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Original article

Seafaring stressors aboard merchant and passenger ships

Marcus Oldenburg[1], Hans-Joachim Jensen[2], Ute Latza[3] and Xaver Baur[4]

[1] *Department of Maritime Medicine; Institute for Occupational and Maritime Medicine (ZfAM), University of Hamburg, Hamburg, Germany*
[2] *Statutory Accident Insurance Institution for Seafaring, Hamburg, Germany*
[3] *University of Applied Sciences, Berlin, Germany*
[4] *Institute for Occupational and Maritime Medicine (ZfAM), University of Hamburg, Hamburg, Germany*

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Abstract

Objectives: The aim of this study was to identify stressors in seafaring aboard merchant and passenger vessels. Furthermore, their dependence on occupational and non-occupational factors was assessed.

Methods: A total of 134 male seafarers sailing under German-flagged vessels were interviewed (response 81.3 %). The seamen rated the individual stress level of 23 different stressors aboard.

Results: Separation from their family (named 48 times), time pressure (30 times), long working days (28 times), heat in workplaces (24 times), and insufficient qualification of subordinate crew members (16 times) were regarded as the most important stressors aboard. In comparison to non-officers, officers stayed on board for considerably shorter periods (4.8 vs. 8.3 months) but had significantly more often an extremely high number of working hours (63.5 % vs. 21.1 %, Chi-square-test: $p < 0.001$). Correspondingly, officers complained more frequently of a higher stress level due to time pressure (52.4 % vs. 36.6 %).

Conclusions: Particular attention should be paid to preventive organizational measures such as avoiding long-time separation from family, time-pressure, extremely long working days, and a long stay on board.

Keywords: Stressor – Seamen – Seafaring – Ships.

Introduction

Job-related psychosocial stressors are often attributable to high job demands, shift work, external work controls and the limited scope for decision-making.[1,2,3,4,5] The effort-reward model is increasingly used to assess job-related stress, mainly with regard to cardio-vascular diseases.[6]

Seafaring is associated with special mental, psychosocial and physical stressors and cannot be compared with jobs ashore.[7,8,9]

The working and living conditions in seafaring are characterized by long-time separation from family and home for months, growing economic pressure as well as considerable and partly extreme psychosocial problems.[8,9,10,11] Crimmins and Hayward observed that work disability was associated with stressful jobs, lack of job control, and environment hazards for humans.[12]

Seamen are often faced with time-pressure and hectic activity during their voyage. The likely stress level depends on the rank and the job tasks on board. It is assumed that officers have to endure high stress due to their comprehensive responsibilities for personnel and material.

Watch-keeping and acute operational failures require increased activities with long and irregular working hours. The International Labour Organization (ILO, 2006) determined the maximum working times of seamen to be 14 hours per day. In seafaring, this time span is often considerably exceeded, especially on ships with frequent port clearances.[13]

The working conditions on board cargo or passenger ships are different. The crew of cargo ships consists of about 10 to 20 seafarers. These crews have a physically stressful job, especially on container ships (i.e. lashing of containers in a storm). Additionally, seafarers on cargo ships or tankers are possibly exposed to dangerous goods (i.e. toxic gases and fumes, explosive substances, chemicals). On passenger liners the physical stress is less when compared with the stress on cargo ships.

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Besides the type of ships, their size also influences the working situation: the stress increases in smaller vessels, with more reduced crews, shorter stays at ports and through insufficient recreation.[13,14] On the other hand, large container ships operating worldwide are regarded as stressful due to monotony and isolation during long-term voyage. Systematic investigations of the current stress profile of seamen have as yet scarcely been performed.

The aim of our study was to identify current stressors of seafarers aboard merchant and passenger ships. Furthermore, their dependence on non-occupational factors as well as on job-related ones was assessed.

Methods

During 3.5 weeks in July 2006, seafarers to be medically examined by the German Statutory Accident Insurance Institution for Seafaring in order to test their fitness as seafarers in the merchant marine service were asked to participate in the study. Since 95 % of investigated seafarers were male and the shipboard working situation probably differs between males and females, only male seafarers with an at least one year employment on ships were included for logistical reasons. In total, 135 of the examined 166 active seamen (81.3 %) participated in this investigation. Due to considerable communication problems, one seaman was excluded. At the time of the study, the subjects were 43.2 years (SD 11.9 years) of age on average.

Questionnaire

The questioning was carried out anonymously. The seafarers were guaranteed that their given answers would not be forwarded to other persons and would not influence the outcome of their fitness test for nautical service. The official language on board is English. As the completion of the questionnaire took place in the presence of a trained investigator it was possible to assist in the case of language problems.

