VIA MEDICA
ORIGINAL PAPER
2015; 66, 2: 61–66
DOI: 10.5603/IMH.2015.0016
www.intmarhealth.pl

ISSN 1641–9251

Risk factors for merchant seafarer repatriation due to injury or illness at sea

Rafael Y. Lefkowitz, Martin D. Slade, Carrie A. Redlich

Yale Occupational and Environmental Medicine Program, New Haven, CT, United States
Department of Medicine, Yale School of Medicine, New Haven, CT, United States

ABSTRACT

Background: *Repatriation represents a serious outcome of illness or injury among seafarers at sea. The aim of this study was to describe repatriation patterns due to injury and illness in a seafarer cohort, and determine risk factors for repatriation.*

Materials and methods: *The study analysed a telemedicine database of 3,921 seafarer injury and illness cases over a 4 year period using descriptive statistics and logistic regression.*

Results: *There were 61 repatriations over the study period (1.6% of cases). Most repatriations were due to illness (38; 62.3%) as opposed to injury (23; 37.7%). Back injuries and gastrointestinal illness were the most frequent causes of repatriations. Using logistic regression, nationality was identified as a significant risk factor for repatriation.*

Conclusions: *This study emphasizes illness as a major cause of seafarer repatriation, and suggests opportunities for future studies to identify potentially modifiable risk factors.*

(Int Marit Health 2015; 66, 2: 61–66)

Key words: epidemiology, occupational health, shipping, telemedicine

INTRODUCTION

Seafarers are an essential workforce, responsible for 90% of global commerce [1]; there are approximately 1.4 million seafarers worldwide [2, 3]. By the nature of their occupation, working seafarers are frequently isolated from professional medical care. For seafarers injured or ill at sea, medical care is administered by the ship's medical officer, a crewmember with mainly non-medical duties and often minimal medical training. Although mandated to have a medical chest with certain recommended components, in practice, available medications and supplies may be limited. Crew size on merchant cargo vessels is approximately 20 seafarers per ship, with roughly equivalent numbers of deck and engine crew as well as 1 to 3 galley (food service) crew members. With ships frequently undermanned [4], lost work due to health problems may contribute to increased demands on other crew members [5]. This is particularly true if the injured or ill seafarer must be repatriated [6].

Repatriation is the process by which a seafarer is returned to his or her home country or an agreed-upon destination. A shipowner must repatriate a seafarer for several defined conditions aside from medical necessity, including at the end of a contract, following a shipwreck, when a shipowner does not meet contractual agreements, if a vessel is war zone-bound without a seafarer's consent, and certain other limited conditions. Repatriating a seafarer includes all costs of transportation, food and lodging along the way, wages covering the time of travel, transportation of luggage, and related medical treatment until the seafarer is deemed fit for travel [7].

In considering the impact of medical repatriation, a repatriated seafarer suffers a serious illness or injury and additionally loses work as a consequence. Ship owners, responsible for their seafarer's medical care [8], bear the high financial cost of the precipitant medical condition as well as indirect costs including evacuations (for example, by

Rafael Y. Lefkowitz, MD MPH, Yale Occupational and Environmental Medicine, 135 College Street #366, New Haven, CT, 06515, USA, e-mail: rafael.lefkowitz@yale.edu

airlift or speedboat), diversions, and if needed, repatriations [7, 9]. It is estimated that seafarer medical conditions cost over $1 billion (760 million in 2013 Euro) to the shipping industry, mainly costs of evacuations and vessel diversions [10], often resulting in repatriation. Repatriation is therefore a significant endpoint representing severe injury or illness at sea, resulting in high costs of care (direct and indirect), and an important target for preventive efforts.

Previous studies have described repatriation events in merchant seafarers to a limited extent [6, 11, 12]. In this study, we describe injury, illness, and subsequent repatriation in a merchant seafarer cohort, and identify risk factors for repatriation.

MATERIALS AND METHODS

STUDY DESIGN AND POPULATION

The data source was the database of Future Care, Inc., a company that manages the health of seafarers globally and provides telemedicine services. This company maintains records of medical illness and injury that occur on contracted ships at sea, with data collected and entered by telemedicine case managers. As in our previous study [13] we utilised data for merchant seafarers aged 18 to 80, during the 4 year period of 2008–2011, on merchant vessels. This study was approved by Yale Institutional Review Board.

