disease have stabilised [17].

European Society of Cardiology also draws attention to the role of mental illness [7], stressing that schizophrenia, depression and post-traumatic stress disorder increase the risk of CVD. In the analysis of 12 studies involving the number of deaths from natural causes among seafarers in 1992–2007 conducted by Iversen [23], it was found that approximately 13% of deaths were caused by suicide. This number would probably be higher if the number of unexplained disappearances at sea was taken into account, as according to some researchers about half of these cases can be explained by suicide [23]. On the other hand, some researchers believe that the problem of depression and burnout among seafarers is not currently more severe than among workers on land [24]. However, given the prevalence of depression and mental illness; and changes in the legislation that allow personnel with mental issues to work at sea [17], mental disorders can be an important and underestimated aspect in estimating the overall risk of CVD.

LABORATORY TESTS

Currently, the ESC does not recommend the use of biomarkers in the assessment of cardiovascular risk in the general population [7], indicating a tendency to overestimate the role of biomarkers in CVD risk assessment. The lack of a clear relationship between the concentration of parameters such as C-reactive protein and thyrotropin and higher cardiovascular risk was also found in a Spanish study conducted by Maria del Carmen Romero-Paredes et al. [25] on a group of 334 seafarers during pre-embarkation medical check-ups. In the Spanish study; however, a correlation was observed between higher serum glycated haemoglobin levels and other known risk factors for CVD — increased glycaemia, metabolic syndrome and obesity/overweight. A relation was observed between the occurrence of microalbuminuria and hypertension [25].

WORK SCHEDULE

Specific working conditions at sea such as long working hours and shift work are also associated with increased cardiovascular risk [7]. Unfortunately, we have failed to find studies describing the relationship between long working hours and CVD among seafarers; however, a meta-analysis of over 600,000 employees published by Lancet in 2015 confirmed the relationship between higher CVD risk (especially the risk of stroke) and long working hours [26]. There is also a relationship between long working hours and the risk of depression [27], which is a risk factor for CVD. Another large meta-analysis carried out by the Scandinavian team of Torquati et al. [28], covering over 17 thousand respondents, showed an adverse effect of shift work on cardiovascular risk, especially in case of people working in shifts for more than 5 years. Another aspect related to shift work is its correlation with higher occurrence of other known risk factors among people working in shifts such as obesity, smoking and eating more calories [29].

PHYSICAL FACTORS

Although the authors did not find any research on the population of seafarers that would document an increased cardiovascular risk caused by physical factors, numerous studies on other professional groups confirm the adverse impact of the above factors on the overall risk of CVD [27, 30]. During work seafarers are exposed to harmful physical factors [5, 31]. As shown by a Swedish study based on an online questionnaire and covering populations of almost 2000 Swedish seafarers [31], harmful factors most frequently reported by the respondents include noise (83% of employees on the machine deck and over 70% of other employees) and vibrations (over 60% of employees machine deck). It is worth noting that in the case of noise, the adverse effect of exposure involves increasing the risk of obesity, diabetes, depression, sleep disorders and hypertension [27, 30]; and in the case of vibrations increasing the risk of sleep disorders and depression [27].

PSYCHOSOCIAL FACTORS

At present, the ESC also emphasizes the adverse impact of psychosocial factors such as discrimination and a sense of lack of control at work on increasing CVD risk [7]. According to the aforementioned Swedish study, more than 20% of male seafarers and over 45% of female seafarers were exposed to harassment and depreciation at work [31].

DISCUSSION

The specificity of working at sea makes seafarers vulnerable to numerous harmful factors both during work and during leisure time. On the basis of available literature, we can see that the cardiovascular risk factors have been occurring for many years with varying frequency in the seaman population. Numerous researchers [4, 8, 9] raise the still-persistent problem of overweight and obesity among seafarers as one of the most common risk factors (even in over 60% of respondents). Also, when analysing a group of seafarers with normal BMI values, one can observe a tendency to a higher normal BMI in people working at sea in comparison to the average BMI in the population of that nationality.

High prevalence of other classical risk factors such as smoking, type 2 diabetes or lipid disorders has also been confirmed in the seaman population [4, 9]. However, the literature review carried out by Pougnet et al. [4] concerned the population of the respondents in the years 1990–2000, and the study published by Oldenburg et al. [8] was carried out in 2010, which is a relatively long time ago. Meanwhile, an Italian study [9] published in 2019 on a relatively large research group of seafarers did not confirm the higher incidence of hypertension and glycaemic disorders than in the general population. In this situation, one should consider whether this tendency also applies to other ethnic groups.

In assessing the prevalence of risk factors among the entire seafarer population, ethnic differences may pose a great difficulty — individual surveys are conducted on different ethnic groups; and there are discrepancies in the years in which individual studies were conducted. Discrepancies in the periods in which individual studies were performed date back even to the 10-year period, so we can say that we are dealing with a completely different research group. Changes in the population of seafarers result not only from the passage of time but also from changes in the legislation on the admission of seafarers after cardiovascular events or people with a diagnosed mental illness, increasing the percentage of chronically ill people in this occupational group. Moreover, as the authors of the German study [8] point out, longer working time at sea is associated with increased cardiovascular risk despite regular medical check-up.

Another underestimated group with an increased cardiovascular risk among seafarers are patients with rheumatism — there are no publications in the literature on the prevalence of rheumatic diseases within people working off-shore. We also cannot forget that exposure to the harmful effects of individual harmful factors depends on the position on the ship and is different for particular groups of seafarers.

CONCLUSIONS

Seafarers, regardless of nationality, have a higher cardiovascular risk than the general population. Although there are numerous publications on this subject, the issue of cardiovascular risk estimation in this group is still valid due to the changing population and a better understanding of current and the emergence of new cardiovascular risk factors.

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REVIEW ARTICLE

Toxic jellyfish in Thailand

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ABSTRACT

Jellyfish stings are common in Thailand. Stings can range from mild skin irritation to severe systemic symptoms resulting in death. Jellyfish envenomation is becoming an important public health concern. The lethal box jellyfish and bluebottle jellyfish are found on the Gulf of Thailand and Andaman coasts, but there are still misconception and mismanagement of these types of severe stings. Prevention and awareness of jellyfish stings are important, as well as knowledge and first aid management of severe envenomation. Educational programmes should be provided to locals including school children, teachers, hotel and tour operators, and medical staff. This will greatly reduce the morbidity and mortality associated with fatal stings.

(Int Marit Health 2019; 70, 1: 22–26)

Key words: jellyfish, bites and stings, *Chironex, Physalia*, jellyfish venom

INTRODUCTION

Jellyfish envenomation is becoming an important public health concern in Thailand. Jellyfish stings range from mild skin irritation to severe systemic symptoms which can result in death. Worldwide, jellyfish are distributed across the subtropical or tropical waters of the Atlantic, Pacific, Asian, and Australian coasts. There are over 10,000 species of which about 100 are toxic to human beings [1].

Jellyfish are invertebrates belonging to the Phylum Cnidaria. There are four classes, namely Schiphozoa, Cubozoa, Hydrozoa, and Anthozoa. Schiphozoa are the most common type and considered "true jellyfish". This class contains *Chrysaora* and *Pelagia* which are common in Thailand, and stings can sometimes result in severe pain which requires treatment in the emergency departments from time to time. Cubozoa are the most lethal types, consisting of *Chirodropidae* and *Carybdeidae*. Hydrozoa are not considered true jellyfish, but are siphonophores, which include the *Physalia* species [2], such as the *Physalia physalis* (Portuguese man-of-war), and *Physalia utriculus* (bluebottle/Pacific man-of-war). *Physalia* can also cause deaths, though it is rare and symptoms are less severe than those caused by Cubozoa. Anthozoa are sea anemones and corals, some of which are classified as venomous.

Cubozoa are quite similar to the true jellyfish, but are boxlike, hence they are known as "box jellyfish". The order *Chirodropidae* consists of the multi-tentacled *Chironex* which is considered the most dangerous animal in the world, causing deaths within 2–10 min after being stung. There have been over 100 reported deaths from *Chironex fleckeri*. The smaller single-tentacled box jellyfish, carybdeids, include *Carukia barnesi* or the "Irukandji jellyfish", can also cause severe systemic symptoms known as the Irukandji syndrome [3], with 2 deaths reported in Australia [4, 5].

In 2008, the Toxic Jellyfish Network in Thailand was setup with collaboration from the Bureau of Epidemiology and experts from the Community Medicine Department, Faculty of Medicine, Chiang Mai University, with initial members including experts from universities in Australia and Divers Alert Network. The membership expanded to stakeholders such as resort or hotels managers or owners, divers, boat operators, and biologists to help gather information and implement education and prevention programs [6]. There were a total of 381 injuries and deaths from toxic jellyfish in Thailand from 2003 to 2018 (Fig. 1) [7].

Fatal stings can be handled with appropriate first aid and management and thus will reduce the morbidity and mortality. In Thailand, there are no lifeguards on public beaches; therefore, it is important that local population and bystanders know about the crucial steps in helping these victims.

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Figure 1. Reported fatalities on both coasts of Thailand (map from cia.gov)

BOX JELLYFISH

The three known species of multi-tentacled box jellyfish in Thailand are *Chironex* spp. A, *Chironex indrasaksajiae* (formerly *Chironex* spp. B), and *Chironex* spp. C. They are genetically different from the Australian *Chironex fleckeri*, but nevertheless are also lethal. *Chironex* have a white or translucent box-shaped bell, which can be as wide as 20 cm. Four bundles of up to 15 translucent or bluish extensile tentacles stream out from 4 fleshy arms (pedalia) under the bell. Tentacles may reach up to 3 m and are covered with millions of stinging capsules or nematocysts, whereas the bell does not contain stinging capsules [8]. The severity of injury is related to the size of the jellyfish and extent of tentacle contact. Children are more prone to the toxic effects of this jellyfish, likely due to their body surface skin being thinner and having a lower body mass index [1, 9]. The venom contains three main components, which is neurotoxin, cardiotoxin, and dermatonecrotic toxin [10]. When envenomation occurs, the victim will feel instantaneous extreme pain, causing them to leave the water. The stung area will develop characteristic ladder-like transverse bands or whip-like marks, which may result in necrosis and permanent scarring. Death can occur within minutes due to cardiorespiratory arrest.

The single-tentacle box jellyfish or carybdeids have one tentacle arising from each corner of their cubic-shaped bell.

Carukia barnesi, the Irukandji, bells are about 12 mm wide and tentacles ranging from a few centimetres to up to 35 cm [8]. Nematocysts cover the bell and on the tentacles. Their bodies and tentacles are almost completely transparent. However, in Thailand, single-tentacle jellyfish that causes Irukandji-like syndrome are currently believed to be from *Morbakka* spp. A, *Morbakka* spp. B, and *Morbakka* spp. C. These species are usually found in deeper waters, but recently there have been more reports of injuries from these species closer to the shore [7]. Irukandji syndrome develops slightly slower than that caused by *Chironex*, usually within 5–40 min, the average being about 30 min. The victim may or may not be aware of a sting, and can go unnoticed until the onset of symptoms, forcing the victim to leave the water. There could be mild erythema or no skin lesions at all. Symptoms consist of low back pain, muscle cramping, nausea, vomiting, coughing, difficulty in breathing, excessive sweating, and restlessness. This might lead to drowning if the victim had not left the water immediately [5]. Shivering, fever, tachycardia, and hypertension may develop. Pulmonary oedema and intracerebral haemorrhage may occur in severe cases [11]. This envenomation is believed to be caused by excess catecholamines and hyperadrenergic states resulting in the aforementioned symptoms [12].

Box jellyfish in Thailand are usually found on days of good weather, when the seas are calm. They are found in shallow water where there are no reefs, and usually in the evening. A study conducted by Sucharitakul et al. [13], found that the most common species of Chirodropid found in Thailand is *Chiropsoides buitendijki*, but this type of jellyfish do not cause severe symptoms, according to Thaikruea and Siriariyaporn [7]. The lethal *Chironex* is found both in the Gulf of Thailand and the Andaman Sea [11], being most common in Surat Thani province, usually found between the months of June to December, the highest being in August. They are also found at the Eastern Gulf of Thailand (Trat province) between December and May. For the Andaman Sea, they are most common during October to January. The timings coincide with the high season of tourism in these provinces, which is why it is an important public concern (Figs. 2, 3).

Figure 2. Chironex spp. found in Samui, Thailand (copyrighted Sakanan Plathong)

Figure 3. Single tentacle box jellyfish, Surin Islands (copyrighted Thanawat Supanitayanon)

BLUE BOTTLE/PORTUGUESE MAN-OF-WAR

Physalia spp. are found in all hot and temperate climate waters [1]. *Physalia physalis* (Portuguese man-of-war) have several tentacles and can cause systemic symptoms. There have been three reported deaths from this species in the United States. *Physalia* are colonies of siphonophores, with a gas-filled float keeping the colony on the surface and allows for wind-assisted travel. Hence, they are usually found floating. Their floats and tentacles have a blue-purplish colour and tentacles of the *Physalia physalis* can reach up to 30 m in length, whereas the smaller *Physalia utriculus* (bluebottle jellyfish) have one main tentacle reaching up to 3 m [8]. Their nematocysts are arranged into stinging buttons and when stung, causes a linear "string of beans" lesion. In vitro studies have shown that their venom causes exocytosis of mast cell granules and release of histamine. Studies have also shown that the venom can stimulate smooth muscles, thus affecting the cardiovascular system. The pain is sharp and violent, which usually subsides within 24 h. *Physalia physalis* can cause headaches, nausea, vomiting, abdominal pain, and unconsciousness. *Physalia utriculus* have been reported to cause a hypersensitivity reaction, though it is rare. *Physalia utriculus* have been reported to be found in Thailand in recent years, and do not cause severe symptoms, but still required medical care in some victims (Fig. 4).

There are other types of toxic jellyfish that are found in Thai waters but do not cause severe systemic symptoms. Some of these are *Chiropsoides buitendijki*, *Pelagia* spp., *Chrysaora* spp., and *Lobonema smithii* [7].

Figure 4. *Physalia* spp. (copyrighted Lakkana Thaikruea)

TREATMENT AND MANAGEMENT

First aid is an important aspect in managing jellyfish envenomation, helping to reduce morbidity and mortality of cases. After removing the victim from the water, it must be assured that the victim has adequate respiration and blood circulation by performing basic life support. In life-threatening stings, calling for help or ambulance (in Thailand 1669) is a must [11]. The wound should not be rubbed, and the stung area must be immediately rinsed with vinegar for at least 30 s to deactivate undischarged nematocysts. Fresh water should not be used as it stimulates nematocysts discharge by osmosis. Seawater should be used if vinegar is not available. Vinegar-treated tentacles should be removed if they are still adhered to the skin, preferably with tweezers, or they could be removed with bare hands, but the rescuers fingers must be carefully rinsed off afterwards to prevent secondary stings [2]. However, in the case of blue bottle jellyfish stings, the use of vinegar as a first aid treatment is still controversial. Some reports have shown more nematocysts firing after vinegar. Thaikruea et al. [13] has reported the testing vinegar and seawater on a live blue bottle found on Koh Lanta, Krabi, and found no significant firing from undischarged nematocysts from both vinegar- and seawater-treated tentacles. However, this still needs more research and laboratory testing. Therefore, it is best to use seawater in cases of blue bottle stings. In Thailand, the plant *Ipomoea biloba* has been used by locals to treat jellyfish stings as well, though the efficacy of this has never been proven.

After tentacle removal, the next step in controlling the victim's pain is by hot water immersion. According to a review by Li et al. [14] there were a few number of trials conducted to compare pain relief from hot water immersion and icepacks. Hot water immersion was found to be clinically significant in alleviating pain when compared to ice packs in the case of *Physalia* stings. As for *Chironex* stings, cold compresses are recommended by the Australian Resuscitation Council [15]. There is limited data of clinical evidence for the use of *C. fleckeri* anti-venom in other species, and it is not available in Thailand [16].

Advanced and hospital-based management is required especially in the case of Irukandji or Irukandji-like syndrome, since the symptoms are often delayed. It is advisable to transport the victim to a hospital [17]. Intravenous magnesium sulphate is the most effective current therapy since this will reduce hypertension and pain associated with this syndrome [12]. Nitrates such as nitroglycerin or nicardipine can also be given in hypertensive emergency cases [11]. Pain is controlled with fentanyl or morphine and benzodiazepines though it should be given cautiously due to risks such as respiratory depression [12]. Pain in mild or moderate cases can be controlled with oral acetaminophen or nonsteroidal anti-inflammatory drugs [7, 18]. Antihistamine combination of H1- and H2-receptor antagonists may be given to reduce the histamine overload from Irukandji syndrome, not because of anaphylaxis, since true anaphylaxis from jellyfish are extremely rare [19]. Misdiagnosis is possible due to the fact that box jellyfish information and management is not included in the Thai medical school curriculum, though some emergency medicine training programs have started to include this in their training [6].

PREVENTION

The most important method in prevention of life-threatening stings and injuries include awareness of the problem and prevention of envenomation [17, 20]. Since the toxic jellyfish network has been setup in Thailand, more concerned authorities and stakeholders are taking into action on prevention programmes. Vinegar poles and stinger nets have been installed in many high-risk areas. Multi-language appropriate signage that includes warning of possible jellyfish encounters, wearing protective Lycra clothing covering the entire body and limbs, and first aid management had been setup in some areas, but this is still difficult due to the sensitive issue of tourism [21]. Brochures should also be distributed to hotel and tour operators, and available in airports, train stations, and bus stations. Moreover, educational programmes including basic knowledge and recognition of jellyfish, first aid management has been given to medical staff, first responders, and volunteers in high risk areas [6]. This educational program should still be an ongoing programme, not limited to medical staff or first responders, but expanded to the local population such as school children and teachers, since bystanders are most likely to be the first responders in helping the victims.

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REVIEW ARTICLE

A Medical Support in Offshore Racing — Workshop on Medical Support for Offshore Yacht Races, Telemedical Advice Service (TMAS), 1–2 December 2018, London, United Kingdom

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ABSTRACT

The safety and health of sailors offshore is of major concern. World Sailing (WS) and International Maritime Health Association (IMHA) are taking seriously the potential dangers to the safety and health at sea. By the nature of their sport, the sailors racing in offshore racing environment can be exposed to injuries and other health problems that can endanger their lives. Being aware of the potential dangers caused by the distance from onshore health facilities and lack of professional help on board, IMHA and WS decided to support the activities that are leading to the enhancement of safety and health protection on board. With common initiative, joint Workgroup on Medical Support in Offshore Racing has been formed and the series of workshop organised. The WS/IMHA Workgroup on Medical Support for Offshore Yacht Races previously reached consensus on the common competences and learning outcomes for medical training for offshore racing. In addition, the Workgroup has also set standards for required medical kit inventory for yachts participating in the various categories of offshore yacht races. Documents were both approved by WS Medical Commission and the IMHA Board. Fourth workshop on Medical Support for Offshore Yacht Races was held in London, United Kingdom, 1–2 December 2018 and workgroup reached consensus on the standards for availability of Telemedical Advice Services (TMAS) for the various categories of offshore yacht races held under the authority of WS. This position paper sets out how the TMAS should be integrated with the practical usage of medicines and medical equipment on board offshore racing yachts. In addition, this position paper also sets out how the level of medical training integrates with appropriate use of the TMAS. Overall, the three WS/IMHA position papers on the triad of medical inventories, medical training and TMAS, are aimed at providing the best possible medical care on offshore racing yachts, by fully integrating each part of the triad of medical support.

(Int Marit Health 2019; 70, 1: 27–41)

Key words: sailing, offshore races, telemedical advice, medical kit

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INTRODUCTION

The safety and health of sailors offshore is of major concern. World Sailing (WS) and International Maritime Health Association (IMHA) are taking seriously the potential dangers to the safety and health at sea. By the nature of their sport, the sailors racing in offshore racing environment can be exposed to injuries and other health problems that can endanger their lives [1]. Being aware of the potential dangers caused by the distance from onshore health facilities and lack of professional help on board, IMHA and WS decided to support the activities that are leading to the enhancement of safety and health protection on board.

With common initiative, joint Workgroup on Medical Support in Offshore Racing has been formed and the series of workshop planned [2].

4TH WS/IMHA WORKSHOP ON MARITIME HEALTH IN OFFSHORE RACING; MEDICAL SUPPORT FOR OFFSHORE YACHT RACES, TELEMEDICAL ADVICE SERVICE (TMAS), 1–2 DECEMBER 2018, LONDON, UNITED KINGDOM

Fourth Workshop on Medical Support for Offshore Yacht Races was held in London, United Kingdom (UK), 1–2 December 2018 on the premises of the WS Headquarters in London. Nine experts from maritime and sailing medicine were gathered: Dr. Arne J. Ulven, from the Norwegian Centre for Maritime Medicine, Dr. Spike Briggs — WS Medical Commission, Volvo RWR from UK, Dr. Roger Nilson, from Sweden, Volvo RWR, Mr. Agnar Tveten from Radio-medico Norway, Mr. Simon Forbes World Sailing Offshore Technical Manager from UK, Carmen Vaz Pardal from WS Medical Commission, Spain, Dr. Lucas Viruly from Radio Medico Netherlands, Netherlands and Dr. Rob Verbist from Maritime Academy Antwerp, Belgium. Workshop was led by IMHA/WS representative Dr. Nebojša Nikolić.