During the standardized interview, demographic and job-related data (rank, professional group, job duration at sea (years in total), usual shipping routes, shipboard working hours, type and size of the ships and average number of crew members on board) were recorded. To assess the stress due to long continuous working days, the occurrence of extremely long working times (at least 14 hours) was registered. Apart from this, the authors asked if the seafarers had suffered from important health problems or diseases.

Furthermore, the most stressful job activities were recorded. In addition to a free text, the following alternatives were included in the questionnaire: watch-keeping at sea (officer on watch on the bridge), district route of a seagoing vessel (navigation through highly frequented routes), port clearance (loading and unloading, safety techniques and hygiene control measures), port manoeuvres (arrival and departure), administrative tasks, and routine activities during the voyage.

Additionally, the individual stress load of 23 known seafaring stressors was asked. The physical stress comprised six factors: heat in workplaces, noise, ship movement/ sea sickness, hard physical work/ lifting and carrying, lack of exercise, and climatic changes during the voyage. In accordance with Jezewska et al.[15] the psychosocial stress was summarized in four stress categories: shift (long working days, irregular working hours, lack of sleep), social problems due to migration (separation from their family, long stay on board, conflicts between crew members, isolation, insufficient separation between workplace and leisure area), high work demand (time pressure/ hectic activities, high volume of work, high responsibility for their own activities, pressure due to decision-making, monotony, lack of independence), high management tasks (only for superiors: insufficient qualification of subordinate crew members, high responsibility for the work of other crew members, conflict between ship safety and economic demands). The seafarers could add further physical or mental stressors that they considered relevant.

To assess the qualitative stress load, the seafarers were asked to mark the three most important stressors in the list. Based on a scale from 1 (very weak) to 5 (very strong), the individual relevance of each factor was recorded to determine the respective quantitative stress level. The values 1 and 2 were summarized as lower stress level and those from 3 to 5 as higher stress level. Therefore, the question of the relevance of each stress factor generates the basis for the dichotomous assessment in lower and higher stress level.

By means of a subsequent factor analysis, the loading of each stressor to the above mentioned stress categories of Jezewska et al. was explored. The analysis did not reveal a high loading of specific stressors to these categories.

Finally, the seafarers were asked about their attitude towards multinational crews (rather positive/ rather negative/ neutral). Based on a scale from 1 (less important) to 5 (very important), the seamen rated (in accordance to Knudsen)[10] the importance of the following potential special conditions in ethnically different crews: problems of communication, national groupings within the crew, no common leisure time activities, frequently insufficient qualification of crew groups, no sense of community and loneliness.

Statistical analysis

Data were analyzed using SPSS for Windows (version 13.0, SPSS GmbH Software, Munich, Germany). Continuous vari-

	Non-Officer (n = 71)	Officer (n = 63)
Age (Y), *mean (SD)*	43.0 (12.3)	43.4 (11.5)
Family status, *n (% origin)*		
Single	12 (16.9 %)	27 (42.9 %)
Married	56 (78.9 %)	33 (52.4 %)
Divorced/ widowed	3 (4.2 %)	3 (4.7 %)
Children, *n (% origin)*	51 (71.8 %)	32 (50.8 %)
Job-related factors		
Well-being on board of the last ship, *n (% origin)*	67 (94.4 %)	57 (90.5 %)
Job duration at sea (years in total), *median (min-max)*	15.0 (1–45)	17.0 (1–48)
Shipping route, *n (% origin)*		
North/ Baltic Sea	12 (16.9 %)	7 (11.1 %)
Worldwide	59 (83.1 %)	56 (88.9 %)
Working hours on board (hours/ day), *mean (SD)*	9.7 (1.6)	10.5 (2.9)
Stay on board (months/ year), *mean (SD)*	8.3 (3.4)	4.8 (2.1)
Extremely high number of working hours on board⁺, *n (% origin)*	15 (21.1 %)	40 (63.5 %)

Table 1. Selected characteristics of the total study population (n = 134) according to the rank of the seamen (Non-officer vs. Officer).

⁺ maximal working hours in one unit > 14 hours

ables were expressed as mean (± standard deviation (SD)) and in the case of non-normal distribution as median (minimum to maximum). For the comparison of two groups (lower vs. higher stress level of each shipboard stressor), the T-test or the Mann-Whitney-test was performed, respectively. The Chi-Square-test of Pearson was used to compare frequencies between groups. All indicated p-values were two-sided and an α-value of <0.05 was regarded as statistically significant.