Data variables included seafarer age, job, nationality, sex, case type (injury or illness), diagnostic information (injured body part, type of illness), work status, and repatriation status (repatriated/not repatriated). Seafarer jobs were classified by the worksite (deck, engine room, and galley) as well as rank (officers or ratings), to allow comparison with previous seafarer studies [12, 14, 15]. The injured body part and illness types as listed in the database were classified into more general categories by the authors. For example, injuries of the foot, knee, or hip were grouped into the injury site category of "lower extremity". The overall distribution of specific injured body parts and illness types was determined. Frequency of illness and injury cases was stratified by age group, sex, nationality, worksite, rank, and repatriation status.

STATISTICAL ANALYSIS

Fisher's exact test was used to test for associations between categorial variables and repatriation status. The z-test for proportions was used to determine if proportions were significantly different [16]. Student's t-test was used to compare means. Unadjusted as well as 2 adjusted logistic regression models (full and parsimonious) were used to model odds of repatriation after injury or illness events. The parsimonious model was developed by initially including all variables (age, sex, job, nationality, and all 2-way interaction terms). The parsimonious analysis used a backward elimination strategy, with a limit of $p \leq 0.05$ for inclusion in the model. All data analyses were performed using SAS version 9.4 (Copyright SAS Institute Inc., Cary, NC, USA).

RESULTS

The study population included 3,921 seafarer cases of injury or illness at sea (Table 1). There were 1,157 (29.5%) injury cases and 2,764 (70.5%) illness cases. Of these cases, 61 (1.6%) resulted in repatriation. The mean age for repatriated seafarers (36.9 ± 10.7) was not statistically different from non-repatriated (39.0 ± 11.4). Among seafarers with repatriations, repatriations were more frequently due to illness (38; 62.3%) than injury (23; 37.7%). There were no significant differences in rates of repatriation by age, sex, rank, or worksite. However, there were significant differences by nationality; Indian seafarers had a significantly higher repatriation rate compared to Filipinos (2.1% vs. 0.8%, $p = 0.01$).

The distributions of types of injuries and illnesses for the seafarers and the repatriated subpopulation are shown (Figs. 1, 2). Back injuries were disproportionally more common among repatriated seafarers (35% vs. 18%, $p = 0.04$). When examined by type of illness, seafarers with gastrointestinal (34% vs. 16%, $p = 0.004$) and psychiatric (5% vs. 0.6%, $p = 0.001$) illness were more common among repatriated cases.

Logistic regression modelling was used to identify potential risk factors for repatriation due to medical illness or injury (Table 2). In final analysis, the demographic variable sex was not included in the model due to low numbers among women (only 1 female seafarer repatriated). Both the unadjusted and the parsimonious model adjusted for age, nationality, worksite, rank, and 2-way interaction terms revealed only nationality as a significant risk factor for repatriation, with Indians more likely to be repatriated compared to Filipino seafarers (OR 2.57, 95% CI 1.13–5.83 and OR 2.61, 95% CI 1.11–6.11, respectively). Of note, the proportion of female seafarers repatriated (1/77; 1.3%) as compared to male repatriations (60/3,844; 1.6%) was not significantly different ($p = 0.86$).

DISCUSSION

This study examines injuries and illness in a seafarer cohort, including the distribution of diagnoses in repatriated cases, as well as risk factors for repatriation. Of note, gastrointestinal illness and back injuries were disproportionally elevated among repatriated seafarers, and Indian seafarers were more likely to be repatriated than Filipinos. There are few comparable studies.