Recommendation for further actions as stated in position paper from the First Workshop on Medical Support for Offshore Yacht Races held from 6 to 7 November 2015, in Sanya, China, where the main work-tasks have been established, had set up the general requirements for TMAS for offshore yacht racing events [2]. Those requirements were re-analysed and tuned by the workgroup. Aim of the workshop was to produce the WS/IMHA position paper on telemedical support for offshore yacht racing.

The format of the workshop requested that 8 participants (4 from WS and 4 from IMHA side) were divided in task teams — each formed of one participant from WS side and one participant from IMHA side. After the current regulations and the context of use of TMAS on board merchant marine ships and on yachts in offshore yacht racing was presented by invited speakers from both sides, the task teams reviewed, evaluated and scored previously agreed training learning outcomes/competences in medical training of designated providers on board offshore racing yachts in the context of TMAS and the previously agreed list of recommended medicines and equipment on board offshore racing yachts, also in the context of TMAS [3, 4]. Each learning outcome was scored as: 0 — no need for TMAS, 1 — need for TMAS (A or B), 2 — need of TMAS and training (A or B) or NA — not applicable, where indication marked as A — meant: *Simple order to do it* and B indicating — *Leading the provider through the procedure.* In a separate session task teams tuned the contents of the medical kit for allocated category of the races with the TMAS in the context offshore yacht racing. Each item in the medical kit was marked (or not marked) with indication that TMAS should be contacted before a procedure or before administering a drug.

In 1 month-period after the workshop, after the consensus papers were tuned and agreed upon, the final consensus paper was produced and send to WS Medical Commission and IMHA Board for adoption as an official position paper.

WS/IMHA POSITION PAPER ON MEDICAL SUPPORT FOR OFFSHORE YACHT RACES — TMAS

This WS/IMHA Workgroup Position Paper sets out the requirements for TMAS for offshore yacht racing events considering the current state of technical equipment in use on board. These requirements should be regarded as a minimum standard, and not a substitute for national regulations or race organiser's rules, if these are more comprehensive.

WS/IMHA WORKGROUP CONSENSUS ON MEDICAL TRAINING AND MEDICAL KIT ON BOARD IN THE CONTEXT OF TMAS IN OFFSHORE YACHT RACING

The WS/IMHA Workgroup on Medical Support for Offshore Yacht Races previously reached consensus on the common competences and learning outcomes for medical training for offshore racing. In addition, the Workgroup has also set standards for required medical kit inventory for yachts participating in the various categories of offshore yacht races. The WS/IMHA Position Paper on Medical Training and WS/IMHA Position Paper on Medical Kit Inventory were both approved by WS Medical Commission and the IMHA Board [3, 4].

MEDICAL TRAINING

The WS/IMHA Position Paper on Medical Training has been evaluated in the context of the availability of telemedical advice on board. Each learning outcome/competence (graded by Likert scale based on "Miller's triangle") has been previously rated on the extent to which it should be achieved by training [5, 6]. Now, each learning outcome/competence has been graded according to whether there is a reasonable requirement for telemedical advice when undertaking the medical assessment, treatment or procedure in question. The WS/IMHA Workgroup Consensus results are included in Appendix 1.

The grading of the requirement to contact TMAS is for guidance only. For any given medical problem that may occur on board, the requirement for calling TMAS depends on the knowledge, training and skills of the designated medical provider on board, and ultimately it is their decision and responsibility whether they call TMAS or not.

MEDICAL KIT ON BOARD

The WS/IMHA Position Paper on Medical Kit Inventory has been evaluated in the context of the availability of telemedical advice on board. Medicines and medical equipment have been previously rated as whether they are required for the various categories of offshore yacht race [4]. Now, each medicine or medical equipment has been graded according to whether there is a reasonable requirement for telemedical advice when considering using the medicine or medical equipment in question. The WS/IMHA Workgroup Consensus results are included in Appendix 2.

The Workgroup acknowledge that there may be occasions when there is an emergency requirement for administration of a medicine or to undertake a medical procedure, when it is not possible to contact TMAS within the required timescale. The responsibility for the decision then lies with the captain and medical officer on board, and should be taken within the context of their medical training and any other available sources of advice, including the medical manual carried on board.

CONCLUSIONS

This position paper recommends the standards for availability of TMAS for the various categories of offshore yacht races held under the authority of World Sailing [7].

Over the past 20 years, there has been a revolution in the availability and cost of global remote communications systems [8–12]. Such systems are already widely used in offshore yacht racing, both for navigation and safety purposes [13]. More latterly, these systems have been used ubiquitously for media coverage of yacht races, proving their worth in publicising the racing, conditions and experiences of those on board [14, 15]. Global communication systems are also already in use for providing remote TMAS to commercial shipping, leisure yachting activities and some offshore yacht races [16–22]. However, provision of an insular, non-integrated TMAS is not the most efficient solution for providing the best level of care offshore when a crew member is ill or injured [23]. The service has to be integrated with both a thorough knowledge of the medical inventory on board, and also the level of medical training and thus skill mix available on board [24].

The workgroup has previously published position papers on medical inventory requirements for offshore yacht races, and also the required level of medical training [3, 4]. Overall, the three WS/IMHA Position Papers on the triad of medical inventories, medical training and TMAS, are aimed at providing the best possible medical care on offshore racing yachts, by fully integrating each part of the triad of medical support.

This position paper sets out how the TMAS should be integrated with the practical usage of medicines and medical equipment on board offshore racing yachts. In addition, this position paper also sets out how the level of medical training integrates with appropriate use of the TMAS.

Future training courses and medical manuals must incorporate this integrated approach, to ensure a consistent and coherent approach to improving medical care offshore.

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APPENDIX 1.

After the training in medical help on board, designated provider on board/crew who has successfully completed the training in medical care on off shore racing yachts will have the ability to:

Outcomes (guideline usual mainstream practice)*	Designated provider	TMAS grading
Carry out a consultation with a patient		
Take a history	4	0
Carry out physical examination	4	2B
Make clinical judgements and decisions	3	2B
Provide explanation and advice to the patient	3	2B
Provide reassurance and support	4	0
Assess the patient's psychological state	4	2B
Assess clinical presentations, order investigations, make differential diagnoses, and negotiate a management plan		
Recognise and assess the severity of clinical presentations	4	2B
Order appropriate investigations and interpret the results	1	1B
Make differential diagnoses	2	2B
Negotiate an appropriate management plan with patients and carers	1	1B
Provide care of the dying and their families	1	1B
Manage chronic illness	1	NA
Provide immediate care of medical emergencies, including First Aid and resuscitation		
Recognise and assess acute medical emergencies	4	0
Treat acute medical emergencies	4	2B
Provide basic First Aid	4	0
Provide basic life support and cardio-pulmonary resuscitation according to current international guidelines	4	0
Provide advanced life support according to current International guidelines	2	2B
Provide trauma care according to current International guidelines	4	2B
Prescribe drugs		
Prescribe drugs (if cannot contact TMAS) according to guidelines	4	0
Match appropriate drugs and other therapies to the clinical context	1	1B
Review the appropriateness of drug and other therapies and evaluate potential benefits and risks	1	1B
Treat pain and distress	4	2A
Carry out practical procedures		
Measure blood pressure and other vital signs	4	0
Venepuncture (put needle in to vein)	1	0
Cannulation of veins	4	2B
Administer IV therapy and use infusion devices	4	2B
Fluid administration: hypodermoclysis, intraosseous and rectal	3	2B
Subcutaneous and intramuscular injection	4	2A
Administer oxygen	2	NA
Move and handle patients	4	0
Wound closure	4	2B
Splinting	4	2B
Blood transfusion	1	NA
Bladder catheterisation	4	2B
Control of bleeding	4	0

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Outcomes (guideline usual mainstream practice)*	Designated provider	TMAS grading
Urinalysis	4	0
Electrocardiography	1	NA
Basic respiratory function tests, pulse oximeter	2	1B
Communicate effectively in a medical context		
Communicate with patients	4	0
Communicate with TMAS	4	0
Communicate in breaking bad news	2	0
Communicate with others (social media, internet, media)	2	0
Communicate with disabled people	1	NA
Communicate in seeking informed consent	2	0
Communicate in writing (including medical records)	3	0
Communicate in dealing with aggression	2	1B
Communicate by telephone/VHF/radio	4	0
Communicate with those who require an interpreter	1	NA
Ability to apply ethical and legal principles in medical practice		
Maintain confidentiality	4	0
Apply ethical principles to patient contact	3	0
Obtain and record informed consent	3	0
Certify death	2	2B
Request autopsy	1	NA
Apply flag state and International law to clinical care	2	0
Assess psychological and social aspects of a patient's illness		
Assess psychological factors in presentations and impact of illness	3	2B
Assess social factors in presentations and impact of illness	3	2B
Detect stress in relation to illness	3	2B
Detect alcohol and substance abuse, dependency	2	1B
Apply the principles, skills and knowledge of evidence-based medicine		
Apply evidence to practice	1	NA
Define and carry out an appropriate literature search	1	NA
Critically appraise published medical literature	1	NA
Keep accurate and complete clinical records	3	0
Use information and information technology effectively in a medical context		
Use computers/communication equipment	4	0
Access information sources	4	0
Store and retrieve information	3	0
Apply scientific principles, method and knowledge to medical practice and research	1	NA
Promote health		
Provide patient care which minimises the risk of harm to patients	3	0
Apply measures to prevent the spread of infection	4	2B
Recognise own health needs and ensure own health does not interfere with professional responsibilities	3	0
Conform with regulation to be in charge of medical care on board	4	0
Receive and provide professional appraisal	1	0
Make informed career choices	1	NA
Engage in health promotion at individual level	2	NA

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Yacht medic professionalism*	Designated provider	TMAS grading
Professional attributes		
Probity, honesty	4	0
Commitment to maintaining skill competency and knowledge	4	0
Interpersonal skills	5	0
Professional working		
Abilities to recognise limits and ask for help	5	0
Capacity to deal with uncertainty	4	0
Ability to lead others	4	0
Ability to solve problems	4	0
Ability to make decisions	4	0
Ability to work safely and independently when necessary	4	0
Ability to communicate with shore-based TMAS and SAR services	4	0
Capacity and ability to organise and pre-plan medical support	5	0
Ethics/confidentiality		
Maintaining confidentiality	4	0
Informed consent	4	0
Concept of 'Acting in the patients best interests'	4	0
Probity, honesty	4	0
The global doctor		
Appreciation of diversity and multiculturality	1	NA
Understanding of cultures and customs of other countries	1	NA
Ability to work in an international context	1	NA
Knowledge of a second language	1	NA
General knowledge outside medicine	1	NA

After the training designated provider should be able to demonstrate knowledge of:

Knowledge outcomes*	Designated provider	TMAS grading
Basic sciences		
Normal function (physiology)	2	0
Normal structure (anatomy)	2	0
Normal body metabolism and hormonal function (biochemistry)	2	0
Normal immune function (immunology)	1	NA
Normal cell biology	1	NA
Normal molecular biology	1	NA
Normal human development (embryology)	1	NA
Behavioural and social sciences		
Psychology	1	0
Human development (child/adolescent/adult)	1	NA
Sociology	1	NA
Clinical sciences		
Abnormal structure and mechanisms of disease (pathology)	1	NA
Infection (microbiology)	1	0

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Knowledge outcomes*	Designated provider	TMAS grading
Immunity and immunological disease	1	0
Genetics and inherited disease	1	NA
Drugs and prescribing		
Use of antibiotics and antibiotic resistance	2	1A
Principles of prescribing	2	1A
Drug side effects	2	1A
Drug interactions	2	1A
Use of blood transfusion and blood products	1	NA
Drug action and pharmacokinetics	1	NA
Use of individual drugs	2	1A
Different types of complementary/alternative medicine and their use in patient care	1	NA
Public health		
Disease prevention	2	0
Lifestyle, diet and nutrition	1	0
Health promotion	1	0
Screening for disease and disease surveillance	1	1B
Disability	1	0
Gender issues relevant to health care	1	0
Epidemiology	1	1B
Cultural and ethnic influences on health care	1	0
Resource allocation and health economics	1	NA
Global health and inequality	1	NA
Ethical and legal principles in medical practice		
Rights of patients	2	0
Rights of disabled people	1	0
Responsibilities in relation to colleagues	1	0
Role of the doctor in health care systems		
Laws relevant to medicine	1	1B
Systems of professional regulation	1	NA
Principles of clinical audit	1	NA
Systems for health care delivery	1	NA

After the training in medical help on board, designated provider on board/crew who has successfully completed the training in medical care on offshore racing yachts should have experienced through simulation practical work in these areas:

Experiential learning*	Designated provider	TMAS grading
Care of acutely ill or traumatised patients	4	2B
Care of general (internal) medical patients	3	2B
Care of general surgical patients	3	2B
Care in the community/family practice/primary care	2	2B
Care for elderly patients	1	NA
Care for sick children	1	NA
Care for the dying, palliative care	1	1B

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Experiential learning*	Designated provider	TMAS grading
Care for mentally ill patients	1	1B
Obstetric and gynaecological care	1	1B
Care for critically ill patients in Intensive Care Units	1	NA
Care of patients with specialised medical conditions (e.g. haematology, renal)	1	NA
Anaesthetic care	1	NA
Rehabilitation medicine	1	NA
Care of patients with specialised surgical conditions (e.g. cardiac surgery, urology)	1	NA

*List of competences as stated in WS/IMHA Consensus Paper on Medical Support for Off Shore Yacht Races — Medical Training

APPENDIX 2. LIST OF RECOMMENDED MEDICINES AND EQUIPMENT ON BOARD OFF-SHORE RACING YACHTS** WORLD HEALTH ORGANISATION FORMAT

I	II	III					IV	V
Item No.	Recommended Medicine and Dosage Strength Representing Best Practice on Board Off-shore Racing Yachts	Recommended Quantity for 10 Sailors on Board Off-shore Racing Yachts (WS OSR Cat. 0–4)					Indications on Board Off-shore Racing Yachts	Need to contact TMAS
		0	1	2	3	4		
MEDICINES								
1.	Acetylsalicylic acid 300 mg tablet **N02BA01**	30	30	20	20	20	To inhibit formation of blood clots in angina pectoris, myocardial infarction, stroke	x
2.	Acyclovir 5% cream (10 g) **D06BB03**	2	2				To treat cold sores	x
3.	Adrenaline auto-injector 0.5 mg **C01CA24**	2	2	2			To raise blood pressure in anaphylaxis; to dilate airways in severe asthma or anaphylaxis	
4.	Adrenaline 1 mg/mL ampoule **C01CA24**	10	10	10			To raise blood pressure in anaphylaxis; to dilate airways in severe asthma or anaphylaxis	x
5.	Amethocaine 5% eye drops (10 mL) **S01HA03**	1	1				For eye examination and procedures	x
6.	Amoxicillin + clavulanate 500/125 tablet **J01CR02**	60	60	10			To treat infections responsive to this antibiotic	x
7.	Amoxicillin + clavulanate 1000/200 ampoule **J01CR02**	10	10				To treat infections responsive to this antibiotic	x
8.	Antacid alginate sodium tablet 500 mg **A02AX**	60	60	20			Heartburn relief	
9.	Azytromycin 500 mg **J01FA10** or doxycycline 100 mg tablet **J01AA02**	15 (50)	15 (50)	3 (10)			To treat infections responsive to this antibiotic	x
10.	B-panthenol ointment 30 g **D03AX03**	3	3	1			Skin care	
11.	Beclomethasone inhaler (200 doses) **R03BA01**	1	1				To control symptoms of asthma	x
12.	Bisacodyl 5 mg tablet **A06AB02**	60	60				For treatment of constipation	

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I	II	III					IV	V
Item No.	**Recommended Medicine and Dosage Strength Representing Best Practice on Board Off-shore Racing Yachts**	**Recommended Quantity for 10 Sailors on Board Off-shore Racing Yachts (WS OSR Cat. 0–4)**					**Indications on Board Off-shore Racing Yachts**	**Need to con-tact TMAS**
		0	**1**	**2**	**3**	**4**		
13.	Ceftriaxone 1 g ampoule **J01DD04**	10	10				To treat infections responsive to this antibiotic	x
14.	Chloramphenicol **S01AA01** or tetracycline eye ointment (4 g) **S01AA09**	2	2	1	1	1	Eye infections	x
15.	Chlorphenamine 10 mg/mL ampoule **R06AB04**	5	5	5			For acute urticaria; control of allergic reactions	x
16.	Choline salicylate gel (15 g) **N02BA03** Other agents for local oral treatment **A01AD11**	1	1				To relieve pain, inflammation, lesions and ulcers in the mouth	x
17.	Cinnarizine 15 mg **N07CA02** or dimenhydrinate + caffeine (30/10 mg) tablet **R06AA52**	170	170	20	20	20	To prevent and treat motion-sickness	
18.	Ciprofloxacin 500 mg tablet **J01MA02**	30	30				To treat infections responsive to this antibiotic	x
19.	Clotrimazole 500 mg pessary **G01AF02**	2	2				To treat vaginal fungal infections	x
20.	Cyclizine 50 mg/mL ampoule **R06AE03**	10	10	10			Treating motion-sickness and vomiting	x
21.	Dexamethasone eye drops 0.1% (10 mL) **S01BA01**	1	1				To treat eye inflammation	x
22.	Diazepam 5 mg tablet **N05BA01**	60	60	30			To treat alcohol withdrawal; to treat anxiety and psychosis	x
23.	Diazepam 10 mg/2 mL ampoule **N05BA01**	10	10				To treat anxiety and seizures	x
24.	Diclofenac 1% gel **M02AA15**	10	10				To reduce moderate pain	
25.	Flucloxacillin 500 mg tablet **J01CF05**	80	80				To treat infections responsive to this antibiotic	x
26.	Furosemide 40 mg tablet **C03CA01**	20	20				Diuretic	x
27.	Fusidic acid 2% ointment (30 g) **D06AX01**	4	4				To treat skin infection	
28.	Glyceryl trinitrate 400 mcg spray (200 metered sprays) **C01DA02**	1	1				To treat angina pectoris (chest pain); to treat myocardial infarction	x
29.	Haemorrhoid preparations – proprietary preparation of choice **C05AX**	2	2				Haemorrhoid preparations	
30.	Hydrocortisone 1% cream (15 g) **D07AA02**	3	3				To treat allergy and some other inflammatory skin conditions	
31.	Hydrocortisone 100 mg/mL (5 mL) ampoule **H02AB09**	5	5	5			To treat life-threatening and severe asthma; to treat anaphylaxis; to treat severe allergic reactions	x

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I	II	III					IV	V
Item No.	**Recommended Medicine and Dosage Strength Representing Best Practice on Board Off-shore Racing Yachts**	**Recommended Quantity for 10 Sailors on Board Off-shore Racing Yachts (WS OSR Cat. 0–4)**					**Indications on Board Off-shore Racing Yachts**	**Need to contact TMAS**
		0	**1**	**2**	**3**	**4**		
32.	Hyoscine hydrobromide 1.5 mg patch **A04AD01**	5	5	3			To prevent motion sickness	
33.	Ibuprofen 400 mg tablet **M01AE01**	100	100	20			To treat inflammation; to reduce mild to moderate pain, especially if associated with inflammation	
34.	Lansoprazole 30 mg tablet **A02BC03**	60	60				To treat gastro-oesophageal reflux; to treat ulcer disease	x
35.	Lignocaine 2% 5 mL ampoule **N01BB02**	10	10				Local anaesthesia	
36.	Lignocaine gel (6 mL) **N01BB02**	1	1				Local anaesthetic	
37.	Loperamide 2 mg tablet **A07DA03**	60	60	20			To treat symptoms of diarrhoea	
38.	Loratadine 10 mg tablet **R06AX13**	30	30	30			To treat allergy symptoms	
39.	Macrogol oral powder (sachets) **A06AD15**	16	16				For treatment of constipation	
40.	Metronidazole 400 mg tablet **P01AB01**	20	20				To treat intestinal infections responsive to this antibiotic	x
41.	Metronidazole 1 g suppository **G01AF01**	10	10				To treat intestinal infections responsive to this antibiotic	x
42.	Miconazole 2% ointment (30 g) **D01AC02**	2	2				To treat fungal skin infections	
43.	Miconazole 2% **D01AC02** + hydrocortisone ointment (30 g) **D01AC20**	2	2				To treat fungal skin infections	
44.	Oral rehydration salts sachets **A07CA**	20	20				To prevent or treat dehydration	
45.	Paracetamol 500 mg tablet **N02BE01**	100	100	40	40	40	To reduce pain and fever	
46.	Permethrin lotion 5% (60 g) **P03AC04**	2	2				To treat scabies	x
47.	Petroleum Jelly 30 g **D02AC**	3	3				To treat chapped skin. For lubricating rectal thermometer	
48.	Phloroglucinol 80 mg **A03AX12** or hyoscine butylbromide 10 mg tablet **A03BB01**	20	20	10	10	10	To relieve intestinal or urinary spasms	x
49.	Prednisone 5 mg tablet **A07EA03**	100	100	100			To treat severe asthma; to treat other inflammatory conditions	x
50.	Prochlorperazine 3 mg oral dispenser (50) **N05AB04**	1	1				To control severe nausea and vomiting	
51.	Salbutamol aerosol (inhaler — 200 doses) **R03AC02**	1	1				To treat asthma; to treat other lung diseases	x
52.	Silver sulfadiazine cream (50 g) **D06BA01**	2	2	1	1	1	Treatment of burns	