Results

Study sample

As a whole, 134 male seafarers were interviewed. As expected, severe or chronic diseases were anamnestically not detectable as they would have led to a disablement for seafarers in the merchant marine.

In total, 71 non-officers and 63 officers participated in the study. The comparison of these groups revealed that the latter ones were more often unmarried (Tab. 1). Single officers were more frequently found in this population. Non-officers had children more frequently.

Most seamen reported a sense of well-being aboard their last ship.

The average job duration at sea (years in total) was 15.5 years (range from 1 to 48 years). Officers, when compared with non-officers, showed a slightly longer job duration (Tab. 1). The average shipboard stay of non-officers (months/ year) lasted markedly longer than that of the officers (8.3 vs. 4.8 months per year; T-test: $p<0.001$), although no differences in the shipping routes among seamen with different ranks exist. Extremely long working times (maximal working time of more than 14 hours in one stretch) were found more often among officers (up to 70 hours per unit) (63.5 % vs. 21.1 %, Chi-square-test: $p<0.001$).

Superior duties were performed by 63.2 % of the European and only by 6.4 % of the non-European seamen. The seafarers of 16 different nationalities were assigned to two groups (number in brackets):

1. Europeans (87): Germany (65), Poland (9), Russia/Ukraine (6), Croatia (3), Bulgaria (1), Spain (1), Romania (1), Portugal (1)
2. Non-Europeans (47): Myanmar (20), Kiribati (12), Philippines (8), China (2), Cap Verde (2), Ghana (1), India (1), Chile (1).

The seamen were furthermore allotted to three groups according to their professional function: deck personnel (69), engine operators (48) and catering staff (17).

The average shipboard stay of Europeans (months/ year) was only half as long as that of the non-European seamen (4.9 vs. 9.9 months per year; T-test: $p<0.001$). European compared with non-European seamen showed a considerably longer job duration.

Stressful job activities on board

The most stressful rated job activities in the questionnaire were watch-keeping at sea (24.3 %), port clearance (23.6 %) and district routes (19.6 %). The stress during port manoeu-

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Table 2. Relevance of physical and psychosocial factors as most important shipboard stressors (total of 325 responses*).

	n	% (related to the 134 examined seamen)
Physical stressors		
Heat in workplaces	24	17.9 %
Noise	15	11.2 %
Ship movement, sea sickness	12	9.0 %
Hard physical work, lifting, carrying	11	8.2 %
Lack of exercise	9	6.7 %
Climatic changes during the voyage	6	4.5 %
Average responses (n):	**12.8**	
Psychosocial stressors		
Shift		
Long working times per day	28	20.9 %
Irregular working times	18	13.4 %
Lack of sleep	12	9.0 %
Average responses (n):	**19.3**	
Social problems due to migration		
Separation from the family	48	35.8 %
Long stay on board	19	14.2 %
Conflicts between crew members	8	6.0 %
Isolation	7	5.2 %
Insufficient separation between workplace and leisure area	3	2.2 %
Average responses (n):	**17.0**	
High work demand		
Time pressure, hectic activities	30	22.4 %
High volume of work	11	8.2 %
High responsibility for the own activities	10	7.5 %
Pressure due to decision-making	8	6.0 %
Monotony	8	6.0 %
Lack of independence	5	3.7 %
Average responses (n):	**12.0**	
High management tasks		
Insufficient qualification of subordinate crew members	16	27.6 %+
High responsibility for the work of other crew members	10	17.2 %+
Conflict between ship safety and economic demands	7	12.1 %+
Average responses (n):	**11.0**	

* 121 out of the 134 seamen named at least one item (106 of them a second and 98 a third one)
\+ only referring to responses of superiors (n = 58)

vres (11.2 %), administrative tasks (9.3 %) and during routine activities on the voyage (5.6 %) played a minor role only. Salvage after accidents, tank cleaning, the handling of chemicals and the cleaning of cabins were considered stressful job activities (6.4 %).

Ranking of shipboard stressors

The seamen marked the three most important stressors in the list of physical and psychosocial stressors (Tab. 2). Out of the 134 seamen, 121 (90.3 %) ticked at least one item (106 ticked a second and 98 seamen three items). 13 seamen did not perform a ranking. The following five stressors were predominant: separation from their family (48 times), time pressure/ hectic activities (30 times), long working days (28 times), heat in workplace (24 times) and insufficient qualification of subordinate crew members (16 times ticked by the 58 superiors) (Tab. 2).