In our study population, 1.6% of medical events at sea resulted in repatriation, a rate comparable to that reported

Table 1. Baseline characteristics of seafarer population with injury or illness at sea and repatriation status

			Repatriated			
	All cases		Yes		No	
	N	%	N	%	N	%
Total	3,921	100	61	1.6	3,860	98.4
Age						
< 30	993	25.3	19	1.9	974	98.1
30–39	1,103	28.1	19	1.7	1,084	98.3
40–49	963	24.6	13	1.3	950	98.7
≥ 50	862	22.0	10	1.2	852	98.8
Sex						
Male	3,844	98.1	60	98.4	3,784	98.0
Nationality*						
Indian	1,041	26.6	22	2.1	1,019	97.9
Filipino	1,019	26.0	8	0.8	1,011	99.2
United States	435	11.1	3	0.7	432	99.3
Ukrainian	468	11.9	7	1.5	461	98.5
Other	958	24.4	21	2.2	937	97.8
Rank						
Officer	1,198	30.6	28	2.3	1,170	97.7
Rating	1,853	47.3	30	1.6	1,823	98.4
Unknown	870	22.2	3	0.3	867	99.7
Worksite						
Deck	1,416	36.1	25	1.8	1,391	98.2
Engine	1,254	32.0	25	2.0	1,229	98.0
Galley	232	5.9	6	2.6	226	97.4
Other/unknown	1,019	26.0	5	0.5	1,014	99.5
Case type						
Injury	1,157	29.5	23	2.0	1,134	98.0
Illness	2,764	70.5	38	1.4	2,726	98.6

*$p < 0.05$ comparing repatriated vs. not repatriated cases

in the limited seafarer repatriation studies available [6, 11, 12], and as two of these studies occurred over two decades ago [6, 12], suggests little change in repatriation rates over time. While a greater (although not statistically significant) percentage of injury cases (2.0%; Table 1) resulted in repatriation compared to illness cases (1.4%), seafarer illness was more frequent overall and subsequently was a more frequent cause of seafarer repatriation. Oliver reported medical causes of repatriation (n = 110) in British fleet merchant mariners over 35 years ago, and found that seafarer illness, as opposed to injury, was the more frequent reason for seeking medical care on board; illness was also the more frequent cause of repatriation [12]. Similarly, 25 years ago Tomaszunas and Mroziński [6] reported on 354 cases of medical repatriation in Polish seafarers, and found similarly that illness rather than injury was the dominant cause.

Back injuries and injuries to the extremities were the dominant injuries in both repatriated and non-repatriated seafarers. However, back injuries were significantly more frequent in repatriated seafarers, suggesting that back injuries at sea may be more severe and debilitating than injuries to other body parts. Regarding illnesses, gastrointestinal, genitourinary, cardiovascular, and psychiatric complaints have been found to be significant contributors of seafarer repatriation in limited prior studies [6, 11, 12], and were similarly represented in our cohort. Our study further identified dermatologic and respiratory conditions as significant contributors to repatriation, although there

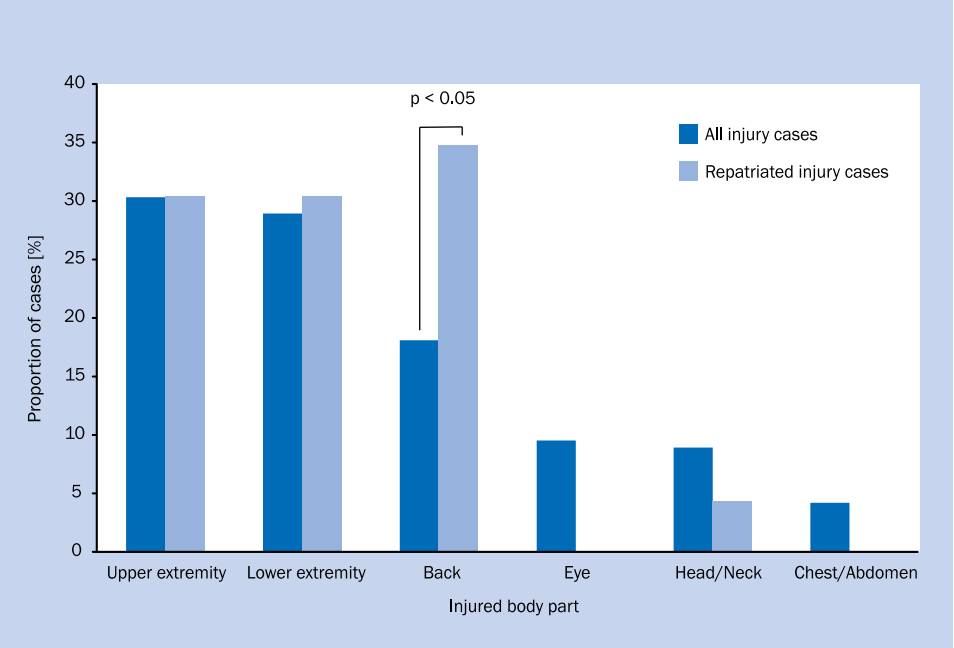

Figure 1. Proportion of total (n = 1,144) and repatriated (n = 23) cases due to different types of injury