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		0	**1**	**2**	**3**	**4**		
53.	Sodium chloride 0.9% infusion (plastic-bottle 1 L or 2 × 500 mL plastic bottle) **B05XA03**	10	10				For fluid replacement	x
54.	Tobramycin/ /dexamethasone eye/ear drops (10 mL) **S01CA01**	2	2				To treat eye and ear infections	x
55.	Tramadol 50 mg **N02AX02** or oxycodone 15 mg tablet **N02AA05**	100	100	20			Against severe pain	
56.	Tramadol 100 mg/2 mL ampoule **N02AX02**	20	20	20			Against severe pain	x
57.	Water for injection ampoule 5 mL **V07AB**	10	10				Reconstitution of injectable drugs provided as powders	x
EQUIPMENT								
RESUSCITATION EQUIPMENT								
58.	Oropharyngeal airway (Guedel/Mayo-tube) size 3 and 4 (medium and large)	2	2	2	2	2	Oropharyngeal airways	
59.	Pocket face mask	1	1	1	1	1	For mouth-to-mouth resuscitation	
60.	Manual aspirator (including 2 catheters)	1	1				Mechanical aspirator to clear upper airways	
DRESSING MATERIAL AND SUTURING EQUIPMENT								
61.	Wound closure strips	30	30	20	20	20	Adhesive skin closures	
62.	Sutures, silk non- -absorbable with curved non-traumatic needle 2/0	10	10				Suturing equipment	
63.	Sutures, absorbable with curved non-traumatic needle 3/0	10	10				Suturing equipment	
64.	Skin Stapler × 15 staples	2	2	1			Wound staplers	
65.	Stapler remover	1	1	1			Wound staplers	
66.	2-octyl cyanoacrylate 0.7 mL ampoule	6	6	2			Skin (wound) adhesive	
67.	Assorted wound plasters	30	30	20	20	20	Adhesive dressing	
68.	Adhesive wound dressing 10 × 10 cm	25	25	5	5	5	Adhesive dressing	
69.	First aid absorbent gauze cowered cotton pad sewn onto a cotton bandage small	1	1	1	1	1	Sterile compressive bandages	
70.	First aid absorbent gauze cowered cotton pad sewn onto a cotton bandage medium	1	1	1	1	1	Sterile compressive bandages	
71.	First aid absorbent gauze cowered cotton pad sewn onto a cotton bandage large	1	1	1	1	1	Sterile compressive bandages	

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		0	**1**	**2**	**3**	**4**		
72.	Sterile gauze compresses 10 × 10 cm	20	20	5	3	3	Sterile gauze compresses	
73.	Low adherent dressing 10 × 10 cm	20	20	2	2	2	Gauze dressing with non-adherent surface	
74.	Iodine non-adherent dressing 10 × 10 cm	10	10	2			Gauze dressing with non-adherent surface	
75.	Burn dressing 10 × 10 cm	2	2	2			Burn dressing	
76.	Burn bag for hands (sterile)	1	1				Burn dressing	
77.	Haemostatic dressing	4	4	1	1	1	Haemostatic agent	
78.	Elastic fixation bandage 6 cm × 4 m	5	5	2	2	2	Bandage	
79.	Tubular bandage 5, 8, 10 cm × 10 m	3	3				Bandage	
80.	Adhesive surgical tape 2.5 cm × 10 m	1	1	1	1	1	Bandage	
81.	Wound wipes (Chlorhexidine)	4	4	4	4	4	Antiseptic	
82.	Sterile gauze swabs 5 × 5 cm	20	20				Sterile swabs	
83.	Adhesive elastic bandage 7.5 cm × 4.5 m	2	2	2	2	2	Bandage	
84.	Cohesive bandage 7.5 cm × 4.5 cm	1	1				Bandage	
85.	Trauma tourniquet	1	1	1	1	1	Compressing device (bandage), to control bleeding	
86.	Eye bath	1	1				To wash away particles — to cleanse the eyes	
87.	Eyewash sterile (20 mL)	4	4	4	4	4	To cleanse the eyes	
88.	Eye pad	1	1				Dressing	
89.	Eye shield	1	1				To cover (protect) the eye	
90.	Surgical gloves sterile, in pairs M	10	10				Gloves	
91.	Surgical gloves sterile, in pairs L	10	10				Gloves	
92.	Gloves non-sterile, disposable	10	10				Gloves	
INSTRUMENTS								
93.	Bandage scissors (tough cut scissors)	1	1	1			Scissors	
94.	Scissors surgical 12 cm	1	1	1	1	1	Scissors	
95.	Artery clamp	1	1				Haemostatic clamp	
96.	Needle holder	1	1				Needle holder	
97.	Teeth tissue forceps	1	1				Forceps	

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		0	**1**	**2**	**3**	**4**		
98.	Splinter forceps (tweezer)	1	1				Forceps	
99.	Razor, disposable	2	1				To cut the clothes	
100.	Scalpel, sterile, disposable	4	4				Disposable scalpels	
EXAMINATION AND MONITORING EQUIPMENT								
101.	Disposable tongue depressor	10	10					
102.	Stethoscope	1	1					
103.	Otoscope	1	1					
104.	Sphygmomanometer manual	1	1				Blood pressure set	
105.	Sphygmomanometer automatic	1	1				Blood pressure set	
106.	Large blood pressure cuff	1	1				Blood pressure cuff	
107.	Thermometer digital	1	1	1			Thermometer	
108.	Pulse oximeter	1	1	1			For monitoring of oxygen saturation	
109.	Urine testing strips 10 parameters	25	25				Reactive strips for urine analysis	
110.	Blood glucose testing kit/25 strips + 25 needles	1	1				Reactive strips for blood analysis	
111.	Pregnancy testing kit	2	2				Reactive strips for urine analysis	
EQUIPMENT FOR INJECTION, INFUSION AND CATHETERISATION								
112.	Syringes 5 mL	10	10				Equipment for injection	
113.	Syringes 2 mL	10	10				Equipment for injection	
114.	Needle 23G hypodermic	20	20				Equipment for injection	
115.	Intravenous infusion cannula 16G and 22G, Luer lock connection	6	6				Equipment for infusion	x
116.	Intravenous giving set, Luer lock connection	3	3				Equipment for infusion	x
117.	Urinary catheters 14G and 16G silicone	2	2				Equipment for catheterisation	x
118.	Urine drainage bag	1	1				Equipment for catheterisation	
119.	Nasogastric tube 12 F, 16 F	2	2				For nutritional support and therapeutic purposes	x
GENERAL MEDICAL AND NURSING EQUIPMENT								
120.	Ethanol 70% hand cleanser gel 250 mL	2	2	1			An alternative to hand washing	
121.	Head torch	1	1	1				
122.	Foil blanket	1	1				To retain body heat	
123.	Cling film	1	1					
124.	Cold pack	2	2	2	2	2	To reduce swelling and pain	
125.	Dental repair kit	1	1					x

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I	II	III					IV	V
Item No.	**Recommended Medicine and Dosage Strength Representing Best Practice on Board Off-shore Racing Yachts**	**Recommended Quantity for 10 Sailors on Board Off-shore Racing Yachts (WS OSR Cat. 0–4)**					**Indications on Board Off-shore Racing Yachts**	**Need to contact TMAS**
		0	**1**	**2**	**3**	**4**		
IMMOBILISATION AND TRANSPORTATION EQUIPMENT								
126.	Malleable splint	2	2	2	2	2	For immobilising bone and soft tissue injuries	
127.	Inflatable splints arm and leg	1	1				For immobilising bone and soft tissue injuries	
128.	Traction splint	1	1				To treat severe midshaft fractures of the femur	
129.	Neck collar, semi-rigid, adjustable	1	1	1	1	1	For neck immobilisation	
130.	Pelvic binder	1	1				For initial management of pelvic ring injuries	
131.	Casting tape fiberglass 10 cm × 3.5 m, foam and wrap	1	1				For immobilising broken or fractured limbs	
132.	Crepe bandage 7.5 cm	2	2				To offer support and compression for joints and strained muscles	
133.	Triangular bandage	2	2				For use as a sling, for splinting or for general padding and protection	
134.	Safety pins	6	6					
135.	Evacuation stretcher	1	1				Stretcher	

**List of recommended medicines and equipment as stated in WS/IMHA Consensus Paper on Medical Support for Off Shore Yacht Races — Medical Kit Inventory

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REVIEW ARTICLE

Request for professional medical aid on board ocean-going ships in the Republic of Croatia

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ABSTRACT

Despite modern ship technologies, high-quality crew accommodation and exceptional communications, the absence of a doctor on board presents an issue in terms of the timely, adequate and efficient response to acute health disorders and life-threatening injuries.

A serious health condition of an injured or sick person, insufficient medical knowledge of the on-board officers, inadequately equipped ship's infirmary, or scarce supply of medicines are among the typical reasons for requesting professional shore-based medical assistance. This can be achieved by requesting Radio Medical Advice or by activating air-borne medical assistance, i.e. bringing a doctor by helicopter or by Medical Evacuation, i.e. transferring the ill or injured person to the shore medical institution. The Maritime Telemedical Assistance Services are available across the world. They use all the technical possibilities available, including e-mails and very widely used photo and video attachments as well as the emergency real-time live videos. In on-board practice, the most common solution is to use medical advice over the radio (through terrestrial or satellite networks). This paper discusses the ways of requesting professional medical advice or aid on board ocean-going merchant ships in the Republic of Croatia.

(Int Marit Health 2019; 70, 1: 42–46)

Key words: radio-medical advice, medical evacuation, maritime transport

INTRODUCTION

As a rule, merchant vessels do not carry a doctor as a crew member, with the exception of passenger and cruise ships. In compliance with the international and national regulations, all merchant vessels are equipped with the medicines specified in the mandatory lists and a ship's infirmary that consists of an adequate room and equipment [1, 2]. All ships subject to the regulations established by the International Maritime Organisation (IMO) and the International Labour Organisation (ILO) must have adequate medical supplies that are periodically inspected, kept in good condition, and are ready for use whenever required. The quantities needed on board will depend on the duration and destination of the voyage, the crew size and the nature of cargo. The list assumes that on-board medical treatment is dispensed by an officer acting under the supervision and responsibility of the master. Ships with a doctor on board may carry an expanded range of medicines and other medical equipment and supplies [2, 3]. According to the legislation in effect in the Republic of Croatia, at least one on-board doctor is required on all passenger vessels in navigating category 1 (unlimited navigation) and in navigating category 2 (great coastal navigation) but the requirement also applies to vessels engaged in international voyage longer than 3 days and carrying 100 or more crew members or professional assistants, e.g. cooks, catering and entertainment staff, and the like [4, 5].

A serious health condition of an injured or sick person, insufficient medical knowledge of the on-board officers, inadequately equipped ship's infirmary, or scarce supply of medicines are among the typical reasons for requesting professional shore-based medical assistance. This can be achieved by requesting Radio Medical Advice or by activating air-borne medical assistance, i.e. bringing a doctor by helicopter or by Medical Evacuation, i.e. transferring the ill or injured person to the shore medical facility [6–8].

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In maritime shipping, the request for professional medical aid on board represents the urgency call. In terms of emergency priorities, this type of message is just below the distress call. The medical urgency call may vary from medical advice to medical assistance including transfer. Medical assistance is available only within the range of the helicopter service, while the medical advice can be provided regardless of the ship's position. The request for medical aid can be performed through satellite radio-communication. These communications are considered to be safety or urgency communications and as such should have priority over routine traffic and will normally be free of charge to the mariner. They are established by dialling the urgency prefix and connecting with medical institutions by using special numerical codes. In the event of natural disasters such as volcano eruptions, the satellite connection/link may be unavailable due to ash particles in the atmosphere [9] and the only remaining option is to establish the radio communication with the shore. Vessels engaged in coastal navigation may lack satellite communication equipment and will use terrestrial radio communication and radio stations to contact the shore-based medical facilities [6–8].

The Maritime Telemedical Assistance Services are available across the world. They use all the technical possibilities available, including e-mails and very widely used photo and video attachments as well as the emergency real-time live videos. In on-board practice, the most common solution is to seek medical advice over the radio (through terrestrial or satellite networks).

RADIO MEDICAL ADVICE

The Radio Medical Advice, commonly called "Radiomedico", which is the prefix for this type of message, is a wide-spread maritime service for providing medical aid on board ships. The service is used to request assistance from various medical institutions or shore-based radio stations that have specialised in providing medical aid to vessels, including the doctor's assistance [7].

Today, there are over 300 radio stations providing medical advice worldwide. An updated list is available on board in the International Telecommunication Union publication *List of Coast Stations and Special Service Stations* which is published once in 2 years and updated with a supplement once in 6 months [7]. Many of these stations are integrated in large communication systems, including the best known:

- Automated Mutual Assistance Vessel Rescue — AMVER, New York;
- United States Navy Coast Guard;
- Medical Telecommunications Response Centre — MTRC, Maryland, USA;
- Medical Advisory System — MAS, Owings, USA;
- Rescue Coordination Centre — RCC;
- International Radio Medical Centre (Centro Internazionale Radio Medico [CIRM]), Rome, Italy.

The International Maritime Satellite Organisation (INMARSAT) was founded in London in 1982. By means of INMARSAT satellites, it is possible to dial the two-digit service code for requesting medical urgency calls free of charge. For example, code 32 is used for providing medical advice and code 38 for providing medical assistance via satellites through the Rescue Coordinating Centre (RCC) [8, 10]. By dialling the service codes for medical aid, the satellite communication and the marine satellite Fleet77 terminal enable the seafarers to establish — within the range of the geo-stationary satellite signal [76°N, 76°S] — the telephone connection via shore-based stations LES/CES (Land/Coast Earth Station) with the adequate hospital or medical emergency unit from any position at sea [8].

The CIRM is a specialised radio station seated in Rome, founded in 1920. It is one of the most frequently called radio stations in the world. Another internationally recognised radio station is the Medical Advisory System (MAS), whose headquarters is in Maryland, USA.

In the Republic of Croatia, medical advice can be provided by any of the three Coast Radio Stations (CRS): Dubrovnik Radio, Rijeka Radio or Split Radio, through VHF DSC Channel 70, VHF Channel 16 or their respective operational channels. Free medical advice is also available through the radio communication (H.24) that is available 24/7. In the event of illness or injury, the CRS forwards the call to the on-duty doctor in the emergency service unit through the direct emergency telephone number 112. In case of a marine accident that involves injuries, e.g. by the sailboat's mast, the call is first forwarded to the Rijeka-based National Maritime Rescue Coordination Centre (Nacionalna središnjica za traganje i spašavanje [MRCC]); then the MRCC coordinator contacts the appropriate medical service.

All vessels must be equipped with communication systems and their officers have to be qualified for providing medical aid. Radio Medical Advice is considered as the urgency call having the priority over any other messages, except for the distress call. Establishing and maintaining the connection with the Radio Medical Advice service can be carried out through the radio, satellite telephone, telefax, telex, or — exceptionally in modern era — radio-telegraphy.

Regardless of the mode of communication, the request for professional medical aid should be well prepared; otherwise the advice may be inefficient or harmful to the ill or injured person. As a rule, the communication with the doctor is performed in English language. At some points of conversation, it is acceptable to communicate in other international languages. The use of mother language is always the best, if this is possible in a particular situation. It is possible to seek advice from a doctor from other vessels:

doctor is a mandatory crew member on board international passenger vessels and cruise ships [4].

The communication can be performed directly or by means of the appropriate signal codes [10] but it is best to communicate directly as this is the most efficient way. It is essential to provide the doctor with concise and clear information regarding the patient, and to understand and record the doctor's advice and instructions. When the communication is carried out through the radio telephone, it is recommended to record the doctor's response so that it could be repeated and interpret correctly. Communication interference may often occur. It slows down the response and the advice seeker should be persistent in order to get complete information on treating the ill or injured person.

It often occurs that the doctor providing medical advice is not familiar with the medicines and medical material available at the ship's infirmary, and a list of available drugs should always be at hand during the communication. The list of medicines (medicine chest and medical equipment) is defined by the category of navigation and complies with the requirements in the current edition of the *International Medical Guide for Ships* issued by the World Health Organisation (WHO). For instance, category A applies for ocean-going merchant ships. The items and their quantities in the medicine chest may vary with the ship's flag, but the required list of medicines and medical supplies should be carried on board and be regularly updated. For each item, the list should include details such as expiry date, storage conditions, and quantities remaining after purchase or use. A record of treatment given to any person on board, including the type and quantity of any medicines administered, must be entered in the ship's log. In some countries, it is compulsory to keep such a record. In addition, the master of the vessel is required to maintain a register of controlled drugs and this register must not be discarded before two years have elapsed after the date of the last entry [2].

The request for Radio Medical Advice is sent to the shore-based services through VHF, MF or HF channels with the appropriate Digital Selective Call (DSC). When the priority of the message is defined as urgent, the message contains the PAN-PAN call in radio-telegraph and radio-telephone communication, followed by the term "MEDICO" [8]. In order to avoid missing any important information during the Radio Medical Advice communication, the marine officer uses a prescribed standardised form that has to be filled in before seeking medical advice [2]. The form consists of separate sections for illness and injury, and makes an integral part of the *International Medical Guide for Ships*. The publications *International Code of Signals* features Chapter 3: Medical marks, with medical codes and numerical atlas of the human body. The use of codes allows avoiding errors in communication between the two parties, in particular when translating and interpreting special medical terminology. For example, the symptom referring to a "patient not having pupils of the same size" has the code MKX [10].

The information about a seafarer's injury or illness should be recorded on standardised forms to ensure that all important medical details are provided to medical care providers, whether on board or shore-based, or to officials such as coroners and the police. This information may also be of interest to others, including insurers, legal representatives, or ship owners. However interested these parties may be, they do not have a right to access any medical information about the patient. These forms, therefore, should not be used to communicate with anyone not concerned with the medical care of the crew member [2]. Owing to the modern technology, the carefully filled in form can be sent to the doctor by telefax or email.

Tables 1 and 2 describe the procedures for requesting medical aid through the terrestrial and satellite systems from the ships to the land-based medical services in the Republic of Croatia.

Terrestrial connections use VHF waves having a limited range of up to 30 nautical miles, but are reliable and in use at sea for all sorts of communication. In case a larger range is needed, MF or HF waves are used. These systems feature predefined frequencies for operation in the event of medical urgency, as described in the second column. The connection is carried out in a semi-duplex way, which implies that it does not allow both of the correspondents to talk simultaneously, but alternately. One of them talks while the other listens until the first correspondent says "over". Then the roles change.

The procedure for medical urgency is described in the second column. During the satellite communication we use the satellite telephone which functions like an ordinary full-duplex telephone. This means that, in case of poor understanding or forgetting details, a correspondent can repeat the question or the information at any moment.