Among the 134 seamen interviewed, 80 (59.7 %) considered the separation from their family as a higher stress level, 72 (53.7 %) the heat in workplaces, 63 (47.0 %) long working

days, and 59 (44.0 %) time pressure/hectic activities; more than 70 % of the superiors regarded the insufficient qualification of subordinate crew members as a higher stress level (Tab. 3–5).

The seamen added ship vibrations (8 times), carrying heavy respirators (twice) and draught (twice) to the important physical stressors aboard. The list of psychosocial stressors was supplemented by communication problems within the crew (twice), frequent time shifts during the voyage (twice) and alcohol problems of crew members (once).

Private stressors were indicated 13 times (9.7 %) (8 times family conflicts, twice reduced leisure time, twice private organizational problems like moving, and once health problems in their family).

Correlation between shipboard stressors examined

Significant associations ($p < 0.05$) between the predicted variables were found for being an officer and being European (95.2 % of officers were European; Chi-square-test: $p < 0.001$) as well as for ship type and shipping route (worldwide shipping route: container ships (94.4 %), cargo ships (81.3 %), tanker (58.3 %) and passenger liners (64.7 %); Chi-square-test: $p < 0.001$). Correlations above 0.5 between the predictors were observed for age and job duration at sea (Spearman correlation coefficient: $r = 0.815$; $p < 0.001$).

The stress level of the five most important stressors revealed that seamen indicating stress by heat in workplaces were five years younger than those experiencing less stress. The stressor separation from their family also depended on the age of the seamen and was more pronounced in younger seafarers, particularly when having children (Tab. 3).

The stress level of the main shipboard stressors did not depend on the available potential compensation strategies in seafaring (smoking, alcohol consumption and sports) (Tab. 3).

Seamen with higher stress due to heat in shipboard workplaces had a 10 year shorter job duration at sea (Tab. 4). The other most important shipboard stressors were not related to the rank of the seafarers (officers vs. non-officers), except for the (not significantly) higher stress level due to time pressure among officers (Tab. 4).

The associations between professional group and shipboard stressors were not significant except for heat in workplaces. Especially the engine room personnel, permanently being close to the heat-producing engines, stated a higher stress level due to heat in their workplaces. Crews regularly sailing worldwide in warmer climatic zones also reported heat-induced stress.

Furthermore, 64.7 % of the catering staff, 49.3 % of the deck personnel and only 37.5 % of the engine operators claimed to have a higher stress level due to long working days. Time

Table 3. Level of the most important shipboard stressors dependent on demographic parameters and potential compensation strategies.

	Heat in workplaces			Extremely long working times			Separation from the family			Time pressure/ hectic activities			Insufficient qualification of subordinate crew members[#]		
	Lower stress level (n = 62)	Higher stress level (n = 72)	p	Lower stress level (n = 71)	Higher stress level (n = 63)	p	Lower stress level (n = 54)	Higher stress level (n = 80)	p	Lower stress level (n = 75)	Higher stress level (n = 59)	p	Lower stress level (n = 17)	Higher stress level (n = 41)	p
Demographic parameters															
Age (Y), mean (SD)[8]	45.9 (11.2)	40.8 (12.1)	***0.013****	42.8 (11.3)	43.6 (12.7)	*0.696*	45.7 (12.5)	41.5 (11.3)	***0.045****	43.6 (11.5)	42.6 (12.5)	*0.644*	44.1 (10.6)	45.5 (10.5)	*0.661*
Children, n (%)[§]	38 (45.8 %)	45 (54.2 %)	*0.886*	42 (50.6 %)	41 (49.4 %)	*0.481*	29 (34.9 %)	54 (65.1 %)	*0.107*	49 (59.0 %)	34 (41.0 %)	*0.362*	9 (28.1 %)	23 (71.9 %)	*0.826*
Origin, n (%)[§]															
European (n = 87)	39 (44.8 %)	48 (55.2 %)	*0.649*	44 (50.6 %)	43 (49.4 %)	*0.447*	40 (46.0 %)	47 (54.0 %)	*0.068*	44 (50.6 %)	43 (49.4 %)	*0.087*	14 (25.5 %)	41 (74.5 %)	***0.006****
Non-European (n = 47)	23 (48.9 %)	24 (51.1 %)		27 (57.4 %)	20 (42.6 %)		14 (29.8 %)	33 (70.2 %)		31 (66.0 %)	16 (34.0 %)		3 (100.0 %)	0	
Compensation strategies															
Smoking, n (%)[§]	20 (43.5 %)	26 (56.5 %)	*0.640*	25 (54.3 %)	21 (45.7 %)	*0.819*	16 (34.8 %)	30 (65.2 %)	*0.347*	29 (63.0 %)	17 (37.0 %)	*0.233*	4 (22.2 %)	14 (77.8 %)	*0.426*
Alcohol consumption, n (%)[§]	46 (46.5 %)	53 (53.5 %)	*0.939*	54 (54.5 %)	45 (45.5 %)	*0.543*	44 (44.4 %)	55 (55.6 %)	*0.100*	53 (53.5 %)	46 (46.5 %)	*0.340*	10 (25.0 %)	30 (75.0 %)	*0.282*
Sport, n (%)[§]	41 (47.7 %)	45 (52.3 %)	*0.662*	45 (52.3 %)	41 (47.7 %)	*0.838*	32 (37.2 %)	54 (62.8 %)	*0.329*	45 (52.3 %)	41 (47.7 %)	*0.255*	10 (26.3 %)	28 (73.7 %)	*0.490*