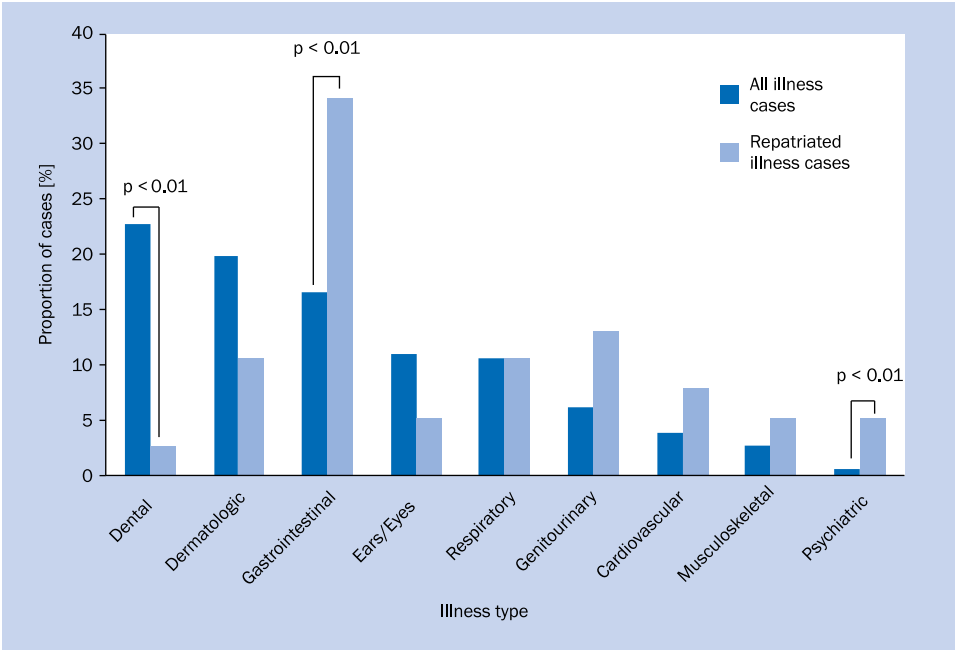

Figure 2. Proportion of total (n = 2,710) and repatriated (n = 38) cases due to different types of illness

were overall low numbers of cases and specific diagnoses were not available.

Gastrointestinal illness was the most significant contributor to repatriation due to illness. Although specific diagnoses were unavailable, this illness category may have included surgical problems such as appendicitis and hernias, conditions frequently observed in prior studies [12, 17]. Dental conditions were the most common illness reported, yet resulted in repatriations only infrequently. Conversely, psychiatric complaints were reported relatively infrequently compared to other conditions, but resulted in repatriations much more frequently.

Table 2. Unadjusted and adjusted main effects models for repatriations

	Unadjusted		Adjusted	
	OR	**95% CI**	**OR**	**95% CI**
Age group				
18–29	1.00	Reference	1.00	Reference
30–39	0.95	(0.48, 1.88)	1.03	(0.51, 2.05)
40–49	0.72	(0.34, 1.53)	0.81	(0.37, 1.75)
≥ 50	0.67	(0.30, 1.48)	0.79	(0.35, 1.79)
Nationality				
Philippines	1.00	Reference	1.00	Reference
Indian	**2.57**	**(1.13, 5.83)**	**2.61**	**(1.11, 6.11)**
United States	0.36	(0.04, 2.87)	0.43	(0.05, 3.52)
Ukraine	1.78	(0.61, 5.16)	1.91	(0.65, 5.63)
Worksite				
Galley	1.00	Reference	1.00	Reference
Deck	0.68	(0.28, 1.67)	0.52	(0.21, 1.30)
Engine	0.77	(0.31, 1.89)	0.53	(0.21, 1.34)
Rank				
Officer	1.00	Reference	1.00	Reference
Rating	0.69	(0.41, 1.18)	0.82	(0.48, 1.42)