CONCLUSIONS

Despite modern marine technologies, high-quality crew accommodation and exceptional ship communications, the absence of a doctor on board most merchant vessels presents an issue in terms of the timely, adequate and efficient response to acute health disorders and life-threatening injuries. Therefore it is essential to educate and train the seafarers in providing medical first aid and medical assistance, and seeking professional medical support. As part of the International Convention for the Safety of Life at Sea requirements, merchant ocean-going vessels are fitted with terrestrial and satellite communication systems. Satellite connection/link is available regardless of the area of navigation and is easily activated by using special prefixes for

Table 1. Emergency procedures in terrestrial systems

Distress call	Urgency call	Safety call
It is transmitted only if the vessel or its crew is in immediate danger and an urgent assistance is required by the master or skipper.	It is transmitted if the distress call is not justified (human life is not at threat), but the call refers to safety of the vessel or its crew. The assistance is explicitly required by the master or skipper.	It is transmitted when an important navigational or meteorological warning should be given by the master or skipper.
1. Press the "distress" key on the appropriate DSC VHF, MF or HF device.	Sending the urgency message to all vessels and shore radio stations, by using the menu on the appropriate DSC VHF, MF or HF device.	Set the VHF radio on Channel 16.
2. If we have time, the above message is prepared and the nature of distress is defined (foundering, collision, fire, grounding, listing...).	Set the VHF radio on Channel 16.	Set the VHF radio on Channel 16.
3. Set the VHF radio on Channel 16 and listen.	"PAN-PAN, PAN-PAN, PAN-PAN"	"SECURITE, SECURITE SECURITE"
4. Only if a vessel or shore station has responded and confirmed the message, the communications resumes:	All stations/name of the shore station ×3 This is (name of the vessel) ×3 MMSI...×3 Position is not necessary here.	All stations/name of the shore station ×3 This is (name of the vessel) ×3 MMSI...×3 Position is not necessary here.
5. MAYDAY This is MMSI. Details of the message include the number of crew members/passengers, number of injured (if any).	Content of the message.	Content of the message.
6. Type of assistance required and supporting details.	Define the type of assistance required (emergency medical aid, medical advice...).	State the details of the warning (storm, obstacle to navigation...).
7. "Over"	"Over"	"Over"

Table 2. Emergency procedures in satellite systems

Distress call	Urgency call	Safety call
It is transmitted only if the vessel or its crew is in immediate danger and an urgent assistance is required by the master or skipper.	It is transmitted if the distress call is not justified (human life is not at threat), but the call refers to the safety of the vessel or its crew. The assistance is explicitly required by the master or skipper.	It is transmitted when an important navigational or meteorological warning should be given by the master or skipper.
1. Take the headphones and press the "distress" key on the satellite terminal (Fleet77).	Take the headphones and select Priority #2 on the satellite terminal (Fleet77).	Take the headphones and select Priority #3 on the satellite terminal (Fleet77).
2. MAYDAY ×3	"PAN-PAN, PAN-PAN, PAN-PAN"	"SECURITE, SECURITE SECURITE"
3. Perform identification, state the vessel's call sign, name and flag.	This is (name of the vessel) MMSI...	This is (name of the vessel) MMSI...
4. State the nature of distress (foundering, collision, fire, grounding, listing...).	Position is not necessary here.	Position is not necessary here.
5. Details of the message include the number of crew members/passengers, number of injured (if any).	Content of the message.	Content of the message.
6. Type of assistance required and supporting details.	Define the type of assistance required (emergency medical aid, medical advice...).	State the details of the warning (storm, obstacle to navigation...).
7. "Over"	"Over"	"Over"

medical urgency. Due to maritime perils and unpredictable conditions, such as technical problems or natural disasters, the satellite connection/link may fail and can be replaced by terrestrial connections/links. This paper describes the emergency procedures in terrestrial and satellite communication systems that enable seafarers to contact medical facilities in the event of health issues, injuries or life-threatening situations at sea in the Republic of Croatia.

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ORIGINAL ARTICLE

Occupational injuries and diseases in fish farming in Finland 1996–2015

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ABSTRACT

Background: *The agriculture, forestry and fishing industry sector has high rates of occupational injuries. Fishing has globally particularly high occupational fatality rates, but injuries and illnesses to people working in its sub-sectors, aquaculture and fish farming, are not well understood.*

Materials and methods: *This study characterised injuries and occupational diseases to fish farmers and people employed on fish farms in Finland using national employment and accident insurance (workers' compensation) data.*

Results: *A total of 392 injuries and 18 occupational diseases were compensated during 1996 to 2015 to fish farmers and people employed on fish farms in Finland. The average injury rate was 3.2 injuries per 100 employed persons with no significant trend over time. Two of the injuries were fatal. Injured persons were primarily male (87.2%), in 45–54 year age group (39.1%), and working in coastal areas (49%). Common injury characteristics included: incident type: slips, trips, and falls (37%); location: building, structure or ground level surface (28%); injured body part: hand or finger (25%); type of injury: dislocation, sprain, strain (35%); and lost worktime: 1 to 2 weeks (26.9%). Seven out of 18 occupational diseases occurred to women, most resulting in cumulative trauma from fish processing.*

Conclusions: *The injury rate in fish farming corresponds to rate in all industries combined in Finland, and is higher than the rate in available Nordic statistics on fish farming. Fish farming injuries could be reduced further by slip resistant surfaces, protection of hands and fingers and ergonomics in processing.*

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Key words: aquaculture, occupational injuries, occupational diseases

INTRODUCTION

In 2015, there were 430 fish farms in Finland; out of which 29% in sea areas. During the period 1996–2015, the number of fish farms decreased as shown in Figure 1, and the quantity of food fish production decreased from 17.7 million kg in 1996 to 14.9 million kg in 2015. The production level remained at about that level through 2017 [1]. Food fish is mainly cultivated in sea areas while most of the fry are cultivated on inland fry farms and natural food ponds. The fry from natural ponds are used primarily for fish restocking.

In spite of declining production quantities, the total value of food fish production has grown remarkably in recent years; from 55.6 million euros in 2015 to 79.8 million euros in 2017, mainly due to higher average producer prices for rainbow trout, which is the main product of Finnish food fish farms.

Domestic food fish production (14.6 million kg in 2017) covers about one third of the consumption in Finland. The national target is that the volume of aquaculture production exceeds 20 million kg and 100 million euros by 2020 in mainland Finland, while ensuring ecologic, economic and social sustainability of the production at the same time [2]. The growth is expected to come from offshore and recirculation aquaculture systems (RAS). In both approaches, ecological and social sustainability can be well maintained, but there are significant economic challenges. Especially for RAS, the required initial investments are heavy, and also the running costs, especially

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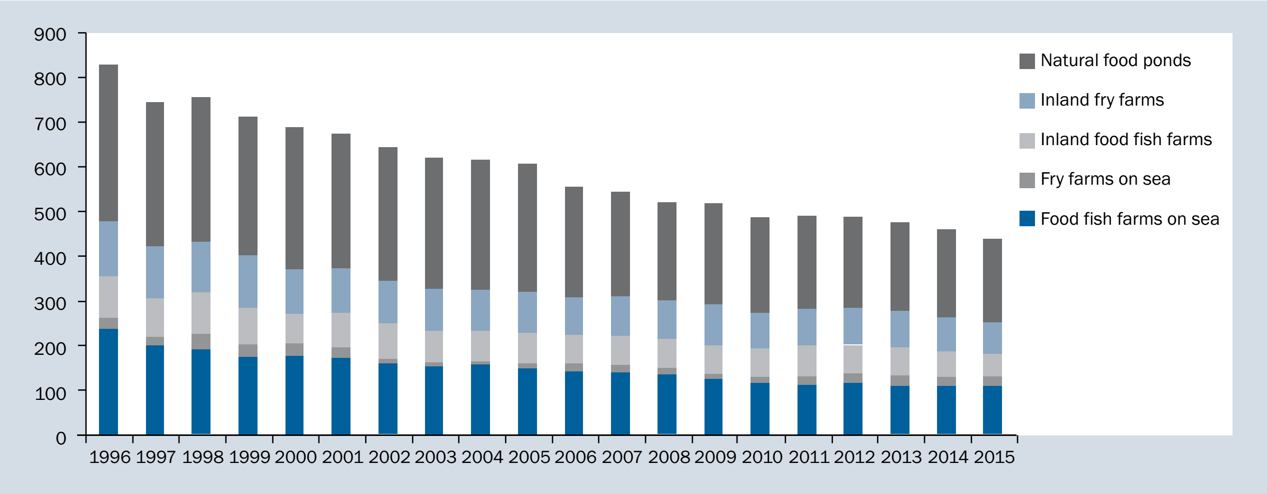

Figure 1. The number of fish farms in Finland during 1996–2015 [1]

energy, are high compared to conventional aquaculture in inland or sea operations.

New technologies may have new consequences for occupational safety. The working environment on RAS farms has characteristics from both intensive animal farming and processing industries. Although offshore fish farming will be automated as far as possible, there is still a need for human efforts at sea, often in rough weather conditions.

Occupational injuries on Finnish fish farms have not been studied in similar detail as e.g. in the construction or manufacturing industries, where the injury rates have decreased significantly in past decades. The aim of this study was to characterise occupational injuries and diseases in fish farming. This information may contribute to the development of safety communication and interventions, as well as to promoting social sustainability in the fish farming trade.

MATERIALS AND METHODS

Injury data used in this study were acquired from the Finnish Workers' Compensation Centre (TVK, www.tvk.fi/en/). TVK is a body that by law, among other responsibilities, compiles statistics on occupational injuries and diseases, including their characteristics and consequences. The data originate from insurance institutions that administer statutory occupational accident insurance policies in Finland.

Occupational injury and disease claims data were acquired for the years 1996–2015, using the Standard Industrial Classification (SIC) 2002 [3] codes "fish farming" for cases before 1999, and SIC 2008 [4] codes "fish farming on sea" and "fish farming on land/lakes" for cases since year 1999. The final data set comprised of 392 injuries that happened to 248 employees and 36 fish farm entrepreneurs. Two of the injury cases were fatal.

The insurance claims data were anonymised by TVK before providing access to the research team. The data comprised of demographic variables including age, gender, and nationality of the injured person, as well as incident information on the time, location, cause, deviation, injured body part, type of injury, task and activity, and a short legend (max. 300 characters) describing the incident. Additionally, compensation type, duration and amount, as well as number of days away from work were available.

Employment statistics [5] were used to estimate the number of employed persons (including both entrepreneurs and salaried workers) in the fish farming trade. These data were available as of year 2001. Injury rates could be calculated only for these years.

Due to changes and development in various data sources used in this study, some data were not available from the beginning of the study period. To simplify reporting, data analysis was performed on two data subsets: One with a "basic" set of variables for the whole period, 1996 to 2015 (n = 392), and another subset with an "extended set" of variables for the years 2003–2015 (n = 196). The extended set comprised of additional European Statistics of Accidents at Work (ESAW)-conformant injury coding as well as employment and fish farm statistics.

Basic data were managed in Microsoft Office Excel 10. Further analysis as well as classifications and creation of compound variables were done in SAS Enterprise Guide version 7.13 [6].

RESULTS

The estimated fish farm worker population consisted of 520 fish farmers and persons employed on fish farms in 2001, decreasing to 396 in 2015. Employment data were not available for years 1996 through 2000. A total of 392

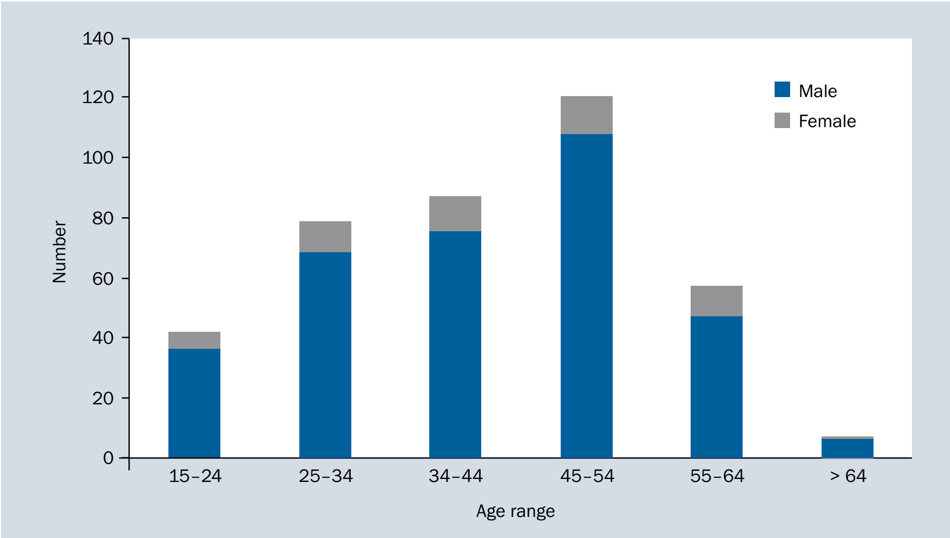

Figure 2. Number of injuries by age range and gender (n = 392)

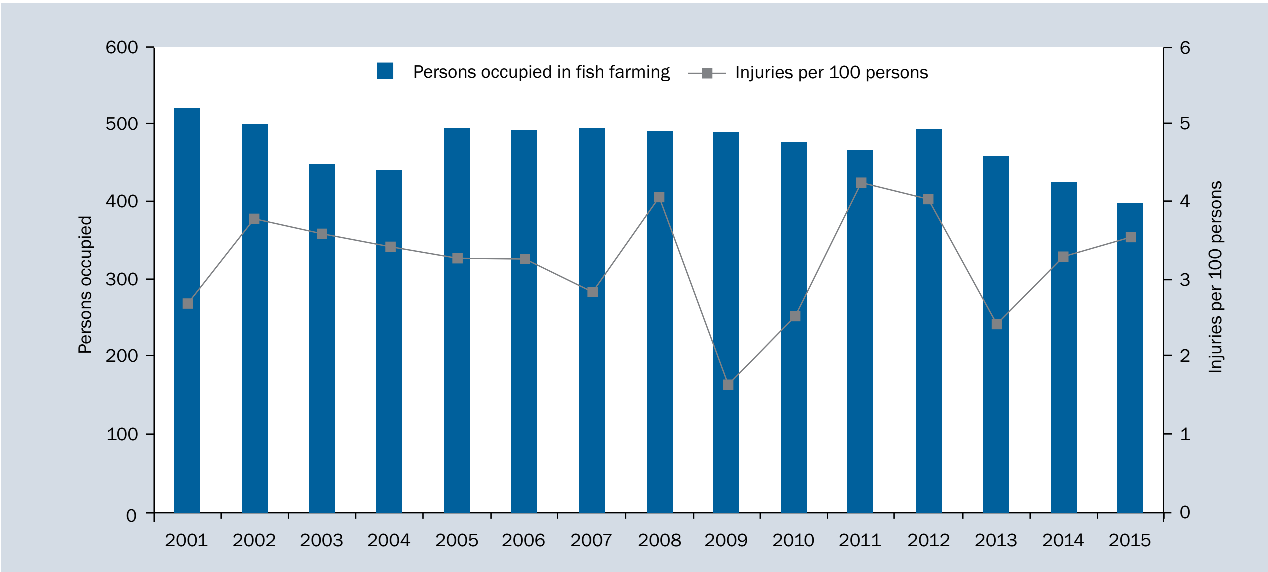

Figure 3. Annual number of persons occupied and injury rate in fish farming

injuries and 18 occupational diseases were compensated during 1996 to 2015 in the fish farming population. The median age of the injured persons was 44 years (mean 42 years), and 87.2% of the injured persons were male. There were no significant differences in gender distribution by age. The highest proportion of injuries (39.1%) was found in the age group 45–54 years (Fig. 2).

The number of compensated injuries in fish farming varied around the mean of 18 per year with a range from 8 to 38. Three out of four (n = 231) injured persons had only suffered one injury, while 18% (n = 52) had two injuries during 1996 to 2015, and the rest (7%, n = 19) had experienced three or more (up to 6) compensated injuries. Injured employees (n = 248) had suffered 1.3 injuries per person on average while injured fish farmers (entrepreneurs, n = 36) had a corresponding mean of 1.8.

The annual injury rate varied around the mean of 3.2 injuries per 100 persons occupied (all injuries included) as shown in Figure 3. No significant trend can be observed in the annual data. The corresponding mean rate for injuries with more than 3 days of lost working time is 2.1.

Nearly half of the injuries (48.5%, or 189) happened in coastal areas (Table 1). The number of fish farming facilities and injury ratios (injuries per mean number of facilities) are based on statistics of fish farming facilities for

Table 1. Number of injuries, fish farming facilities, and injuries per facility by geographical region

Region	Injuries*		Facilities**		Injuries per facility
	N	Per cent	N	Per cent	
Coast	189	48.5%	109	51.4%	1.7
Lake district	88	22.6%	24	11.3%	3.6
Northern Finland	71	18.2%	44	20.8%	1.6
Åland	42	10.8%	35	16.5%	1.2
Total	390	100%	212	100%	

*Missing or not known (n = 2)
**The number of facilities is a mean for the years 1996–2015

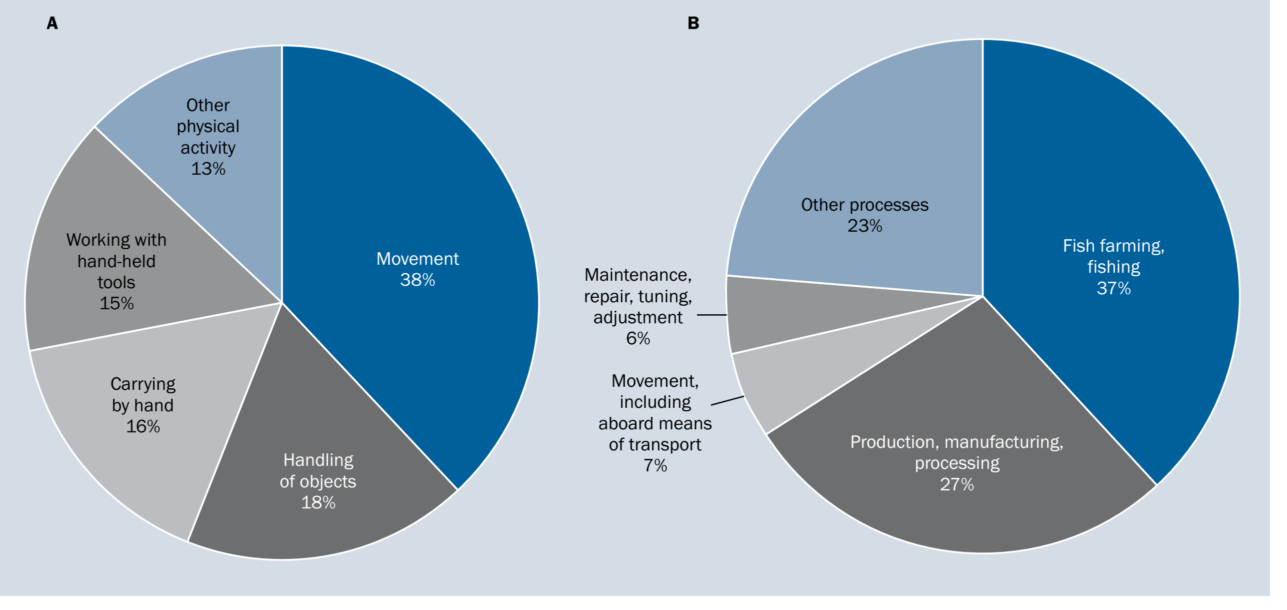

Figure 4. Specific physical activity (**A**) and working process during injury (**B**) (n = 196)

1999–2015 and linearly extrapolated values for the years 1996–1998.

Information on the working process, as well as the specific physical activity at the time of injury was available only for injuries that happened between the years 2003–2015 (n = 196). In these data, most injuries happened when moving (the specific physical activity) either during actual fish farming or fishing (16% or 31 injuries), or other production processes (11% or 22 injuries) (Fig. 4A, B).

Typical case descriptions for corresponding combinations of a special physical activity and working process include the following: *"The injured person was feeding the fish, slipped, fell over, and hit her head."* and *"The injured person was washing the facilities in a bent posture. When raising his position, he hurt his head against a tipping device."*

More than one third of the injuries were the result of slipping, stumbling, and falling (Table 2). These events (deviations) resulted in a horizontal or vertical impact (Table 3)

Table 2. Deviations that lead to injuries

Deviation	N*	Per cent
Slipping, stumbling, and falling	141	36.5%
Body movement without any physical stress	84	21.8%
Body movement under or with physical stress	48	12.4%
Loss of control of machine, tool, or object	44	11.4%
Breakage, fall, or collapse of material agent	28	7.3%
Overflow, overturn, leak, flow, vaporisation, emission	18	4.7%
Other	14	3.6%
Electrical problems, explosion, fire	8	2.1%
Shock, fright, violence, aggression, threat, presence	1	0.3%
Total	386	100%

*Missing or not known (n = 6)

Table 3. Contact modes of the injuries

Contact — mode of injury	N*	Per cent
Horizontal or vertical impact (the victim is in motion)	71	36.8%
Physical or mental stress	37	19.2%
Contact with sharp, pointed, rough, coarse material agent	28	14.5%
Struck by, or collision with object in motion	20	10.4%
Trapped, crushed, etc.	17	8.8%
Contact with hazardous substances	10	5.2%
Other contacts (involving heat, and human/animal interaction)	10	5.2%
Total	193	100%

*Missing or not known (n = 3)

Table 4. Material agents in injuries

Material agent	N*	Per cent
Buildings, structures, surfaces — at ground level	106	27.7%
Materials, objects, products, machine or vehicle components, debris, dust, waste	74	19.3%
Other material agents not listed in this classification	59	15.4%
Hand tools, hand-guided tools	40	10.4%
Conveying, transport, distribution and storage systems, pipe networks	25	6.5%
Buildings, structures, surfaces — above or below ground level	22	5.7%
Chemical, explosive, radioactive, biological substances	20	5.2%
Machines and equipment, fixed or mobile/portable	17	4.4%
Land and other transport vehicles	13	3.4%
Living organisms, human beings, physical phenomena and natural elements	7	1.8%
Total	383	100%

*Missing or not known (n = 9)

Table 5. Part of body injured

Part of body injured	N*	Per cent
Hand, finger	97	24.9%
Leg from hip to ankle	75	19.2%
Arm from shoulder to wrist	63	16.2%
Back, spine	37	9.5%
Eye	32	8.2%
Head, excluding eyes	26	6.7%
Foot and toes	22	5.6%
Other, e.g. internal organ injury	16	4.1%
Neck and body excluding back	14	3.6%
Multiple body parts	8	2.1%
Total	390	100%

*Missing or not known (n = 2)

Table 6. Type of injury

Type of injury	N*	Per cent
Dislocations, sprains and strains	137	35.0%
Wounds and superficial injuries	115	29.4%
Concussion and internal injuries	69	17.6%
Bone fractures	35	9.0%
Other (e.g. poisoning, suffocation)	17	4.3%
Not known	8	2.0%
Burns, scalds and frostbites	7	1.8%
Traumatic amputations	3	0.8%
Total	391	100%

*Missing or not known (n = 1)

with or against a stationary object in 79.5% of the cases. Typical material agents (Table 4) in these cases include slippery ground or floor, as well as debris and various objects, on which the victims stumbled.