[8] T-test [§] Chi-Square-test of Pearson * P <0.05 [#] only answered by superiors

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Table 4. Level of the most important shipboard stressors dependent on job-related parameters.

	Heat in workplaces			Extremely long working times			Separation from the family			Time pressure/ hectic activities			Insufficient qualification of subordinate crew members[#]		
	Lower stress level (n = 62)	Higher stress level (n = 72)	p	Lower stress level (n = 71)	Higher stress level (n = 63)	p	Lower stress level (n = 54)	Higher stress level (n = 80)	p	Lower stress level (n = 75)	Higher stress level (n = 59)	p	Lower stress level (n = 17)	Higher stress level (n = 41)	p
Job duration at sea (Y), *median (min-max)*[+]	20.0 (1–48)	10.5 (1–40)	***0.001*** **	16.0 (1–48)	15.0 (1–45)	*0.836*	16.5 (1–48)	15.0 (1–45)	*0.187*	16.0 (1–48)	15.0 (1–45)	*0.186*	17.0 (4–41)	18.0 (3–48)	*0.791*
Rank, *n (%)*[§]															
Officer (n = 63)	24 (38.1 %)	39 (61.9 %)	*0.074*	34 (54.0 %)	29 (46.0 %)	*0.830*	23 (36.5 %)	40 (63.5 %)	*0.399*	30 (47.6 %)	33 (52.4 %)	*0.067*	17 (29.3 %)	41 (70.7 %)	
Crew rank (n = 71)	38 (53.5 %)	33 (46.5 %)		37 (52.1 %)	34 (47.9 %)		31 (43.7 %)	40 (56.3 %)		45 (63.4 %)	26 (36.6 %)		0	0	
Professional group, *n (%)*[§]															
Engine personnel (n = 48)	11 (22.9 %)	37 (77.1 %)	***<0.001*** ***	30 (62.5 %)	18 (37.5 %)	*0.134*	16 (33.3 %)	32 (66.7 %)	*0.183*	32 (66.7 %)	16 (33.3 %)	*0.170*	9 (34.6 %)	17 (65.4 %)	*0.424*
Deck personnel (n = 69)	40 (58.0 %)	29 (42.0 %)		35 (50.7 %)	34 (49.3 %)		28 (40.6 %)	41 (59.4 %)		35 (50.7 %)	34 (49.3 %)		8 (25.0 %)	24 (75.0 %)	
Catering staff (n = 17)	11 (64.7 %)	6 (35.3 %)		6 (35.3 %)	11 (64.7 %)		10 (58.8 %)	7 (41.2 %)		8 (47.1 %)	9 (52.9 %)		0	0	
Shipping route, *n (%)*[§]															
North/ Baltic Sea (n = 19)	14 (73.7 %)	5 (26.3 %)	***0.010****	9 (47.4 %)	10 (52.6 %)	*0.596*	12 (63.2 %)	7 (36.8 %)	***0.028****	8 (42.1 %)	11 (57.9 %)	*0.189*	2 (33.3 %)	4 (66.7 %)	*0.819*
Worldwide (n = 115)	48 (41.7 %)	67 (58.3 %)		62 (53.9 %)	53 (46.1 %)		42 (36.5 %)	73 (63.5 %)		67 (58.3 %)	48 (41.7 %)		15 (28.8 %)	37 (71.2 %)	
Stay on board (month/ year), *mean (SD)*[&]	6.8 (3.6)	6.5 (3.1)	*0.724*	6.7 (3.4)	6.6 (3.3)	*0.808*	6.0 (3.4)	7.1 (3.3)	*0.051*	7.3 (3.3)	5.9 (3.3)	***0.016****	5.1 (2.0)	4.7 (2.3)	*0.511*
Working time (hours/ day) on board, *mean (SD)*[&]	10.4 (2.5)	9.8 (2.2)	*0.110*	10.0 (2.7)	10.2 (1.8)	*0.636*	10.4 (2.2)	9.8 (2.4)	*0.127*	9.8 (2.1)	10.5 (2.6)	*0.076*	9.2 (2.4)	11.2 (3.1)	***0.013****