CI — confidence interval; OR — odds ratio

While the aging seafarer workforce remains of increasing concern [3], our data did not find a significant effect of age on repatriation. Also of note, seafarer rank and worksite were not found to be significant risk factors for repatriation. However, there was a statistically significant difference in repatriation rates by nationality, with Indians having a higher rate of repatriations compared to Filipinos (Table 1). Logistic regression modelling similarly determined nationality as the only significant risk factor for repatriation among seafarers with medical events, with Indians more than twice as likely to be repatriated compared to Filipino seafarers (Table 2). Recent studies [18, 19] have found that Filipinos seafarers reported fewer accidents at sea compared to other nationalities. Of note, one large study of cruise ship workers found fewer Filipino disembarked for medical treatments compared to other nationalities, and noted potential differences in work assignments by nationalities as well [20]. While the threshold for a crewmember to leave a cruise ship with on-board physicians and medical facilities would likely be higher than on merchant vessels (without doctors or significant medical equipment), our study demonstrated a similar protective effect of Filipino nationality. Although our data did not demonstrate significantly less reported injuries among Filipinos, Filipinos were significantly less likely to be repatriated compared to Indian seafarers. However, differential reporting bias by nationality could potentially underlie this result if Indians did not report less serious injuries, while Filipinos more often reported less serious injuries.

This study has several important strengths. The large dataset with high numbers of injury and illness cases was likely representative of the typical illnesses and injuries among seafarers at sea. Although the total number of repatriations was small, few studies report such data. Unlike other studies, a significant strength of this study is the demographic and occupational variables available on the cases, allowing for analysis of repatriation rates and risk factors. To the authors' knowledge, no similar analysis has been previously reported.

A major weakness remains the small number of repatriations in the dataset, likely a significant factor limiting detection of other potentially important risk factors for repatriation. In addition, without baseline medical information, risk for repatriation due to pre-existing medical conditions could not be determined. Although we had data on age, sex, worksite, and rank of seafarer cases, we did not have data on pre-existing medical conditions, medications, work experience, vessel characteristics, and other factors that may potentially impact the risk of repatriation. Finally, although the analysis identified a significant difference in repatriation risk between Indian and Filipino seafarers, it is possible that a difference between other nationalities exists but was not detected due to low numbers of other nationalities in

the database. However, as Filipino and Indian seafarers comprise a significant proportion of the current seafarer population [21], this finding should be further elucidated in future studies.

CONCLUSIONS

In summary, the data present several finding of note. Analysis of types of illness and injury in repatriated cases indicates back injuries and gastrointestinal illness are major causes of repatriation in seafarers, confirming findings in limited prior studies. Our study also provides important new insights, as nationality was identified as a significant risk factor for medical repatriation in seafarers, with Indians more likely than Filipinos to be repatriated. However, the basis of this finding could not be determined with the study data. It is possible that baseline characteristics of the seafarers (medical, socioeconomic, job training or skill), pre-employment screening criteria, cultural differences, or other factors (reporting bias, data limitations) underlie this significant finding. Importantly, this study identifies the need for additional, larger research studies towards identifying potentially modifiable risk factors for seafarer illness and injury at sea, thereby informing seafarer wellness initiatives and helping determine criteria for evidence-based medical fitness standards, for which there is great need [22]. Scovill et al. [23] found a high prevalence of cardiovascular risk factors in a small study (n = 388) of United States inland waterway captains and pilots, demonstrating an important opportunity for risk-factor modification in a subset of seafarers that may translate to substantial cost-savings via reduced medical expenses and repatriations. If risk factors for other dominant types of illness and injury could be identified and mitigated in seafarers, then seafarer injury and illness at sea, and the subsequent need for repatriation, may be significantly reduced.

ACKNOWLEDGEMENTS

This study was funded in part by Future Care, Inc.