Hands and fingers were most frequently injured body parts (Table 5), typically resulting in wounds and superficial injuries (n = 60 or 62%). Dislocations, sprains and strains were most frequent types of injuries (Table 6) affecting the back and spine, as well as arms and legs.

Dislocations, sprains, and strains had relatively severe consequences, two thirds of them (66%) resulting in 1 to 4 weeks of lost time. Wounds and superficial injuries were less severe, nearly two thirds (62%) of them leading to up to 2 weeks of absence from work. The categorised numbers of days lost due to injury are presented in Figure 5. The statistics do not separate the number of injuries with no days lost in the 0–3 day category.

FATALITIES

The injury data included two fatalities in the fish farming industry during the years 1996–2015. Both happened to men (aged 49 and 59) in fish farming on sea. The material agent of the first causality was a conveyor or other transport or storage system, but no further injury details were available. The second causality has been investigated and reported by the Workers' Compensation Centre [7]. The victim was walking on newly frozen sea ice to check the winter basins between two islands. Despite thorough knowledge of local circumstances, over two decades of fish farming

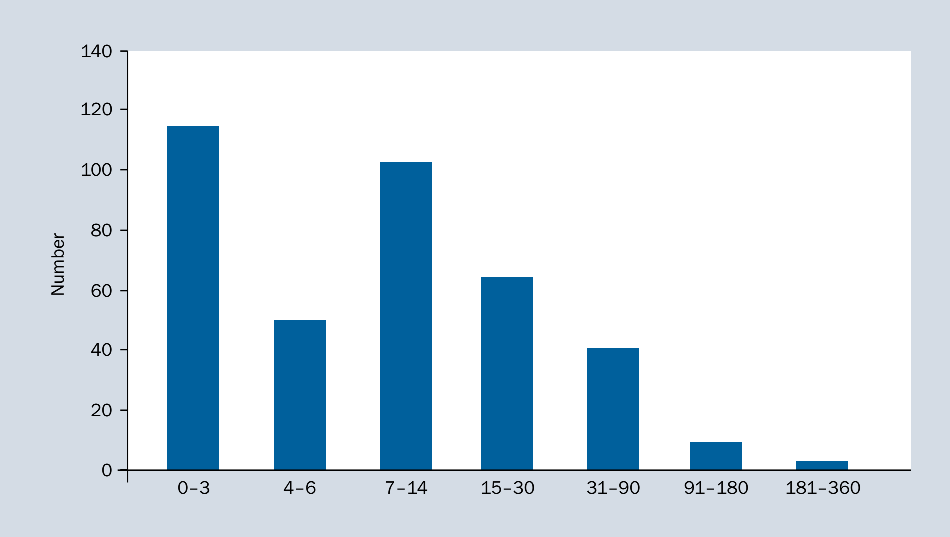

Figure 5. Number of days lost due to injuries (n = 384), excluding full pension (n = 1) and two fatalities; missing: n = 5

experience in the same area, as well as wearing some safety equipment (e.g. ice picks) and having experience of getting out of water when falling through sea ice, he drowned and was recovered from the sea bottom later on the same day.

OCCUPATIONAL DISEASES

There were 18 occupational diseases or suspected occupational disease cases in the insurance claims data of fish farmers and fish farm employees in 1996–2015. Mean age of the subjects was 44.4 years, and 7 out of the total 18 were female. In 5 out of 10 indicated cases (missing information in 8 cases), the person was mainly working in fish processing. In these cases, carpal tunnel syndrome, synovitis/tenosynovitis, allergic contact dermatitis and asthma diagnoses were registered. Predisposition to formalin was indicated in two other asthma cases.

DISCUSSION

Fishing and aquaculture have had the steepest rise in non-fatal injury incidence rate in the European Union during 2010 to 2015 [8], while agriculture has had the third highest rise. Fish farming involves tasks that resemble both fishing and agricultural farming [9]. In Finland, both have high occupational injury rates: 7.9 injuries/100 person-work-years in fishing [10] and 6.2 to 7.5/100 in agriculture (all recorded injuries) [11]. The corresponding rate for all salary and wage earners ranged from 1.8 in 2013 to 2.9 in 1997 (injuries with 4 or more days of disability) [12].

The injury rates for most industries, including construction work, have shown decreasing trends in Finland [13], but such development cannot be observed in fish farming in the current study. The injury rate of fish farmers and fish farm employees (on average 3.2 injuries per 100 persons working in fish farming, all injuries included) calculated in this study is in the same order as reported for the Norwegian aquaculture in the beginning of the millennium (2.0 to 2.8 for the years 2001–2005) [14]. Since then, there has been a significant decrease in the Norwegian injury rate to around, or below, 1 injury per 100 employed persons. For injuries with four or more days of disability, the calculated injury rate (2.1) corresponds to that of all salaried work force in Finland.

About half of fish farming injuries occurred in coastal areas. However, the incidence rate (injuries per fish farming facility) was highest in the lake district area. The differences may be partially attributed to different production methods and equipment. The difference may also be due to employee numbers per facility; this information was not available in our data sources. It has been suggested that inland aquaculture farms that use more advanced technology are less likely to experience severe injuries [15]. Cultural and social differences between areas may also have a role in safety at work. In earlier studies, Finnish mother tongue (vs. Swedish, which is also an official language in Finland) has been identified as a risk factor for injuries among fishers [16], and farmers [11]. Similar differences have been found in overall mortality across the Finnish population [17]. Åland is predominantly a Swedish speaking area, as are many other coastal municipalities. National statistics show that overall morbidity is lowest in Åland and highest in the eastern areas (Lake district) [18]. These differences based on language and culture may affect the utilisation of services and reporting of injury incidents to insurance systems used in our study. Other risk factors may differ between districts as well, but their role is unknown. A systematic review of risk factors for agricultural injury has revealed over 20 significant risk factors, such as regular medication use, hearing loss, sleep deprivation, stress and depression [19, 20]. Many of these risk factors may apply to injuries in fish farming as well.

Fish farm employees and entrepreneurs in this study had a lower rate of injuries than commercial fishers [10], but the injury characteristics are quite similar. Slipping and falling hazards are often present at workplaces, and they should be taken seriously when designing workplaces and other preventive actions. Attention should also be paid to the protection of upper extremities, which is the most commonly injured body part in our study as well as in corresponding studies in aquaculture in Norway [14] and commercial fishers in Finland [10]. Sprains and strains, wounds, and other superficial injuries generally indicate the need for making fish handling processes more ergonomic and safe.

The age distribution of the fish farmer and fish farm employee population could not be assessed in our data. The mean age of the injured population during injury was 42.0 years, which is clearly lower than that of the commercial fishers (47.6 years, [10]).

The distribution of severity of injuries in fish farming, when assessed by number of days lost due to injury, corresponds fairly well to that of the wage and salary earners in Finland [13]. One common characteristic is the high number of minor injuries (0 to 3 days lost): 30.5% for fish farms and 52% for all wage and salary earners. This is in contrast with corresponding injury compensation claims data for commercial fishers, where only 1% of injuries led to the lowest days lost category [10]. The explanation to this difference may lie in differences in typical job statuses: The professional fisher population comprises almost completely of self-employed entrepreneurs while persons occupied in fish farming are for the most part (80% to 85% in 2011–2015) full- or part-time wage and salary earners. The median days lost category is the same for both populations (7 to 14 days lost), when accounting for injuries with 4 or more days lost.

LIMITATIONS OF THE STUDY

This study used existing data from insurance and public employment data sources. National employment data were used for estimating the number of employed persons. Occupational accidence insurance (workers' compensation) is mandatory for all employees and entrepreneurs. While these data could be expected to represent total employment and total injury and occupational disease experience in Finland, it is likely that under-reporting of injuries and other biases in estimating both employed persons and injury counts may exist, and their role and direction could not be assessed in this study. It has been widely reported that workers' compensation data under-report actual injury and occupational disease cases [21–24]. On the other hand, compensated claims and self-reported incidents have been compared among farmers in Finland, indicating relatively small level of under-reporting in accident insurance statistics [25].

Occupied person and injury data could not be merged at individual level, and therefore regression methods could not be used to identify injury risk factors or intervention effects. Exact numbers of people occupied in fish farming were not available for the whole observation period, limiting the ability to construct incidence rates for all years. There is also strong variability in working hours and numbers of full- and part-time workers, so only incidents per persons occupied (not per working hours) could be assessed. One reason for this variation is the seasonal nature of the fish farming trade.

Changes in available variables and their classifications, as well as the adoption of the ESAW methods during the observation period, limited some of the analyses to cover only those years with consistent data. Even with careful consideration of source data variables, interpretation errors may remain in constructing the analysis datasets.

CONCLUSIONS

The injury rate calculated in this study indicates an occupational injury risk in fish farming that corresponds to that of all salaried work force in Finland. The incident rate has not decreased during the observed period which is in contrast to the positive development in other industries, or fish farming in Norway. The expressed intention to grow the Finnish fish farming industry volume stresses the importance of taking actions to reduce injury risks in the trade.

The new approaches in the Finnish aquaculture, growing RAS and offshore farming, will without doubt change occupational safety challenges in future aquaculture. Automation can contribute to reducing the risks, but as it also changes the ways of working, it may introduce new challenges to injury prevention. As the number of fish farms and people working on fish farms is low in Finland, it may be difficult to study health determinants and injury risk factors in detail, or calculate morbidity rates for this population in different geographical or cultural sub-groups. Instead of that, systematic analyses of working processes, technologies and user experiences could result in more detailed information on challenges in injury prevention and produce useful solutions for better safety at work.

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ORIGINAL ARTICLE

Dungeness crab fishermen perceptions of injury causation and factors in staying safe

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ABSTRACT

Background: *Commercial fishing is a hazardous occupation in the United States (US). Injury surveillance data relies heavily on US Coast Guard reports, which capture injuries severe enough to require reporting. The reports do not incorporate the fishermen's perspective on contributing factors to injuries and staying safe while fishing.*

Materials and methods: *We conducted a pre-season survey of Dungeness crab fishermen during 2015 to 2016. Community researchers administered surveys to fishermen. Respondents reported their opinions about factors contributing to injuries and staying safe, which were grouped into similar themes by consensus. Descriptive statistics were calculated to explore the number of injuries, crew position, age, and years of experience. Chi-square tests compared perceptions of injury causation, staying safe, and other factors.*

Results: *Four hundred twenty-six surveys were completed. Injury causation perceptions were sorted into 17 categories, and staying safe perceptions were sorted into 13 categories. The most frequently cited causes of injury were heavy workload (86, 21.9%), poor mental focus (78, 19.9%), and inexperience (56, 14.3%). The most frequently cited factors in staying safe while fishing were awareness (142, 36.1%), good and well-maintained fishing gear/vessel (41, 10.4%), and best marine practices (39, 9.9%). Opinions were not significantly associated with experiencing an injury in the past while fishing, but some opinions were significantly associated with crew position, age, and years of experience.*

Conclusions: *The perceptions of fishermen can be evaluated further and incorporated into training or intervention development. The fishermen-led approach of this project lends itself to developing injury prevention strategies that are effective, realistic and suitable. The resources available at FLIPPresources.org, such as informational sheets for new fishermen, sample crew agreements, and first aid kit resources, supply workers in this fishery with real solutions for issues they identified through their survey responses.*

(Int Marit Health 2019; 70, 1: 55–60)

Key words: fisheries, wounds and injuries, occupational health, community-based participatory research

INTRODUCTION

Commercial fishermen have the second highest fatality rate of all civilian job categories in the United States (US), with a rate of 86 fatal work injuries per 100,000 full-time equivalent workers (FTEs) [1]. Comparatively, it is over 23 times the fatal injury rate for all civilian job categories nationally, 3.6 per 100,000 FTEs [1]. While much published data exists about fatalities and factors relating to fatal incidents, little exists about non-fatal injuries in this industry.

The Dungeness crab fishery is economically important to the US states of Washington, Oregon, and California. In 2015, it produced 22.7 million pounds of crab and generated $105 million in revenue [2]. It employs approximately 1700 workers each year [3]. This crab fishery has been identified as the second most hazardous fishery in Washington, Oregon, and California, with 114 fatalities per 100,000 FTEs during 2000 to 2014 [4]. An analysis using information abstracted from US Coast Guard (USCG) investigation reports found 28

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fatal and 45 nonfatal injuries in the Dungeness crab fleet over a 12-year period [5], which encompasses only the most severe injuries and is vulnerable to underreporting [5]. A study assessing non-fatal injuries directly with fishermen in this fishery could identify non-fatal injuries that are not consistently captured by USCG systems. Identifying all injuries — not just severe ones — could mean a substantial reduction in worker morbidity and potential cost savings.

The Fishermen Led Injury Prevention Programme (FLIPP) characterised the patterns of non-fatal injuries in the West Coast Dungeness crab fishery to obtain comprehensive estimates of injury burden. It also collected information on safety and injury perceptions of fishermen to inform prevention strategies. This was achieved through the development of a survey instrument in collaboration with the crab fishing fleet. No published research describing injuries to date has surveyed Dungeness crab fishermen directly. This identified the perceived causes of injuries and factors in staying safe as a Dungeness crab commercial fisherman, as assessed by fishermen themselves. It also determined whether perceptions differ by previously experienced injuries, crew position, age, or years of fishing experience. By incorporating the fisherman's perspective, injury prevention strategies can be more closely tailored and more readily adopted.

MATERIALS AND METHODS

PARTICIPANTS

Participants included individuals working in commercial fishing who were at least 18 years of age. They were recruited from coastal fishing docks in the US states of California, Oregon, and Washington. All participants consented to participation.

DATA SOURCE

This analysis utilises data from the FLIPP pre-season survey of Dungeness crab fishermen during the 2015–2016 season. The survey was developed using knowledge gained from focus groups held in seven West Coast crabbing ports. During the focus groups led by trained local fishing community researchers, fishermen and relevant stakeholders gave their input on perceived gaps in the current injury research in the Dungeness crab fleet. The participants gave their feedback on which factors should be assessed to enhance understanding of injury risk. Community researchers pilot-tested the survey in Washington, Oregon, and California. The survey included consent procedures; it did not collect identifying information. The study was approved by the Oregon State University Human Research Protection Program and Institutional Review Board.

The survey included 27 questions, consisting of a combination of free response, multiple choice, multiple answer, and Likert scale questions. Fishermen were asked to self-report all injuries experienced in the past year while commercial fishing. Respondents reported on their commercial fishing activities, injury experience, opinions on safety while engaged in fishing activities, and demographics. In the survey, we asked specifically for injuries that happened in relation to commercial fishing, including shore and/or land-based activities such as working in the gear yard. Per the survey instructions: "By injury we mean a time when your body was damaged and required first aid/medical care at the time of injury or after the injury OR caused time away from fishing or other work OR required you to change how you did your job to accommodate the injury."

Community researchers administered the paper-based surveys directly to fishermen dockside in the states of Washington, Oregon, and California prior to the 2015–2016 Dungeness crab season. A total of 426 surveys were completed and collected from 21 ports in the three states.

DATA ELEMENTS

The outcomes of interest, perceived causes of injury, and factors in staying safe, were measured in the survey by two open-ended questions: "What do you think contributes most to commercial fishing injuries?" and "What are two things you think are most important for staying safe while commercial fishing?" Additional survey items included in the analyses were respondent-reported number of injuries in the past year and over the fishing career, crew position (deckhand, captain, owner), age, and number of years of experience as a commercial fisherman.

ANALYSIS

We asked for one response to the question, "What do you think contributes most to commercial fishing injuries?", and two responses to the question, "What are two things you think are most important for staying safe while commercial fishing?" First, the individual responses from both questions were condensed into 250 unique responses. Research team members (n = 7) independently sorted them into common themes. These independently derived themes were then reviewed by two of the research team to arrive at a consensus. The finalised themes were then assigned by a third member of the research team to each individual response for analysis.

Descriptive statistics characterized the outcomes, number of injuries in the past year, number of injuries over the fishing career, crew position, age, and years of fishing experience. Chi-square tests of independence were used to compare categorical variables by the outcomes. Chi-square tests for equality of medians were used to compare continuous variables by the outcomes. Missing (no response) values were not included in percentage calculations or chi-

Table 1. Fishermen demographics

	Range	Mean ± SD
Age (n = 395)	18–80	39.7 ± 14.7
Years of experience (n = 422)	0–60	17.4 ± 14.2
	Frequency	**%**
At least one injury in past year:		
Yes	77	18.6
No	336	81.4
Missing	13	
Total	426	100
At least one injury in career:		
Yes	203	51.4
No	192	48.6
Missing	31	
Total	426	100
Crew position:		
Deckhand	207	52.0
Owner	140	35.2
Captain	51	12.8
Missing	28	
Total	426	100

SD — standard deviation

square tests. All statistical analyses were completed using R version 3.5.0 [6].

RESULTS

A total of 426 surveys were completed and collected from 21 ports in three states. The mean age of fishermen was 39.7 years (range: 18–80), and the mean years of experience was 17.4 years (range: 0–60). Approximately 1 in 5 fishermen reported experiencing at least one injury in the past year (77, 18.6%); however, roughly half reported experiencing at least one injury in their fishing career (203, 51.4%). The crew positions of respondents consisted of 207 (52.0%) deckhands, 140 (35.2%) owners, and 51 (12.8%) captains (Table 1). For the outcome "What do you think contributes most to commercial fishing injuries?", 17 response themes were identified. Respondents cited heavy workload (86, 21.9%), poor mental focus (78, 19.9%), and inexperience (56, 14.3%) as the most frequent causes of commercial fishing injuries (Table 2). For the outcome "What are two things you think are most important for staying safe while commercial fishing?", 13 response themes were identified. Respondents cited awareness (142, 36.1%), good and well-maintained fishing gear/vessel (41, 10.4%), and best marine practices (39, 9.9%) as the most frequent factors in staying safe while commercial fishing (Table 3).

There were no statistically significant differences in perceived causes of injury opinion or staying safe opinions among those who had and had not experienced at least one injury in the past year, nor among those who had and had not experienced at least one injury in their career.

For perceived causes of injury opinions, poor mental focus, inexperience, drugs/alcohol, unsafe practices, and poor physical condition/self-care differed by crew position. Inexperience and bad luck differed by age. Poor mental focus, inexperience, unsafe vessel and/or gear, unsafe crew, and poor working conditions differed by years of experience. For staying safe opinions, experience differed by crew position and age. Chi^2 results for each opinion are presented in Tables 2 and 3.

DISCUSSION

Injuries among Dungeness crab fishermen are common. This study helps shed light on the opinions of these fishermen regarding what they believe causes injuries and what factors are important for staying safe while fishing. By requesting free-text responses from fishermen, the research team was able to elicit a wide variety of feedback, without leading or restricting respondents.

Common themes emerged when the individual responses were systematically categorised. Heavy workload, poor mental focus, and inexperience were the top perceived causes of injuries. Awareness, good and well-maintained fishing gear/vessel, and best marine practices were the top perceived factors for staying safe while fishing. Previously experiencing an injury did not influence opinions. Similarly, Eklöf [7] found that previously experiencing an injury did not influence a sample of Swedish fishermen's reported engagement in safe work practices. Given the common nature of injuries in fisheries, particularly minor injuries, past experiences could have little impact on future opinions and behaviours. A study of North Atlantic fishermen in the US reported a similar finding: workers who experienced more injuries found various types of dangerous fishing conditions less concerning [8].

Some differences were found by crew position, age, and years of experience. In particular, the themes of inexperience (perceived causes of injury) and experience (factors in staying safe) differed by both crew position and age. Generally, deckhands are more likely to experience the harshest working conditions. However, Dungeness crab vessels typically have crews of only 3 to 5. Work roles are often not clearly delineated, with captains and owners commonly engaging in strenuous deckhand tasks as well. Younger workers generally have less experience in commercial fishing than older workers. Focused, standardized training for those new to Dungeness crab fishing should be implemented, given the unique nature of fishing for this particular species.