[+] Mann-Whitney-test [&] T-test [§] Chi-Square-test of Pearson * p <0.05 ** p <0.005 *** p <0.001 [#] only answered by superiors

pressure aboard was regarded as more stressful by only one third of the engine personnel, but by half of the deck and catering staff.

A higher stress level due to insufficient qualification of subordinate crew members was slightly more frequently complained about by deck than by engine room personnel.

In spite of similar shipboard stays, crews sailing worldwide stated a significantly higher stress level due to the separation from their family than those sailing in the North or Baltic Sea (6.3 vs. 6.7 months per year; T-test: p = 0.650). The routes did not essentially influence the stress by long working days and by time pressure.

Seamen with a shorter stay on board (months/ year) had a higher stress level due to time pressure (Tab. 4).

Compared with the crews of cargo ships and passenger liners, the seamen of the usually worldwide sailing container ships and tankers regarded heat in workplaces and separation from their family as the higher stress levels (Tab. 5). The most important stress factors aboard did not depend on the vessel's size or the average number of crew members.

In total, 129 seamen (96.3 %) stated having worked on ships with crew members of different nationalities (on average for 11.5 years (SD 9.2 years)). Fifty-one seafarers (39.5 %; 47.6 % Europeans vs. 25.5 % non-Europeans) had a positive attitude towards multicultural crews, 7 (5.5 %; 6.1 % Europeans vs. 4.3 % non-Europeans) a rather negative one and 71 (55.0 %; 46.3 % Europeans vs. 70.2 % non-Europeans) were neutral (Europeans vs. non-Europeans Chi-square-test: p = 0.031).

Based on a scale from 1 (= less important) to 5 (= very important), the relevance of the above mentioned potential special conditions in multinational crews scored between 2.23 and 2.63. European seamen considered the frequently insufficient qualification of crew groups (scale value 2.88 vs. 2.19; T-test: p = 0.004) and communication problems (scale value 2.80 vs. 2.06; T-test: p = 0.005) more important than non-European seafarers.

Discussion

This study revealed that separation from their family, time pressure/ hectic activities, long working days, heat in workplaces and insufficient qualifications of subordinate crew members are the most important stressors on board.

In the presented study population, the Europeans had shorter stays on board (4.9 vs. 9.9 months/ year). Salyga and Juozulynas explored the job-related stress of Lithuanian and Latvian seamen, and found that psycho-emotional stress was already experienced after an average of 2.7 months after the beginning of the voyage.[7] It is additionally known that workplace

security and the payment of the European seamen are much better.[10] This social gradient (only 6.4 % of the Non-Europeans performed superior duties) likely also constitutes a strong stress factor on ships.

Officers stated a higher stress level due to time pressure and hectic activities on board. This can be attributed to their frequently extremely long working days due to unexpected situations and to the increasing amount of administrative duties (i.e. paper work). Extremely high number of working hours over a lengthier period of time combined with a lack of sleep can elicit chronic fatigue, health problems and safety risks on the vessels.[16]

The low qualification of subordinate crew members was a further important stressor in superiors.

In addition, the presented study showed that engine room personnel had a lower stress level than deck and catering staff due to long working days and time pressure or hectic activities. This indicates regular working hours and routine procedures in the engine room, whereas especially the deck personnel has to react to permanently changing job demands (port clearance, district routes and watch-keeping at sea).[17,18] Correspondingly, these activities were considered to be the most stressful job activities in our study.

Heat in workplaces was also regarded as an important current stressor on ships. The relevance of heat in workplaces was surprising since many vessels are air-conditioned nowadays. But at least in engine rooms, and due to the climatic impact in warmer climatic zones, seafarers are still exposed to heat at work.