REFERENCES

1. United Nations (UN). 2014. International Maritime Organization. http://business.un.org/en/entities/13. Accessed May 27, 2014.
2. International Maritime Organization. (IMO). IMO, 2014: Day of the seafarer. http://www.imo.org/About/Events/Pages/Day-of-the-Seafarer.aspx. Accessed May 27, 2014.
3. Baltic and International Maritime Council (BIMCO) 2010. BIMCO manpower update: The worldwide demand for and supply of seafarers DMUalfER, University of Warwick.
4. Smith A. Adequate crewing and seafarers' fatigue: the international perspective. Cardiff Centre for Occupational and Health Psychology 2006.
5. Bloor M, Thomas M, Lane T. Health risks in the global shipping industry: an overview. Health, Risk and Society 2000; 2: 329–340.
6. Tomaszunas S, Mroziński W. Diseases and injuries in Polish seafarers repatriated from ships. Bulletin of the Institute of Maritime and Tropical Medicine in Gdynia 1990; 41: 17.
7. Maritime Labour Notice 2.5. Repatriation. http://www.ilo.org/dyn/normlex/es/f?p=1000:53:0:::53:P53_FILE_ID:3132754. Accessed April 2, 2015.
8. Maritime Labour Convention (MLC) 2006 T. http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:91:0:::P91_SECTION:MLC_A4. Accessed October 7, 2014.
9. Christodoulou-Varotsi I. Critical Review of the Consolidated Maritime Labour Convention (2006) of the International Labour Organization: Limitations and Perspectives. J Mar L and Com. 2012; 43: 467.
10. Henny C, Hartington K, Scott S, Tveiten A, Canals L. The business case for telemedicine. Int Marit Health 2013; 64: 129–135.
11. Abaye A, Rodlin S, Ongchangco J, Tabuton K, Ronquillo R, Sarmiento R. Repatriation rates in Filipino seafarers: a 3-year study of 3882 cases. Archives des Maladies Professionnelles et de l'Environnement 2013; 74: 555.
12. Oliver P. A study of the causes of medical attendance aboard British merchant ships. Public Health 1981; 95: 74–81.
13. Lefkowitz RY, Slade MD, Redlich CA. Injury, illness, and work restriction in merchant seafarers. Am J Industrial Med 2015; 58: 688–696.
14. Jensen OC, Sorensen JF, Canals ML, Hu YP, Nikolic N, Thomas M. Incidence of self-reported occupational injuries in seafaring: an international study. Occupational Med 2004; 54: 548–555.
15. Tomaszunas S, Weclawik Z. Accidents and injuries in Polish seafarers. Bulletin of the Institute of Maritime and Tropical Medicine in Gdynia 1997; 48: 59–73.
16. Rosner B. Fundamentals of Biostatistics. Brooks/Cole, Cengage Learning, Boston 2011, pp. 730–732.
17. Tomaszunas S, Weclawik Z, Lewinski M. Morbidity, injuries and sick absence in fishermen and seafarers: a prospective study. Bulletin of the Institute of Maritime and Tropical Medicine in Gdynia 1988; 39: 125–135.
18. Hansen HL, Laursen LH, Frydberg M, Kristensen S. Major differences in rates of occupational accidents between different nationalities of seafarers. Int Marit Health 2008; 59: 7–18.
19. Ádám B, Rasmussen HB, Pedersen RNF, Jepsen JR. Occupational accidents in the Danish merchant fleet and the nationality of seafarers. J Occupational Med Toxicol [electronic resource] 2014; 9: 35–35.
20. Bell SS, Jensen OC. An analysis of the diagnoses resulting in repatriation of seafarers of different nationalities working on board cruise ships, to inform pre-embarkation medical examination. Med Marit 2009; 9: 32–43.
21. Galić S, Lušić Z, Pušić D. Seafarers market. Int J New Trends Arts, Sports Science Education 2012; 1: 33–39.
22. Carter T. The need for international seafarer medical fitness standards. Int Marit Health 2009; 60: 1–5.
23. Scovill SM, Roberts TK, McCarty DJ. Health characteristics of inland waterway merchant marine captains and pilots. Occupational Med 2012; 62: 638–641.