Table 2. Perceived causes of injury among Dungeness crab fishermen

Theme	Frequency	%	Injury past year		Injury career		Crew position		Age		Years of experience	
			Chi[2a]	p	Chi[2a]	p	Chi[2a]	p	Chi[2b]	p	Chi[2b]	p
Heavy workload	86	21.9	0.37	0.829	0.19	0.909	6.84	0.144	4.82	0.090	4.86	0.088
Poor mental focus	78	19.9	0.19	0.909	0.06	0.971	**10.21**	**0.037**	8.14	0.017	**7.12**	**0.028**
Inexperience	56	14.3	0.70	0.706	0.20	0.903	**10.07**	**0.039**	**9.45**	**0.009**	**10.41**	**0.005**
Weather and/or sea conditions	38	9.7	4.98	0.083	0.59	0.744	6.58	0.160	4.40	0.111	5.47	0.065
Stupidity	29	7.4	1.34	0.512	0.06	0.973	6.62	0.157	4.91	0.086	5.51	0.063
Unsafe vessel and/or gear	26	6.6	0.17	0.919	0.64	0.726	8.23	0.083	4.24	0.120	**6.38**	**0.041**
Unsafe attitude	18	4.6	2.00	0.368	3.45	0.178	7.20	0.126	4.28	0.118	4.89	0.087
Drugs/alcohol	16	4.1	1.79	0.409	1.54	0.463	**10.47**	**0.033**	4.84	0.089	4.89	0.087
Bad luck	11	2.8	5.61	0.060	1.50	0.473	6.96	0.138	**7.94**	**0.019**	5.46	0.065
Rushing	10	2.6	0.17	0.917	0.12	0.943	5.83	0.212	4.42	0.110	5.12	0.077
Lack of training/ /safe procedures	6	1.5	0.16	0.921	0.31	0.859	8.43	0.077	5.20	0.074	4.87	0.088
Unsafe crew	5	1.3	1.71	0.425	0.20	0.903	7.38	0.117	5.69	0.058	**9.51**	**0.009**
Unsafe practices	4	1.0	0.27	0.873	0.05	0.975	**14.00**	**0.007**	4.25	0.119	4.86	0.088
Bad attitude	3	0.8	0.83	0.660	0.44	0.804	6.28	0.179	4.24	0.120	5.12	0.078
Poor physical condition/self-care	3	0.8	0.83	0.660	0.34	0.845	**14.44**	**0.006**	4.71	0.095	5.28	0.071
Ego	2	0.5	1.48	0.478	0.05	0.975	8.70	0.069	3.38	0.066	4.86	0.088
Poor working conditions	1	0.3	0.38	0.827	1.10	0.576	7.73	0.102	3.48	0.062	**4.04**	**0.044**
No response	34											
Total	426	100										

[a]Pearson Chi^2 test of independence; [b]Pearson Chi^2 test for equality of medians

The ideas presented by the fishermen can have an impact on realistic intervention development. Several of the themes appear related and can be grouped together when planning prevention strategies. For example, inexperience, "stupidity," unsafe crew, unsafe practices, and lack of training/safe procedures can all be addressed with appropriate training and training requirements. Revising the current make-up of training for new crew, ongoing training practices for continuing crew, and the mechanisms for training delivery can all help to improve crew safety. Rushing and heavy workload could be addressed with work organisation and practices that pace and allow for appropriate rest, while not affecting productivity. Health promotion resources that are tailored for and readily accessible to fishermen can address poor physical condition/self-care and drugs/alcohol. Outreach to fishermen by fisheries management and regulatory bodies in the US is not always seen as successful [9]. All of the potential interventions mentioned above would be bolstered by collaborative relationships between fishermen and management.

Captains must be responsible for best marine practices, good and well-maintained fishing gear/vessel, and emergency drills and preparation. Captains and owners should promote safety culture, while all crew members have a role in communication on board. In a study by Poggie et al. [10], an owner-operator on board the vessel was strongly correlated with the perception that human error and carelessness contributed to accidents. Having a good crew agreement and identifying resources to help captains should be explored. Also, educating new potential fishermen on how to assess these issues is key in keeping captains accountable. Crew agreements and informational sheets to be distributed to new fishermen have been developed by this research team and are publicly available online at the project website [11]

LIMITATIONS OF THE STUDY

This study was the only to date to directly survey Dungeness crab fishermen for the purposes of describing injuries. One limitation was reliance on self-reported data. Fishermen

Table 3. Perceived factors in staying safe among Dungeness crab fishermen

Theme	Frequency	%	Injury past year		Injury career		Crew position		Age		Years of experience	
			Chi[2a]	p	Chi[2a]	p	Chi[2a]	p	Chi[2b]	p	Chi[2b]	p
Awareness	142	36.1	0.03	0.984	4.60	0.100	5.27	0.261	0.27	0.873	0.14	0.930
Good/well-maintained fishing gear/vessel	41	10.4	2.37	0.305	1.27	0.529	3.89	0.421	2.14	0.343	0.89	0.641
Best marine practices	39	9.9	0.03	0.985	1.65	0.438	5.74	0.219	0.10	0.950	0.24	0.888
Crew/skipper	35	8.9	1.54	0.463	1.37	0.504	6.19	0.186	2.45	0.294	5.00	0.082
Self-care	35	8.9	0.48	0.786	1.33	0.515	1.51	0.825	0.32	0.853	3.76	0.153
Wisdom	26	6.6	1.99	0.370	1.64	0.439	8.42	0.077	0.40	0.821	2.92	0.232
Experience	20	5.1	0.19	0.909	1.29	0.524	**19.50**	**0.001**	**6.21**	**0.045**	5.60	0.061
Physicality	14	3.6	0.97	0.617	3.41	0.181	2.47	0.650	0.05	0.97	0.30	0.860
Communication	13	3.3	1.33	0.515	2.82	0.244	8.73	0.068	1.63	0.442	3.77	0.152
Drills and preparation	11	2.8	0.51	0.775	2.96	0.228	1.86	0.761	0.64	0.724	0.18	0.915
Drug/alcohol free	6	1.5	0.89	0.642	2.83	0.243	4.53	0.339	0.89	0.642	0.06	0.972
Understand fatigue management	6	1.5	0.89	0.642	2.12	0.346	1.57	0.814	0.33	0.850	0.79	0.675
Personal	5	1.3	1.54	0.462	5.90	0.052	2.00	0.736	0.46	0.796	0.23	0.890
No response	33											
Total	426	100										

[a]Pearson Chi^2 test of independence; [b]Pearson Chi^2 test for equality of medians

might be unwilling or unable to accurately report their injury experiences, particularly for non-severe injuries. Typically, recalling severe injury experiences from memory results in more accurate information than recalling minor injury experiences. The vast majority of injuries reported were not treated by medical professionals, so there is no practicable alternative to self-report. Primary data collection of injuries, even with limited reliability, can provide some insight for injury prevention strategies especially when worker perceptions of what causes injuries and what works to stay safe are included. Another limitation is the use of only the first response to the question "What are two things you think are most important for staying safe while commercial fishing?" The second response to this question was excluded because of the low response rate and to avoid non-independent responses.

CONCLUSIONS

The fishermen-led approach of this project lends itself to developing interventions that are feasible and suitable to the Dungeness crab fishing community. Fishermen may be more likely to take part in future interventions if they are incorporated into the decision-making process, and, in addition, if the interventions reflect their priorities and experience. The FLIPP study included perceptions of injury cause and of factors relating to staying safe based on fishermen recommendations during survey development. Injury control measures may be more likely to be successful if informed both by epidemiologic data and the perceptions of the workforce who will be implementing those measures.

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VIA MEDICA

ORIGINAL ARTICLE

Study of the changes in respiratory function in self-contained underwater breathing apparatus divers

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ABSTRACT

Background: *The objective was to investigate the respiratory function of professional divers by conducting spirometry and to compare the data obtained with those of non-divers.*

Materials and methods: *This study involved 52 military divers who carried out dives at small and medium depths using a self-contained underwater breathing apparatus (SCUBA) with open-circuit regulators attached to a mouthpiece. The control group consisted of 48 persons from deck commands with similar physiological characteristics and lifestyle that were not divers and had never been under increased pressure.*

Results: *It was found that, compared with non-divers, the spirometry parameters of the divers are characterised by higher values of forced vital capacity (FVC) of the lungs ($p = 0.02$), but significantly lower values of the mid-expiratory flow (MEF) parameters: MEF_{25} ($p = 0.06$), MEF_{50} ($p = 0.04$), and MEF_{75} ($p = 0.01$), as well as for the ratio of forced expiratory volume in 1 second (FEV_1) to forced vital capacity (FEV_1/FVC; $p = 0.001$) and MEF_{25-75}/FVC ratio ($p < 0.001$).*

Conclusions: *Hyperoxia, gas decompression bubbles, hypothermia, mouth-breathing dry, cold, compressed air, and other factors accompanying the diving activity are capable of initiating damage to the airways, which is reflected in characteristic changes in spirometry. The pattern of these changes is consistent with small airway obstruction and they could be related mostly to diving activities.*

(Int Marit Health 2019; 70, 1: 61–64)

Key words: spirometry of divers, airway injuries in divers, respiratory function

INTRODUCTION

Divers working on small and medium depths represent the main group of the representatives of this profession; however, the nature of functional changes in their organisms, including those involving the respiratory system, have not been clearly explained. Diving is a strenuous underwater activity in which environmental conditions affect the functions and structure of tissues. Of all body systems, the respiratory system is the most affected by diving, and from this point of view, pulmonary function test of the divers can give us valuable information about the consequences of this activity.

Early studies in commercial offshore divers [1] and one study in recreational self-contained underwater breathing apparatus (SCUBA) divers [2] indicated an accelerated loss of forced vital capacity (FVC) over time that was associated with diving exposure. Long-term effects on respiratory function have been found in commercial divers who perform deep dives [3]. In contrast to these results from commercial diving cohorts, more recently a number of studies in military or recreational SCUBA divers using air or nitrox reported no accelerated decline in lung function over time. A study of divers who dive in shallow water using compressed air showed lower mid-expiratory flow at 25% of vital capacity (MEF_{25}) than controls [4]. Another study at 93 United States Navy divers [5] showed higher FVC (12.2%) than predicted and forced expiratory volume in 1 second (FEV_1) 4.3% below predicted values. Years of diving was not significantly related to lung function. In a study on 120 military divers, Najim AH Alewi et al. [6] found that forced expiratory time (FET) was significantly higher in divers than in non-divers. All other pulmonary function tests were found to be lower in divers as compared with non-divers.

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Table 1. Comparison of physiological characteristics of diving group and controls

Parameters	Age [years]	Height [cm]	Weight [kg]	BMI [kg/m^2]	Atopics [%]	Smokers [%]	Smoking index
Divers	35.20 ± 10.050	178.50 ± 8.250	84.30 ± 11.045	25.80 ± 4.600	19.60	25.00	14 (10–21)
Controls	36.40 ± 11.025	177.50 ± 6.750	82.40 ± 10.175	25.70 ± 4.400	18.75	22.92	8 (9–12)
P	NS	NS	NS	NS	NS	NS	NS

Values are means ± standard deviation; only values of smoking index are medians with range. Differences were considered statistically significant at $p < 0.05$. BMI — body mass index; NS — not significant

It can be said that the results of the various studies assessing the consequences of regular underwater dives are contradictory. The influences reported range from insignificant [7] to substantial [8]. The published studies usually include a small number of subjects and are relatively underpowered, so it is necessary to conduct more observational studies to determine the impact of the diving activity on the diver's respiratory function.

The purpose of this paper is to present the results of a comparative study of respiratory function of professional military divers by carrying out a spirometry and to compare the results with the data obtained in non-divers.

MATERIALS AND METHODS

The results of the study of 52 military divers using SCUBA with open-circuit regulators attached to a mouthpiece were analysed. Dives were carried out in small and medium depths, using compressed air as breathing gas. The control group consisted of 48 persons from deck commands with similar physiological characteristics and lifestyle who were not divers and had never been under increased pressure. The lung function was assessed with a spirometer (Cosmed-Pony FX, Italy). Measurements were performed in accordance with the recommendations of the American Thoracic Society and European Respiratory Society (ATS/ /ERS, 2005) [9]. The following indicators were analysed:

- forced vital capacity (FVC);
- forced expiratory volume in 1 second (FEV_1);
- peak expiratory flow (PEF);
- forced expiratory flow (FEF), also known as mid-expiratory flow (MEF); the rates at 25%, 50% and 75% FVC;
- forced expiratory flow between 25% and 75% (FEF_{25-75}), MEF_{25-75};
- FEV_1/FVC ratio, also called Tiffeneau-Pinelli index;
- FEF_{25-75}/FVC ratio.

We took into account the smoking rates among the divers, because it is a proven risk factor of developing chronic obstructive pulmonary disease (COPD) [10]. The smoking index is an empirically established indicator that shows the relationship between smoking rates and the likelihood of developing COPD. It is calculated by multiplying the number of cigarettes smoked per day by the smoking years and dividing the resulting number to 20. If the smoking index is higher than 10, there is a high risk of developing COPD.

The statistical analysis was performed using the IBM SPSS Statistics Version 25 software package. The characteristics of the groups are presented as means values standard deviation (M ± SD).

The total length of service of the divers was 10.2 ± 2.500 (range 5–16) years. Underwater experience: the total number of hours under water was 2028.50 ± 358.750 (range 500–3500), average depth of dives was 13.75 ± 0.575 (range 12–16) metres, and maximum depth of dives was 39.50 ± 8.250 (range 30–60) metres.

The study groups were not statistically significantly different in age, height, body weight, percentage of smokers and the smoking index, or the proportion of subjects with a history of atopy (Table 1). Differences were considered statistically significant at $p < 0.05$.

ETHICAL CONSIDERATIONS

Throughout the research processes we have observed the ethical principles for medical research involving human subjects of the Declaration of Helsinki.

RESULTS

The absolute values of spirometry parameters of divers and the control group are presented in Table 2. The parameters in percentage of the predicted values are presented in Table 3.

For 3 divers Tiffeneau's index did not reach 70%, although they showed FEV_1 values above 100% of the predicted values. These divers underwent additional medical tests to reject the presence of bronchial obstruction. There were no such cases in the control group.

DISCUSSION

Forced vital capacity, expressed both in absolute values and in percentage of predicted values, was higher for the divers compared to controls. Differences in volume parameters (FEV_1 and PEF) were not found, but the other flow parameters (MEF_{50}, MEF_{25}, FEF_{25-75}) were higher in subjects in the control group. Also, the FEV_1/FVC and FEF_{25-75}/FVC ratios were higher in the control group. Recent research

Table 2. Values of the parameters of the divers and the control group

Parameters	Divers	Control group	p
FVC [L]	5.7 ± 0.820	5.3 ± 0.710	0.02
FEV_1 [L]	4.3 ± 0.630	4.3 ± 0.705	NS
PEF [L/s]	10.0 ± 1.840	9.9 ± 1.720	NS
MEF_{75} [L/s]	7.8 ± 1.480	8.5 ± 1.620	0.05
MEF_{50} [L/s]	4.3 ± 1.280	4.9 ± 1. 320	0.04
MEF_{25} [L/s]	1.4 ± 0.560	1.8 ± 0.610	0.01
FEF_{25-75} [L/s]	3.5 ± 0.950	4.0 ± 1.050	0.01
FEV_1/FVC	0.78 ± 0.060	0.82 ± 0.040	0.002
FEF_{25-75}/FVC	0.66 ± 0.190	0.80 ± 0.160	0.001

Values are means ± standard deviation. Differences were considered statistically significant at $p < 0.05$; NS — not significant; FVC — forced vital capacity; FEV_1 — forced expiratory volume in 1 second; PEF — peak expiratory flow; MEF — mid-expiratory flow; FEF — forced expiratory flow; FEF_{25-75} — forced expiratory flow between 25% and 75%

Table 3. Values of the parameters of the divers and the control group in percentage of the predicted values

Parameters	Divers, % of predicted	Control group, % of predicted	p
FVC [L]	113.2 ± 16.110	105.6 ± 9.050	0.03
FEV_1 [L]	105.3 ± 13.960	105.8 ± 11.870	NS
PEF [L/s]	107.1 ± 11.750	102.9 ± 10.660	NS
MEF_{75} [L/s]	98.5 ± 14.120	102.0 ± 13.640	NS
MEF_{50} [L/s]	83.4 ± 9.650	93.4 ± 10.110	0.04
MEF_{25} [L/s]	58.2 ± 8.780	75.7 ± 9.020	0.002
FEF_{25-75} [L/s]	77.4 ± 10.980	87.4 ± 11.450	0.02

Values are means ± standard deviation. Differences were considered statistically significant at $p < 0.05$; NS — not significant; FVC — forced vital capacity; FEV_1 — forced expiratory volume in 1 second; PEF — peak expiratory flow; MEF — mid-expiratory flow; FEF — forced expiratory flow; FEF_{25-75} — forced expiratory flow between 25% and 75%

suggests that FEF_{25-75} or FEF_{25-50} may be a more sensitive parameter than FEV_1 in the detection of obstructive small airway disease [11, 12]. The data we have obtained show similar results.

There are many factors accompanying diving that are capable of causing an adverse effect on the respiratory system and numerous physical and chemical changes. Stringent medical requirements for the health of military divers lead to better functional reserves and adaptive capabilities of this category of persons. On the other hand, higher environmental pressures, higher density of breathing mixture, hyperoxia, and decompression stress are most important factors. Moreover, diving is associated with development of early airway hyperresponsiveness in atopic subjects [13]. Under the influence of these stressors there are significant changes in the mechanics of breathing, pulmonary circulation and the respiratory drive, aimed at maintaining an adequate gas exchange under hyperbaric conditions.

Frequent diving can result in persistent long-term changes from the respiratory organs [14]. The results of various studies on the impact of regular underwater diving are controversial. Skogstad suggest that diving has contributed to the reduction in lung function [15]. However, the analysis of literature data suggests that professional divers may notice certain changes in external breathing, which result in an increase in static pulmonary volumes and a moderate reduction in forced expiratory volumes [8, 14]. We found a small increase in the FVC without a proportional increase in the speed indicators ($MEF_{25, 50, 75}$ and FEF_{25-75}).

The causes and mechanisms of development of the described changes, as well as their physiological significance, remain unclear. The obstructive type of imbalance between vital capacity and FEV_1 can be determined by the inborn characteristics of the divers, as well as unfavourable environmental factors. Some studies have demonstrated that these changes are associated with bronchial hyperreactivity and are likely to play a role in the development of bronchial asthma and COPD [16].

The hyperoxia, decompression gas bubbles, hypothermia, which accompanies diving activity are able to initiate damage of the airways and pulmonary parenchyma. When using an open-circuit diving regulators, the mouth-breathing of dry, cold, compressed air can irritate the airways and provoke further damage of the airway epithelium and changes in airway wall structure and function [17]. An increase in bronchial susceptibility to bronchoconstrictive factors during diving [13], as well as the rapid rate of decrease in FEV_1 and FEF_{25-75} in divers, also shown in dynamic observation [15], confirm these findings.

CONCLUSIONS

Hyperoxia, gas decompression bubbles, hypothermia, mouth-breathing of dry, cold, compressed air, and other factors accompanying the diving activity are capable of initiating damage to the airways, which is reflected in characteristic changes in spirometry. The pattern of these changes is consistent with small airway obstruction and they could be related mostly to diving activities.

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SHORT COMMUNICATION

Malaria vaccine for travellers — where are we now?

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ABSTRACT

The authors present a short summary of the current state of malaria vaccine development and the perspectives for the availability of a malaria vaccines for travellers from non-endemic countries. There is currently no commercially available malaria vaccine for travellers. The efficacy of the RTS,S/AS01 vaccine is limited and differs dramatically from the effects of other vaccines administered in travel medicine. In the current recommendations, the use of repellents is deemed the most important measure to prevent malaria infection, and in the high-risk destinations, chemoprophylaxis is strongly advised. Many questions in malaria vaccinology remain unanswered.

(Int Marit Health 2019; 70, 1: 65–67)

Key words: malaria, communicable disease control, protozoan vaccines, travel-related illness

INTRODUCTION

Malaria is a parasitic, vector-borne disease transmitted mainly through the bites of *Anopheles* mosquitoes. There are five species of the *Plasmodium* parasite that can infect humans — *P. falciparum, P. vivax, P. ovale, P. malariae* and *P. knowlesi*. The first one, *Plasmodium falciparum,* is known to be the most serious cause of malaria morbidity and mortality concentrated in sub-Saharan Africa, where limited access to medical services and poor living conditions contribute to intense malaria transmission [1, 2].

The individual susceptibility to the disease varies, depending on the age and the natural immunity acquired as a result of repeated episodes of malaria infection. Young children and non-immune population (e.g. travellers) are at risk of the most severe forms of the disease. The mechanism of this progressive protection against malaria infection is not fully understood [2].

According to the World Malaria Report 2018, there were 219 million cases of malaria worldwide and 435,000 deaths in 2017. Ninety-two per cent of malaria infections and 93% deaths occurred in the World Health Organisation (WHO) African Region. Children under the age of 5 years are the most affected group. The number of malaria infections declined between 2010 and 2015, but no significant reduction was noted thereafter, and 10 African countries reported an increase in the incidence rate of malaria [3].

The United Nations (UN) Millennium Development Goals were adopted in September 2000 and signed by 191 UN members. Among the 8 Development Goals, three of them aimed for combating malaria along with reducing child and maternal mortality. These ambitious goals were to be achieved by 2015 [4]. The declaration has been followed by the *Global Technical Strategy for Malaria 2016–2030* and *Action and Investment to defeat Malaria 2016–2030 — for a malaria-free world* [5].