The stress level due to heat in workplaces was lower in seamen with a longer job duration at sea (and consequently of older age) than in those with a shorter job duration. This may be due to the adaptation to job demands or the healthy worker effect. The topicality of the stressors heat and noise shows that physical stressors on ships currently are still very important in spite of the increasing mechanization in seafaring.[7]

On account of the insufficient separation between workplace and leisure area on vessels, stressors do not only occur during working hours but also during leisure time through psychosocial factors. Thus, in our study separation from the family is regarded as a further important stressor on ships.[14] Particularly affected were younger seamen with children, this factor probably increasing their feeling of separation. The stress level due to separation from their family was also higher in non-European seamen often originating from East-Asia and mainly working on vessels to financially support their families at home.[10]

The stress level on ships travelling worldwide was considered higher due to the separation from their family. This is probably caused by the long distance from home as well as by

Table 5. Level of the most important shipboard stressors dependent on ship-related parameters.

	Heat in workplaces			Extremely long working times			Separation from the family			Time pressure/ hectic activities			Insufficient qualification of subordinate crew members[#]		
	Lower stress level (n = 62)	Higher stress level (n = 72)	p	Lower stress level (n = 71)	Higher stress level (n = 63)	p	Lower stress level (n = 54)	Higher stress level (n = 80)	p	Lower stress level (n = 75)	Higher stress level (n = 59)	p	Lower stress level (n = 17)	Higher stress level (n = 41)	p
***Ship type**, n (%)*[§]															
Container ship (n = 89)	31 (34.8 %)	58 (65.2 %)		45 (50.6 %)	44 (49.4 %)		30 (33.7 %)	59 (66.3 %)		51 (57.3 %)	38 (42.7 %)		13 (30.2 %)	30 (69.8 %)	
Cargo ship (n = 16)	13 (81.3 %)	3 (18.7 %)		8 (50.0 %)	8 (50.0 %)	*0.489*	9 (56.3 %)	7 (43.7 %)	***0.012****	10 (62.5 %)	6 (37.5 %)	*0.705*	0	7 (100.0 %)	*0.206*
Tanker (n = 12)	4 (33.3 %)	8 (66.7 %)	***<0.001******	6 (50.0 %)	6 (50.0 %)		3 (25.0 %)	9 (75.0 %)		5 (41.7 %)	7 (58.3 %)		2 (50.0 %)	2 (50.0 %)	
Passenger liner (n = 17)	14 (82.4 %)	3 (17.6 %)		12 (70.6 %)	5 (29.4 %)		12 (70.6 %)	5 (29.4 %)		9 (52.9 %)	8 (47.1 %)		2 (50.0 %)	2 (50.0 %)	
Ship size[+]			*0.365*			*0.737*			*0.426*			*0.984*			*0.146*
***Average number of crew members**, median (min-max)*[+]	21.0 (5–500)	20.5 (10–400)	*0.416*	21.0 (5–500)	20.0 (5–380)	*0.396*	22.0 (5–500)	20.0 (5–400)	*0.263*	20.0 (5–320)	21.0 (5–500)	*0.880*	20.0 (17–300)	21.0 (5–400)	*0.724*

[+] Mann-Whitney-test [§] Chi-square-test of Pearson * p < 0.05 ** p < 0.005 *** p < 0.001 [#] only answered by superiors

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missing social contacts due to the fact that these ships only stop a few times in ports. Moreover, the seamen of vessels sailing worldwide regarded heat in workplaces as the higher stress level. In contrast, Smith and Bowring described a greater situation- and job-related stress and strain in the national and coastal trade (especially in feeder ships < 10,000 gross tonnage) which was related to short voyages, frequent port manoeuvres and a low number of crew members.[19,20]

Especially the number of watch-keeping officers on feeder ships needs to be mentioned. It is assumed that nautical officers in two watch-systems (2 nautical officers, 2 shifts daily, each of at least 6 hours) have a markedly higher stress level due to their restricted relaxation possibilities than seafarers in three watch-systems (3 nautical officers, 2 shifts daily, each of at least 4 hours). More studies are needed to elucidate this problem.

The current social situation on board is characterized by multinational crews; approximately 80 % of the world's merchant fleet are manned with multinational crews.[21] It is assumed that this factor considerably enhances the social isolation and loneliness of seamen. On account of linguistic and intercultural problems, this situation can also affect the safety on ships.[22] Reports showed that casualties occurred more often on ships with mixed crews (IMO News, No. 3 1994).

