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Objective and subjective measures to assess stress among seafarers

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ABSTRACT

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

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

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

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

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

INTRODUCTION

An essential feature of employment in the maritime sector are the relatively long assignments of up to 12 months on board ships and thus a long period of separation from the family and social relationships at home [1–3]. There are many different job requirements for the multicultural crews on board, with a high proportion of East Asian crew members among ratings. A 24-hour ship's operation with the corresponding watch system — primarily for nautical officers — unpredictable work demands, malfunctions, and cargo handling in the ports (often around the clock) require the virtually constant availability of crew members [4]. Thus, life on board is primarily determined by work, and there is no clear demarcation between work and leisure [5]. The shipboard 24-hour rhythm on 7 days a week leads to the disintegration of the traditional structure of the day, week, month and year [6].

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

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

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

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

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

MATERIALS AND METHODS

Mental stress of seafarers on board container ships was assessed with the objective instrument for situational screening of mental workload (SMW-S) [17, 18] and a standardised interview [19]. The observation of a total of 70 workplaces on board 11 container ships according to the SMW-S and the interviews with 198 crew members were carried out by a trained psychologist with experience in seafaring.

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

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

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

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

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

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

ETHICAL APPROVAL AND INFORMED CONSENT

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

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

RESULTS

SITUATIONAL SCREENING OF MENTAL WORKLOAD (SMW-S)

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

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

On the whole, the workplaces of all four occupational groups have limited decision latitude and stressful physical and psychosocial working conditions. According to the SMW-S item list, the decision latitude is, for example, limited when work content as well as communication and cooperation are predominantly restricted by technical and organisational requirements in addition to legal requirements. This is relevant for the maritime context. In SMW-S, stressful physical and psychosocial working conditions are assumed, for example, in the case of irregular working hours, work compaction, unpredictable disruption, no error correction, difficult environmental conditions and lack of support from supervisors or employees.

SUBJECTIVE ASSESSMENT OF THE STRESS ON BOARD

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

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

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

DISCUSSION

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

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

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

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

When evaluating the objective working situation with SMW-S, the occupation-specific conditions of seafaring must be taken into account. They should include the lack of shore leave, long working assignments on board and thus the separation from family and friends [29]. Corresponding to the results in the observation-based approach of the SMW-S (stressful physical/psychosocial working conditions and low decision latitude), the subjective assessments of the seafarers surveyed also show high stress in the work situation. This is, above all, due to the irregular and long working hours, work under time pressure, increased risk but also the specific situation of the long assignments and low shore options [30]. But the managerial behaviour of superiors, such as a lack of openness, inadequate or lacking understanding, is also rated negatively by several sailors and experienced as a stressful work situation [31, 32].

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

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

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

CONCLUSIONS

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

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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