KEY INTERVENTIONS

The success in the reduction of number of malaria cases has been attributed to the application of the so-called key interventions. In many African countries, the implemented malaria control programmes of proven efficacy have relied on:
- LLINs — use of long-lasting insecticidal bed nets;
- IRS — indoor residual spraying;
- RDTs — rapid diagnostic tests;
- ACTs — artemisinin combination therapies [2].

In some African settings, a fifth strategy has been involved, SMC — seasonal malaria chemoprevention with the administration of full course of malaria treatment to young children at monthly intervals during malaria season [6]. Although individual protective measures against mosquito bites the improvement in diagnosis and treatment of malaria

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prove to be very efficient, the eradication of the disease seems to be unachievable without a vaccine [7].

MALARIA VACCINE CANDIDATES

Plasmodium parasite is a complex eukaryotic organism and has a complicated life cycle involving two hosts: mosquito and human. More than 30 *Plasmodium falciparum* vaccines are in development [8] and one has completed Phase III clinical testing. *Plasmodium vivax* is only distantly related to *P. falciparum* and has a different biology; only two subunit vaccines have reached clinical trials [1].

Currently investigated malaria vaccine candidates are designed as pre-erythrocytic vaccines: whole sporozoite and liver-stage subunit, blood-stage vaccines and transmission-blocking vaccines.

The whole sporozoite vaccine (WSV) strategy has demonstrated high level of protection and includes administration of live-attenuated sporozoites or live sporozoites accompanied with antimalarial drugs. This approach aims to prevent the blood-stage infection. The first whole sporozoite vaccine contained radiation-attenuated parasites (PfSPZ Vaccine) and relied on intravenous administration with subsequent eliciting of potent immunity in humans. Cytotoxic CD8+ T cells response is the main immune mechanism responsible for sterile protection after WSV administration [9]. The first clinical trial using genetically modified *Plasmodium* (GAP) is promising; the parasite used lacks two genes required for breakthrough infection [9].

Liver-stage subunit vaccine focuses on identifying antigens on parasitized hepatocytes resulting in their destruction. Vaccination should generate strong CD8 + T cell response against infected liver cells. Phase 2b field trial provided 20–25% sterile protection against controlled human malaria infection [10].

Blood-stage vaccines are based on merozoite antigens and inducing antibodies that block erythrocyte invasion. Production of a broad spectrum of antibodies against merozoites and infected erythrocytes induces naturally acquired immunity to malaria infection [9].

Transmission-blocking vaccines are designed to impact the parasite's life cycle in the mosquito and not in the human body to prevent its further transmission [9]. These approaches focus on protection of the community and impact on public health than on individuals herd immunity.

THE RTS,S/AS01 VACCINE

The most advanced vaccine is composed of the repeat region of circumsporozoite protein (CSP) added to the hepatitis B virus surface antigen (HBsAg) and AS01 adjuvant, leading to the induction of high level of human immunity (antibody titres) [7, 9]. In July 2015, the RTS,S/AS01 vaccine marketed by GlaxoSmithKline under the brand Mosquirix€ was the first and so far the only one to receive a positive regulatory assessment issued by the European Medicines Agency [11]. The vaccine belongs to the sporozoite subunit vaccine (pre-erythrocytic) group.

A phase 3 trial involved 15,460 children in 7 sub-Saharan countries. All children received three doses of immunisation at 1-month intervals and were divided in two age groups: infants aged 6–12 weeks and young children aged 5–17 months. The fourth dose was administered after 18–20 months. The RTS,S/AS01 trial began in 2009 and has recently been completed [2].

During over 48 months of follow-up, the efficacy of RTS,S/AS01 was estimated to be 36.3% in older group after four doses of immunisation and 28.3% after three doses. The observation period for infants was shorter; during over 38 months of follow-up, the protection against clinical malaria was assessed to be 25.9% after four doses and 18.3% after three doses [12]. Thus, the efficacy is moderate in the group of older children, but it is not sufficient in infants to encourage further studies.

The RTS,S/AS01 was generally well tolerated in the trials, with typical side effects similar to other established childhood vaccines. Among older children, an increased risk of febrile seizures was identified, albeit without any serious consequences of these episodes [2]. There were also 16 cases of meningitis with 8 deaths and cerebral malaria cases, only in the older children group. A clear link between meningitis or cerebral malaria and administration of the RTS,S/AS01 remains unconfirmed and needs to be evaluated in pilot study that has begun in Africa [2].

The level of protection depends on the antibody titre against sporozoite surface and wanes over time [12, 13].

The major limitations of the RTS,S/AS01 vaccine include only moderate level of protection, the number of doses to maintain the efficacy (high antibody titres), the delivery system in the African countries, the cost of vaccine, the probable interference with the maternally acquired antibodies against *Plasmodium*, the side effects and safety issues of the vaccine.

A MALARIA VACCINE FOR TRAVELLERS?

There is currently no commercially available malaria vaccine for travellers. The efficacy of the RTS,S/AS01 vaccine is limited and differs dramatically from the effects of other vaccines administered in travel medicine. For example, the vaccine against yellow fever results in nearly-total immunity within 1 month for 99% of people vaccinated [14]. Other candidates for vaccines against malaria are not similarly advanced in development and clinical trials.

What is the correct prevention for travellers? Currently, the principles of malaria prophylaxis rely on the key interventions, the same ones, as successfully implemented in the endemic regions. The vaccine RTS,S/AS01 has not been designed for and tried in non-immune and adult population. In the current recommendations, the use of repellents has been singled out as the most important measure to prevent malaria infection, and in the high-risk destination, chemoprophylaxis is strongly advised [15].

The vaccine RTS,S/AS01 is only one of the key intervention in malaria endemic countries to preserve health and life of young children. As the sole prophylactic measure, it would not eradicate malaria disease to the year 2030, as it has been planned. Furthermore, without improving the vaccine efficacy, the 2030 goal will be difficult to achieve even with intensive implementation of well-established key interventions.

CONCLUSIONS

Many questions in malaria vaccinology remain unanswered: When will we receive the next-generation vaccine? Can whole sporozoite vaccines be improved or should we rather search for another adjuvants or components? What is the optimal schedule, doses, intervals and timing of booster? Should we include any additional antigens or genes along with the ones currently used or investigated? And should we maybe eliminate any of them? What do we know about human immunity against malaria infection? Does the level of anti-CSP truly correspond to the efficacy of vaccine RTS,S/AS01? Will there be anything in the future that we could offer for the travellers wishing to be immunised? Does immunity maternally acquired confer with antibodies induced by vaccination? Should we expect a rebound in malaria morbidity as a result of key interventions failures (resistance of mosquitoes to repellents and insecticides, spreading of resistance to artemisinin in the parasite's populations)?

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VIA MEDICA

ORIGINAL ARTICLE

Food safety on board tankers. Results of analysis from 'Healthy Ship' project

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ABSTRACT

Background: *Microbiological monitoring of surfaces used for food preparation, as required by the Hazard Analysis and Critical Control Points (HACCP) plan, is important in risky conditions as those observed in the kitchens of ships. Limits to introduce a classification of risk levels and methods to adopt in conditions as those occurring in tankers have not been investigated. This paper presents the results of the "Healthy Ship" project on HACCP monitoring of surfaces used in food preparation on Italian flag tankers.*

Materials and methods: *Microbiological monitoring was carried out on 19 tankers between 2013 and 2017. Food handlers were also trained on board ship according to HACCP standards. Contact plates (ISO 18593:2004 compliant) were used to determine the colonies and bacterial charge according to the Wirtanen and Salo's method.*

Results: *A total of 1074 samples, 108 before the first course, 168 after the first course, 390 during the period of refresher (2015–2016), and 408 after the refresher training, were obtained from the three main kitchen surfaces: the worktop, cutting board, and kitchen sink. A good level of hygiene was observed in 56.9% of all samples, 0.1% were classified as adequate, and the remaining 43% as poor. The highest contamination was observed on the cutting board and kitchen sink and involved the total aerobic count. The only surface with inadequate levels of hygiene was the worktop. A reduction of contaminated samples was noted after training.*

Conclusions: *Our results suggest that continuous training should be provided for personnel responsible for handling foodstuffs on board ships.*

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Key words: microbiological surveillance, food-handling, seafarers, HACCP, food hygiene, food safety

INTRODUCTION

Food contamination can be attributed to natural contamination from raw materials (primary contamination) or to cross-contamination caused by the transfer of microorganisms from contaminated surfaces or vehicles (such as water, air, etc.) onto food. Appropriate standards of hygiene in the environment where food is prepared, such as surfaces, types of equipment and utensils are essential to prevent microbial contamination and to obtain safer food [1]. In the last decade, this topic has stimulated research to develop surfaces with antimicrobial activity [2–4].

This problem is more relevant in conditions characterised by a higher level of risk such as kitchens on board ships, and, in particular, the kitchens of cargo ships. Merchant (cargo) ships do not carry health professionals, may be involved in long journeys and seafarers work in an enclosed environment. Despite the low number of crew-members working and living on a cargo ship, seafarers are exposed to quite a high risk of infection [5–13]. To minimise the risk of infection and food poisoning in a closed environment such as the one found on a cargo-ship, ensuring microbiological safety in the kitchen should be a priority.

Taking into account that gastrointestinal disorders are at the first or second place as problems affecting seafarers healthy, the Centro Internazionale Radio Medico (CIRM) has

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launched a project called “Healthy Ship”. This project includes a series of preventive measures aimed at protecting seafarers’ health as a survey on the knowledge of seafarers about food hygiene, and a panel of interventions to improve the quality and the control of food and water distributed on board [13–18]. CIRM is the Italian Telemedical Maritime Assistance Service (TMAS) and represents the Centre with the largest worldwide experience [10, 12, 19]. This project included periodic training of galley’s personnel and periodic on board inspections.

The present work reports the results of microbiological monitoring on the kitchen surfaces of cargo merchant ships before and after the seafarers training and suggests a new procedure for storing samples. Analysis started on August 2013 and was concluded in October 2017.

MATERIALS AND METHODS

MICROBIOLOGICAL MONITORING

Analysis of the microbiological safety of kitchens and of the compliance with good production practices was performed by a direct on board inspections done between August 2013 and October 2017, on tankers belonging to two shipping companies. Monitoring was carried out twice a year (frequency of 6/7 months) by medical and technical CIRM personnel on 19 ships, when they were docked. Ships were tankers shuttling service from not more than 6 years from the date of enrolment in the project. They were sailing from 7 to 10 days. Origin and destination were in the Mediterranean and in the Black sea. The “Healthy Ship” project established a training course on Hygiene and Sanitation for Ship’s Messman and Stewards on the main rules of conduct and correct handling of foodstuffs foreseen by the Hazard Analysis and Critical Control Points (HACCP) plan on board ship as prevention of food-borne disease, HACCP and self-assessment, the HACCP principles and the keywords of the HACCP, food hygiene, personal hygiene, storage and labelling of leftovers. Courses were made by ship first officers, properly trained by the Hygiene group of the School of Pharmacy of Camerino University. Training lasted 1 week and was accompanied by a final exam, and the Italian Ministry of Health authorized the program. In 2013, a preliminary monitoring was carried out to supervise of the hygienic level of the kitchen of cargo ships, and subsequently, the topics and the level of training were established (for the “Hygiene and Sanitation for Ship’s Messman and Stewards” course). After the first training started in 2014, refresher training has been conducted between 2015 and 2016 only in the ships that have shown a negative trend of monitoring. The refresher training of personnel in each cargo ships has been conducted during different periods of this biennium, according to the availability of the ship in the port. Critical kitchen surfaces as sink, worktop and cutting boards were tested. These surfaces were chosen because the kitchens of ships are quite small and have few utensils or surfaces. It is impossible to identify different rooms to separate various levels of food processing as, for instance, the ‘clean room’ and the ‘dirty room’. Food-handlers often manipulate food on the same surfaces, and for this reason we think it is necessary to monitor frequently used utensils or surfaces. The cutting board is a critical utensil because it is often used to cut clean and dirty foods as well as raw and cooked foods and is a critical point for cross-contamination. This study was carried out by monitoring kitchen surfaces with BIOLIFE contact plates with a diameter of 60 mm and a contact surface of 25 cm^2 (ISO 18593:2004) [20]. The plates used included a Contact Plate Count Agar for identifying total aerobic bacteria (at 30°C), a contact plate Violet Red Bile Agar to evaluate the number of coliforms (*Escherichia coli*) (at 37°C) and a contact plate Sabouraud Dextrose Agar to count the total fungal load (at 25°C) [21]. The sampling procedure applied was a development of the contact plate method. A contact plate filled with a suitable medium is pressed against the surface to be tested, avoiding lateral movements. The contact time was 10 s and a pressure obtained with a 500 g mass was applied onto surface. For each sampling point, a single contact plate agar surface specific for the test under examination, and a negative control was performed. Generally, the plates are incubated immediately after sampling. In order to analyse samples obtained on board ships, it is necessary to transport them from the ship to the laboratory. This may take days, depending on the ship’s port of call. For this reason, the plates were stored at 4°C and incubated after their arrival in the laboratory. To check if the above method was suitable, a validation procedure was performed.

METHOD VALIDATION

Before monitoring kitchen surfaces on board, the sampling procedure, using contact plates, was repeated 6 times, in duplicate, in the Hygiene Laboratory of Camerino University, to verify its implementation. For each replication a plate was incubated immediately after the sampling, other plates were incubated at 4°C after storage periods (24, 48, 72, 96 h), and then incubated to count the number of Colony Forming Units on 20 cm^2 (CFU/20 cm^2). Total aerobic count, coliforms and fungal charge were tested independently. The data were transformed using Log10 and then over-dispersion and repeatability limits were calculated. Each test might be affected by casual errors caused by the way the samples were obtained, the temperature of incubation, the number of colonies, etc. The sum of these errors adds an additional dispersion of results, namely over-dispersion. This value is then added to the dispersion of the Poisson distribution. The

Table 1. Limits for coliforms (*E. coli*), aerobic bacteria count and fungi, yeast and moulds proposed by Wirtanen and Salo [17]

Strict	Coliforms (*Escherichia coli*) CFU/20 cm^2	Aerobic bacteria count CFU/20 cm^2	Fungi, moulds and yeast CFU/20 cm^2
Good quality	< 1	Up to 15	Up to 1
Adequate or not recommended	< 1	15–50	1–20
Poor	≥ 1	> 50	> 20

CFU/20 cm^2 — Colony Forming Units on 20 cm^2

method could be considered valid if over-dispersion does not statistically modify the theoretical dispersion of Poisson data.

The statistical analysis was conducted using the formula:

$$\chi^2_{n-1} = \frac{\sum_{i=1}^{n}\left(c_i - \bar{c}\right)^2}{\bar{c}}$$

where n is equal to number of observations, c_i is the value given to each observation and $\bar{c}$ is the mathematical average of observations.

The data distribution was evaluated in agreement with the theoretical Poisson distribution if: (χ^2 experimental) ≤ χ^2_{n-1} theoretical (with n-1 degrees of freedom, p ≥ 0.95).

No significant differences were noticeable in the CFU/20 cm^2 results between plates incubated immediately after contact if stored at 4°C. The method resulted was valid, and in particular: the test of aerobic bacteria count by a χ^2 of 1.90 ≤ χ^2 theoretical of 11.071 (n = 6; p ≥ 0.95), the test for coliforms (*Escherichia coli*) by a χ^2 of 2.144 ≤ χ^2 theoretical of 11.071 (n = 6; p ≥ 0.95). The test for Enterococci by a χ^2 of 1.903 ≤ χ^2 theoretical of 11.071 (n = 6; p ≥ 0.95) and the test for fungal by a χ^2 of 3.687 ≤ χ^2 theoretical of 11.071 (n = 6; p ≥ 0.95).

HYGIENE CLASSIFICATION LEVEL

Lacking an international classification, in this study, the hygiene level of the kitchen on board was categorized into classes of risk and consequently hygiene levels, applying the classification proposed by Wirtanen and Salo [17]. This method was based on three different scales and has three different levels of judgment for contact surfaces. The three scales in relation to the hazard level are loose, normal and strict. Levels are good (A), adequate (B) and poor (C). The limits for coliforms (*Escherichia coli*), aerobic bacteria count (37°C) and fungi, yeast and moulds are summarised in Table 1.

STATISTICAL ANALYSIS

The results obtained for each parameter (Enterococci, *Escherichia coli*, total aerobic bacteria count at 37°C, and total fungal charge) monitored were processed using a descriptive statistical analysis, the Shapiro-Wilk test for non-normality, and the Paired Student's t test using XLSTAT Software [22]. In the Shapiro-Wilk test, if the data showed a p-value > α, the null hypothesis (H0) could be accepted, and therefore the distribution resulted as normal [23].

To analyse the efficacy of training, the results obtained from the monitoring process conducted in the first visit and after the refresher training were compared using the Paired Student's t test. The variables on which the Paired Student's t test was based are shown by the number of colonies found, both before and after the safety inspection was conducted, relative to aerobic bacteria count, coliforms, Enterococci and fungal load, and the p-values at 95% confidence interval were measured.

RESULTS

During the 4 years spent monitoring 19 ships, 1074 microbiological samples, 108 before the first course, 168 after the first course, 390 during the period of refresher (2015–2016), and 408 after the refresher training, from the three most critical surfaces (worktop, cutting board and kitchen sink) were collected and analysed.

When examining the percentage of positive samples over time, we noted a similar trend for all species monitored, and a decreasing of the positive samples percentage after the refresher training completed in 2016 (Fig. 1).

Among the total (1074) microbiological samples examined, a good level of hygiene was reported for the 56.9% of surfaces, 0.1% was classified as adequate and 43% as poor. In particular, after the first course, and before the refresher, the percentage of positive samples was 39.1%; while after the refresher the number of positive samples was reduced to a percentage of 28.6%.

This suggests that the development of the microbiological charge until 2016 is related with the lack of respect for good procedures by food handlers.

The results on surfaces classified as good, adequate and poor reported in percentage for each single surface are summarised in Figure 2.

Figure 2 shows that the "good level" is the level registered with the highest frequency for all microbiological parameter. An adequate level for aerobic bacteria counting was found only in a worktop sample, during the first inspection in 2013. In particular, the total aerobic count recorded

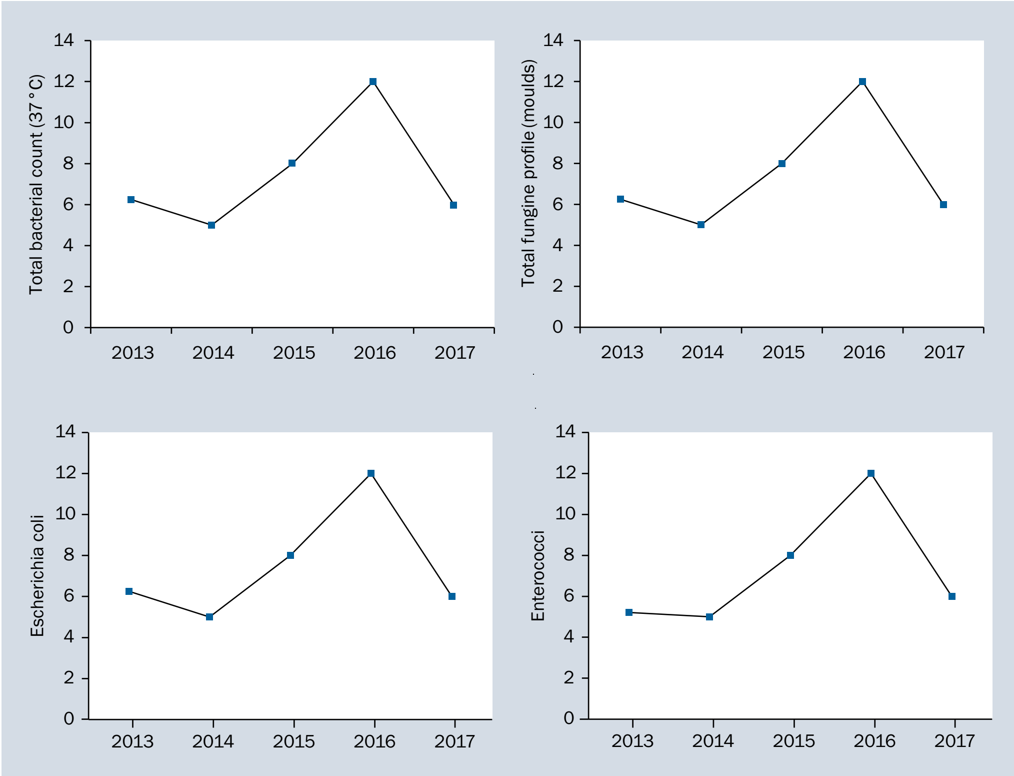

Figure 1. Percentage of positive samples in the years of monitoring

in this sample was 25 CFU/20 cm^2, inside the range of 15 and 50 CFU/20 cm^2, defined as an adequate level. Considering the surfaces classified as poor, the cutting board was recorded as the surface with the highest percentage of positive samples by fungal, *Escherichia coli*, and aerobic bacteria count. Whereas, the enterococci were recorded with the lowest percentage, but values were similar to the other microorganisms recorded.