In our investigation, 40 % of the seafarers regarded multinational crews as positive, only 5 % as negative, and 55 % were of neutral opinion. Concerning the living and working conditions in multinational crews, the European seamen had some problems with the frequently insufficient qualification of crew groups and with communication difficulties. The National Maritime Polytechnic Manila performed a study on the attitude of Filipino seamen to multinational crews.[21] About two-thirds (66 %) of the respondents did not have serious problems with crews of different nationalities and 31 % experienced some problems (communication, arrogance and the lack of trust of non-Filipino superiors in them).

Stress can be compensated by compensation strategies like smoking, alcohol consumption and sports.[23] In the presented study, the most important stressors on ships do not seem to be related to such strategies. Only 34.3 % of the seafarers reported to be current smokers. It cannot be excluded that there were not true and sincere answers. In another study the authors observed a relative low validity of seafarer's anamnestic data concerning smoking habits compared with the cotinine level as an objective parameter of smoking.[24] The true nicotine and alcohol consumption of seafarers may be higher than stated in this study.

In 2006, only 5 % of the German seafarers were female. A gender-sensitive analysis that might detect specific risks of female seafarers was logistically not feasible.

Psycho-emotional and somatic consequences may be serious. Jaremin evaluated more than 750 fatal cases at sea in the Polish fleet and regarded stress as the concomitant reason of work-related accidents.[25,26] Also other authors describe that great work-related stress can increase the coronary risk of employees.[27,28,29] In recent years, an augmention of merchant marine seafarers´ disablement in Germany due to cardiovascular diseases was observed (Statutory Accident Insurance Institution for Seafaring; statistics on the merchant marine disablement on German-flagged vessels from 1990 to 2004) which may be a consequence of increased stress on vessels.[30]

In the questionnaire, the seafarers were asked if they had suffered from important health problems or diseases. No seafarer mentioned severe or chronic health diseases. In another study the authors also asked about the complaints of seamen and found out that only a few of them reported work-related symptoms.[31] In the experience of the authors it is not common for many – especially Asian – seafarers to mention health problems to unknown persons.

One limitation of the presented study is its cross-sectional design, probably leading to an underestimation of the stress-level due to the healthy worker effect. A second limitation is the use of self-reported information on stressors on board without validation through objective measurements. Third, the authors asked several questions and tested 84 independent hypotheses in a relative small sample. If the Bonferroni correction is used as a safeguard against the multiple comparison problem, only p-values below 0.00006 are unlikely to have occurred by chance. Only the association of professional group and heat in workplaces was significant at this threshold. Further investigations are needed to show which of the predictors have the strongest impact on important outcomes (e. g., mortality, incidence of cardiovascular diseases, and work-related accidents).

As the interview took place during the fitness test for merchant marine service, biased answers due to fear of job loss cannot be ruled out. However, the remarkable participation rate (more than 80 %) indicates confidence in the confidentiality of the survey.

A further problem of this study was the heterogeneous sample of seafarers reflecting the real situation in multicultural crews nowadays. In spite of the attending investigator during the completion of the questionnaire it cannot be excluded that some questions were misunderstood owing to language problems.

Agterberg and Passchier described more problems of work-related stress in seamen than in the general population.[14] On account of the extraordinary diversity of job-related stressors in seafaring, particular attention should be paid to preventive occupational and organizational measures. According to

the presented results, it appears to be especially important to shorten the shipboard stay of non-Europeans seamen, to avoid extremely high number of working hours and to improve the qualification of subordinate crew members. In respect of the long separation from their families the shipboard internet or cell phone use should be improved to facilitate the communication ashore. Regarding the assumed high smoking and alcohol consumption among seafarers more attention needs to be paid to anti-smoking, respective anti-alcohol campaigns. In addition, considering the lacking of exercising on board, the crew should be advised and motivated to do more sports. All these measures may contribute in promoting seafarers' health and in reducing their stress-related diseases in the terms of primary prevention.

Beside these life-style factors the seafarers should learn how to prevent and how to manage stress, for instance by making use of anti-stress relaxation techniques. Such training programs can already be implemented in the educational program of maritime students as future officers.[15] A more qualified education in stress-managing in maritime schools is a promising effort to help in coping with stress on ships and subsequently to improve the safety aboard.

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Address for correspondence

Dr. med. Marcus Oldenburg
Department of Maritime Medicine
Institute for Occupational and Maritime Medicine (ZfAM), University of Hamburg
Seewartenstrasse 10, D-20459 Hamburg
Germany
Tel: +49-40-428894508
Fax: +49-40-428894514
E-mail: marcus.oldenburg@bsg.hamburg.de