In all tankers, a reduction in the frequency of positive samples was found. In fact, by evaluating the positivity or negativity of samples, a ratio of 0.5 (50%) between poor and good samples in all ships was detected. Only one ship showed a ratio equal to 0.8 (80%) among samples.

To test the effects of training, the average of the colony-forming units in the first sampling (year 2013) was compared with the average of colony-forming units detected in sampling after doing the refresher course (2017). As expected, the monitored surfaces in the first sample showed a CFUs concentration over the limits. In the second sample, the concentration of CFUs was within limits, with a higher than 99% reduction for all surfaces. Different levels of contamination were found among surfaces. The kitchen sink and the cutting-board had the highest contamination levels of total bacteria count at 37 °C. The worktop was contaminated too, but showed a lower concentration of microorganisms. When considering the microorganisms found in a higher frequency, the total bacterial count at 37 °C on all surfaces was the principal cause of microbial contamination (Fig. 3). The total fungal charge showed a similar trend on all surfaces while the Enterococci were found in a higher concentration on the worktop. The highest concentration of *Escherichia coli* was detected on the worktop and on the cutting board (Fig. 3).

Sanitary conditions were positive after seafarers employed in the kitchen underwent a period of training. In fact, after the first surveillance (2013) followed by a negative outcome, a food safety training was conducted and during the second inspection the efficacy of this training was evaluated. After the training was carried out, all surfaces showed a decrease in the level of microbial charge. This result was common for all microorganisms and for all surfaces (Fig. 3). Analysing the percentage of reduction of CFUs between the first surveillance and the surveillance after refresher, the highest percentage of reduction (100%) was noticeable for *Escherichia coli* and Enterococci in all surfaces monitored, whereas a reduction of 97.9% of the total aerobic charge was obtained for the worktop. The distribution resulted as normal and the Student's *t*-test showed the efficacy of the food safety training especially in the reduction of total bacteria count, the principle cause of contamination (Table 2).

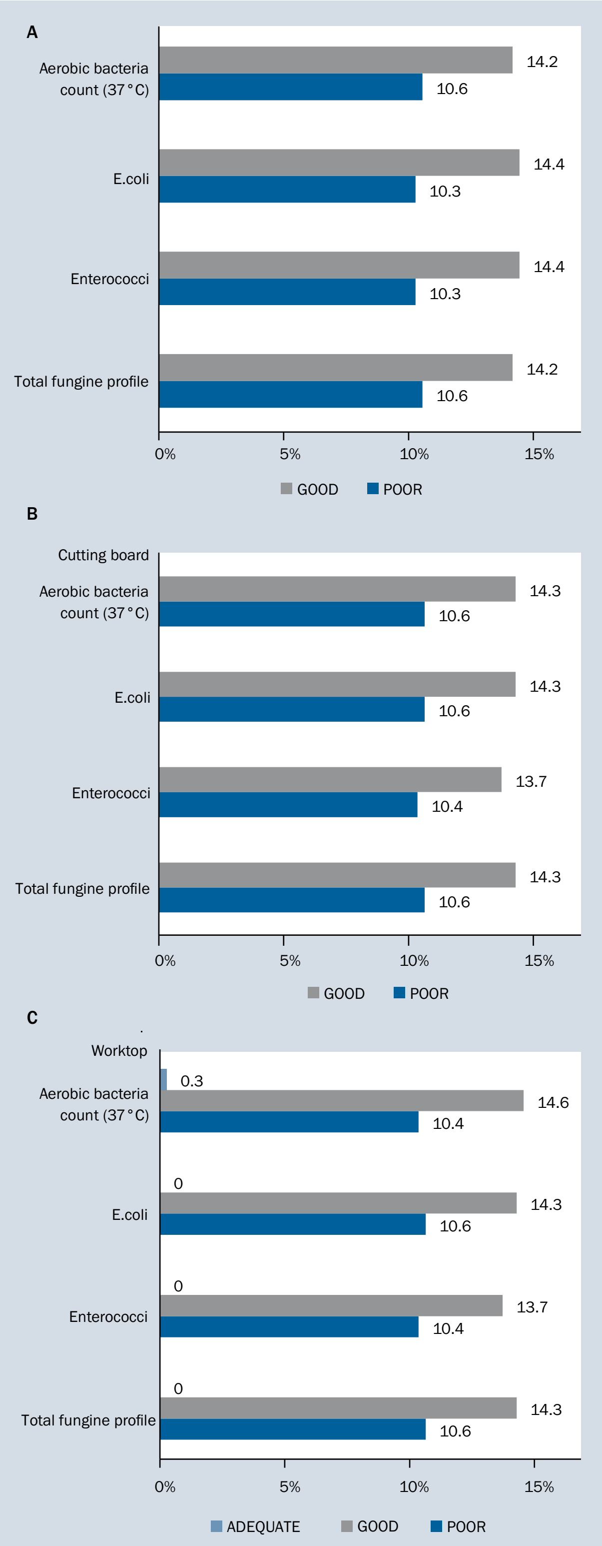

Figure 2. Percentage of surfaces classified as poor, adequate, and good (on 1074 samples): kitchen sink sampled: n = 360 (**A**); cutting board sampled: n = 357 (**B**); work top sampled: n = 357 (**C**)

DISCUSSION

This paper has looked at the procedures applied to identify the level of microbial contamination over all surfaces in contact with food and, in particular, the efficacy of training given to food handlers on board tankers.

In our work, surfaces used in food production on board cargo ships were categorised as strict and not normal or loose, because they are exposed to a high risk of contamination due to the hard conditions on cargo ships [17, 24–30]. In these surfaces, a microbiological survey was conducted to identify the ones which were more susceptible to the risk of contamination. Even if the number of samples increased over time, the decrease in the percentage of contaminated samples showed that the training program on safe food handling on good handling practices (GHP) (surfaces sanitation procedures), followed by continuous inspections on board, ensured surfaces were under control.

In terms of evaluation of the effects of monitoring surfaces initially classed under a "poor" level of hygiene reached an "adequate" level after the second visit. Analysis of the statistical significance value of the Student's t test obtained in correlating the microbiological charge, in particular of total bacterial count (37°C), between the first and second visit showed the positive effect on the hygienic quality of surfaces monitored and allowed the real value of intervention to be evaluated. This result is comparable with similar findings of other researchers that emphasized the importance of training food services staff on board ships [25].

Microbiological surveillance revealed a relevant percentage (43%) of surfaces classified as "poor".

Probably, the bacteria come from the manipulation of foods by food-handlers. In fact, after checking the compliance of the storage temperature of food boarded, and of the cooling room temperature, we have investigated the compliance of sanitisation procedures. As a result, we have found a cleaned cold room, while all the criticalities were observed in the kitchen where the ordinary manipulations of food take place. In particular, the greater contamination was related to total mesophilic aerobic counts. This charge is a standard parameter used to assess the microbiological quality of surfaces used by food-handlers. In particular, an increase of the total mesophilic charge could be caused by the presence of microorganisms transferred by food employees, particularly by using dirty hands.

The presence, on surfaces monitored, of some bacteria such as Enterococci and Gram-negative, such as coliforms (*Escherichia coli*), suggests strengthening the knowledge and procedures relating to the personal hygiene of food-han-

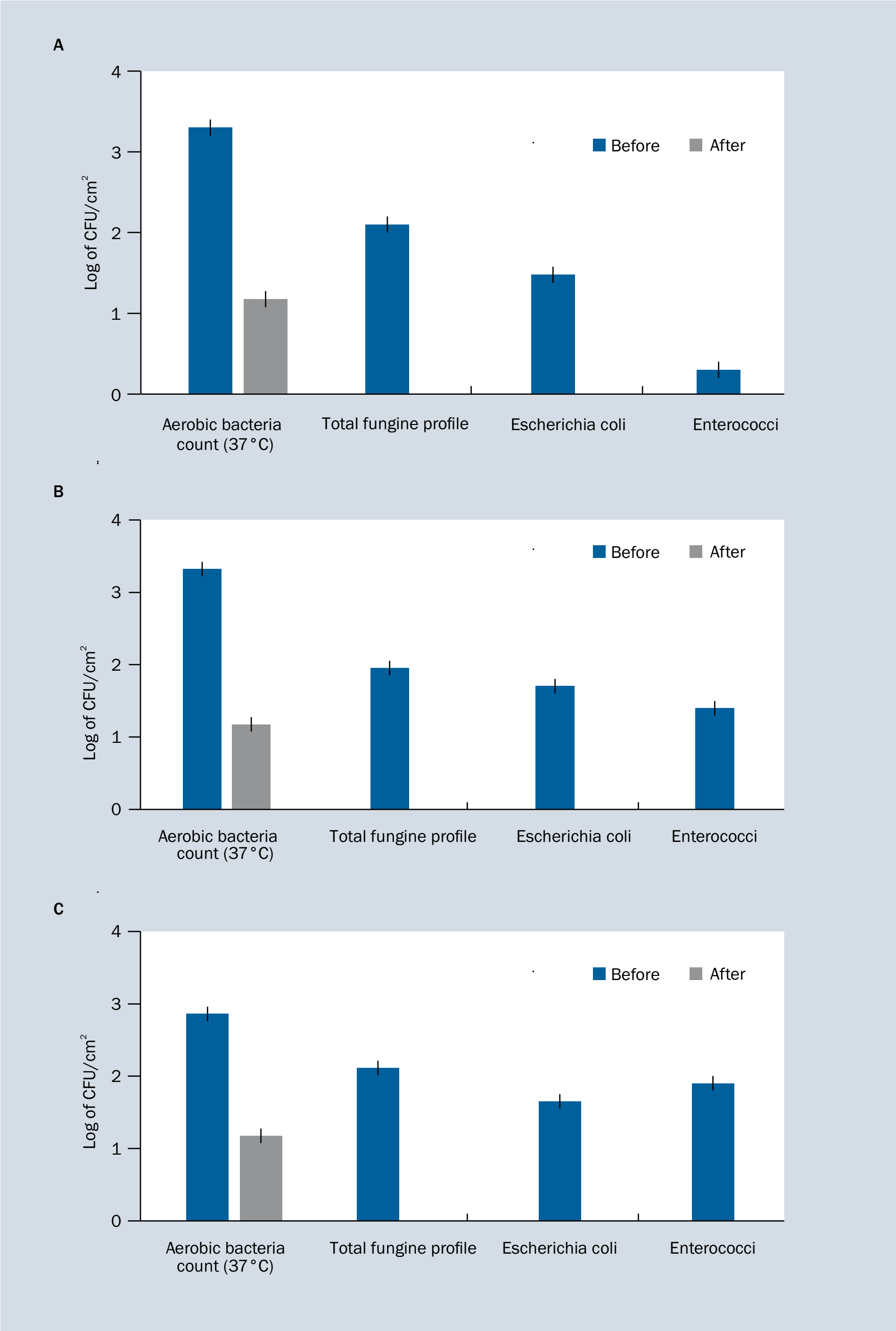

Figure 3. Microbiological charge detected in the first sampling before the first training course, year 2013 (before) and after doing a new refresher course, year 2017 (after); **A.** Kitchen sink sampled: n = 172 (36 before and 136 after); **B.** Cutting board sampled: n = 172 (36 before and 136 after); **C.** Work top sampled: n = 172 (36 before and 136 after); CFU — Colony Forming Units

dlers and their environment [31–33]. Coliforms (*Escherichia coli*), associated with a high aerobic mesophilic bacteria count, revealed a lack in the sanitation procedures because aerobic heterotrophic bacteria are more capable of growing on surfaces enriched by food residuals. For instance, the high contamination recorded on the cutting board with the lack of respect for the GHPs can be explained. The presence of Enterococci, even if detected with a lower number of viable counts than *Escherichia coli*, has been a severe hazard of contamination for the seafarer's health. In fact, Enterococci are common in the environment, and when present in food they can infect people, causing severe infections [34].

Table 2. Paired Student's *t*-test

Sample	P-value: before-refr vs. after-refr	95% confidence interval
Total bacterial count (37°C)	0.00*	1054.58 to 1613.42
Total fungine profile	0.08	–15.78 to 102.45
Escherichia coli	0.05	0.41 to 62.92
Enterococci	0.27	–43.89 to 90.56

*p < 0.05; before-refr — first sampling, before the first training; after-refr — after doing a new refresher course

The sampling of fungi showed they were present in all surfaces monitored. This result suggests the environmental conditions of the kitchen should be further investigated, particularly levels of aeration and damp.

The training of seafarers on HACCP and the constant monitoring practices on board promoted a decrease of microbial positive samples. The ratio of 0.5 (50%) between positive and negative samples collected on cargo ships showed that microbiological surveillance achieved only half the objective. In this respect, we should mention that during the inspections, some unsafe practices such as the production of food in high quantities with consequent storage of leftovers were recorded. In fact, the production of surplus food was closely related to the risk of undercooked food and cross-contamination. Recent studies have shown that even at low temperatures, some bacteria such as Salmonella spp., are able to contaminate meat (poultry), highlighting the risks of consuming undercooked meat [35, 36].

A correct implementation of GHPs within a HACCP plan is the principal practical measure used to stop the spread of cross-contamination. In fact, cross-contamination events were attributed to deficient hygiene practices, contaminated equipment, contamination via food handlers, processing, or inadequate storage, generally a result of poor hygiene [37, 38]. The results of this study suggest checks on board merchant ships should be continued to improve sanitation standards operating procedures (SSOPs) and, finally, to enforce the knowledge of food handlers employed on board. In comparison to other studies [23, 39] that evaluated positive effects after training, in our case constant monitoring allowed critical hygienic conditions to be found.

CONCLUSIONS

Our study suggests that it is necessary to carry out a constant activity of training on food handlers over time to take under control the contamination episodes. The fact that merely introducing a HACCP plan is not sufficient to remove the mishandling of food, but continuous monitoring on board combined with refresher training for the seafarers must be adopted, is an important result of our study, as well as one of its strong points. In fact, only by applying this type of approach it will be possible to keep the hygiene level of kitchens on board ship under control. Furthermore, this research demonstrated the possibility of carrying out microbiological monitoring on board cargo ships docked far away, proposing restrictive limits to classify the hygiene levels of surfaces used for food preparation. However, one limit of this study was given by the restricted number of ships used in the study as well as the difficulty of carrying out continuous monitoring, as is normally done on land, on ships which are often at sea for long periods of time.

It is important to remember that seafarers represent one of the most isolated demographic working groups in the world, with limited access to medical care because they are at sea for days or weeks before ships can reach a port and also are exposed to high physical stress [40–42].

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THE BEST INTERNATIONAL MARITIME HEALTH SCIENTIFIC ARTICLE OF THE YEAR 2018

The "IMH Scientific Article of the Year" recognizes the best and most relevant peer-reviewed, scientific work in maritime medicine and adjacent fields, published in the prior calendar year in the International Maritime Health.

Scientific Committee of five members selects the winner from nominated candidates. Nomination is free to all, including the Scientific Committee itself. The first Scientific Committee was appointed by the IMHF Management Board.

COMMITTEE

The members of the Committee for the 5 years 2018–2023:

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- Dr. Brice Lodde — Laboratoire d'Etudes et de Recherche en Sociologie (LABERS), Sociology, European University of Brittany, Brest, France

NOMINEES

1. Antonio Roberto Abaya, Jose Jaime Lorenzo De Rivera, Saren Roldan, Raymond Sarmiento. Does long-term length of stay on board affect the repatriation rates of seafarers? International Maritime Health 2018; 69(3): 157–162, doi: 10.56.03/IMH.2018.0025. **Two votes**
2. Christopher James Taylor. Gastroenteritis outbreaks on cruise ships: are sanitation inspection scores a true index of risk? International Maritime Health 2018; 69(4): 225–232, doi: 11.5603/IMH.2018.0037. **Two votes**
3. Stephen E. Roberts, Tim Carter. Causes and circumstances of maritime casualties and crew fatalities in British merchant shipping since 1925. International Maritime Health 2018; 69(2): 99–109, doi: 10.5603/IMH.2018.0015.

→

THE WINNER

Two equivalent prizes

1. **Antonio Roberto Abaya, Jose Jaime Lorenzo De Rivera, Saren Roldan, Raymond Sarmiento. Does long-term length of stay on board affect the repatriation rates of seafarers? International Maritime Health 2018; 69(3): 157–162, doi: 10.56.03/IMH.2018.0025.**

Abstract

Background: *The length of seafarers' contract has undergone scrutiny regarding the health, welfare, and fatigue of the crew. This study investigates whether a stay of more than 200 days can increase the risk of medical repatriation among Filipino seafarers.*

Materials and methods: *We reviewed the number of medical repatriations from January 2014 to December 2016, specifically those who were repatriated after more than 200 days on board. We used WHO ICD-10 classification to categorise diseases and medical events that cause the repatriation, and classified them under "Injury" or "Illness" as defined by the Occupational Injury and Illness Classification Manual. We also separated those who worked on cargo vessels as well as those who worked on passenger ships. We requested for the total number of seafarers who worked longer than 200 days on board. After calculating a repatriation rate for this specific group of long-term workers, we then compared this with a previous study. Chi-square analysis and regression analysis were applied to analyse the data comparing the passenger versus cargo ships repatriation rates.*

Results: *There were a total of 840 cases of long-term repatriations in this study for the 3 year period. The total number of crew who had stayed for more than 200 days was 51,830. The different causes of repatriation are presented. Repatriation rates are also shown and a study of the regular stay and long term contracts are also compared.*

Conclusions: *There are various disease entities significantly higher in the long term work group. We offer some possible explanations for some of these differences in repatriation rates. This data could be useful in planning of schedules, work hours and contracts as well as the prevention of disease in seafarers.*

Key words: maritime health, medical repatriation, seafarers

2. **Christopher James Taylor. Gastroenteritis outbreaks on cruise ships: are sanitation inspection scores a true index of risk? International Maritime Health 2018; 69(4): 225–232, doi: 11.5603/IMH.2018.0037.**

Abstract

Background: *The utility of cruise ship sanitation scores as indicators of future gastroenteritis outbreak was investigated by means of a 5-year review of inspection scores and outbreaks of gastroenteritis as reported under the Vessel Sanitation Programme of the United States Public Health Centers for Disease Control.*

Materials and methods: *Between 2012 and 2017 a total of 1197 inspections were published online, with a mean score of 95.7 out of 100. During the same interval there were 50 separate outbreaks of acute gastroenteritis.*

Results: *No significant difference was found between pre-outbreak inspection scores, mean 96.4, and inspections that were not followed by an outbreak, mean 95.1 ($z = 0.81$, $p = 0.42$).*

Conclusions: *This study shows that the current format of the inspection audits carried out under the Vessel Sanitation Programme generates scores that have no prognostic value with regard to future outbreaks of gastroenteritis on board cruise ships.*

Key words: acute gastroenteritis, outbreak, Vessel Sanitation Programme, United States Centres for Disease Control and Prevention, cruise ships, norovirus

CONGRATULATIONS!

ISMH15 – HAMBURG, 12–15 JUNE 2019

SEA, PORT, HEALTH AND ENVIRONMENT

2nd Announcement and further call for abstracts

Dear colleagues,

The upcoming **15th International Symposium on Maritime Health** (**ISMH15**) will be held at HafenCity University Hamburg, Germany, from 12 to 15 June 2019. Three months ahead of the symposium under the title *Sea, Port, Health and Environment*, the preparations are well on track.

To give you an update: we received about 110 abstracts to date which are currently evaluated. Attached you will find an overview of the programme and time schedule. Among others, plenary sessions will be held with respect to cruise medicine, travel medicine, digitalisation as well as environmental aspects of maritime health. About 20 parallel sessions and poster presentations will cover all aspects of maritime medicine and will show the latest research results in the field.

Please note: the deadline for abstract submission has been extended and we will be very happy to receive your contribution to ISMH15 until 24 March 2019! Please submit your abstract online via the conference website: http://ismh15.com/en/submitting-abstracts/. On the website you will find detailed information on abstract format and requirements. All abstracts will be evaluated by the scientific committee of ISMH15. Notification of acceptance will be sent out by end of March 2019.

In addition to the scientific programme, the ISMH15 team also arranged an attractive social program for you including a welcome reception at historic Hamburg Town Hall, a visit and dinner at Hamburg Seaman's Club as well as boat trips through the harbour and city channels and the conference dinner at a traditional rowing club.

Registration for ISMH15 is open and can be made via the conference webpage where you will also find more detailed information and news on ISMH15: http://ismh15.com/en/.

Important dates for ISMH15:

24 March 2019 — Deadline for abstract submission
31 March 2019 — Notification of abstract acceptance
15 April 2019 — Early bird registration ends
31 May 2019 — Regular registration ends
12–15 June 2019 — ISMH15 Conference

We look forward to welcoming you to Hamburg and to your contribution to ISMH15!

Volker Harth
President ISMH15

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 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.).

Reference to books should give the title, names of authors or of editors, publisher, place of publication, and the year.

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

For full information for authors refer to the web page: www.intmarhealth.pl.

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