DIAGNOSIS OF STRESS AND FATIGUE IN MARITIME WORK ON BOARD. "THE CASE OF SPANISH SEAFARERS"

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Abstract
All seafarers wishing to work on a ship must undergo a medical examination prior to embarkation, according to the Maritime Labour Convention, (MLC,2006), and the Standards of Training, Certfication, and Watchkeeping (STCW), in compliance with STCW Regulation I/9 and Section A-I/9. In Spain, this focuses mainly on physical tests of the individual and not so much on his or her mental health. This paper shows the results of a survey on "stress and fatigue in maritime shipboard work". Despite having suffered from both stress and fatigue in the last campaign on board, 49.79% of the respondents acknowledge that they have never been diagnosed with stress, and 52.04% reveal that they have not been diagnosed with fatigue. On the other hand, 55.50% of the participants in this consultation consider it necessary to diagnose stress in the medical examination and 61.40% believe that tests relating to the diagnosis of fatigue are necessary in these examinations. In view of these data, the competent authorities, as well as the different contracting companies, are urged to promote both prevention and mitigation of the possible consequences of suffering from both stress and fatigue in order to avoid unintended consequences such as maritime accidents as a result of stressed and/or fatigued crews, i.e. to include tests on the crew member's mental health before, during and after embarkation in medical examinations, as well as protocols for action by the companies in terms of training and information on these two problems.

1 INTRODUCTION

According to the guidelines of the International Labour Organization (ILO), specifically Convention 16 concerning Medical Examination of Young Persons Employed at Sea, Convention 73 regarding Medical Examination of Seafarers, and Convention 113 on Medical Examination of Fishermen, the "*Instituto Social de la Marina (ISM)"* provides free medical examinations prior to maritime embarkation for all maritime workers.

These examinations, which are mandatory, aim to ensure that the psychophysical conditions of the seafarer are compatible with the requirements of their job and do not pose a danger to the health and safety of the individual or the rest of the crew, nor do they put maritime navigation at risk.

The obligation for medical examinations prior to embarkation according to the International Labour Organization (2013) begins with the implementation of the Convention concerning Medical Examination of Seafarers in 1946 (No. 73) (ILO, 1946), after the ILO adopted the Convention concerning Medical Examination of Young Persons Employed at Sea. 1921 (No. 16) (ILO, 1921).

Today, the aforementioned instruments have been consolidated into the Maritime Labour Convention, 2006 (MLC, 2006), through which the legislations of the signing countries ensure that all seafarers hold a valid medical certificate.

Work-related stress and fatigue are shown to be highly important issues addressed at both national and international levels, due to their impact on individuals' physical and mental health. It is necessary to seek a balance between life and work, especially in terms of workload. The consequences of work-related stress are diverse and affect both the individual and the organization. Cardiovascular and respiratory disorders, as well as sleep disturbances, are exacerbated by workplace harassment, leading to increased depression, anxiety, and exhaustion among seafarers. Stress impairs situational awareness and decision-making, and in extreme cases, it can lead to increased drug and alcohol consumption, even resulting in suicide.

Regarding fatigue, it can lead to various consequences such as a higher likelihood of workplace accidents, increased absenteeism among fatigued workers, elevated risk of cardiovascular diseases, decreased alertness and vigilance, reduced attention span, diminished visual and auditory discrimination, increased memory errors, potential development of chronic fatigue syndrome with challenging medical solutions and frequent relapses, as well as stress, demotivation, and the development of various pathologies.

It is noteworthy that fatigue is considered both as a primary cause and a significant factor contributing to human error that lead to maritime accidents (Reyner, 1998; Louro et al., 2012; Smith et al., 2013; Uğurlu et al, 2015). Several studies (Jensen et al., 2006; Wadsworth et al. 2008) have demonstrated that chronic fatigue issues, stress-related matters, and other health concerns are associated with on board working conditions.

In connection with this article, Ruano (2009) is consulted to create a chronological classification of Spanish regulations regarding pre-embarkation medical examinations, in which it is advisable to highlight:

- "*Ley 116/1969 de 30 de diciembre*" where, regarding the Special Social Security Scheme for Sea Workers, it is established that "in the case of seafarers on board, the data relating to affiliation shall be recorded in the Maritime Registration Book, or in the medical record for those with qualifications, and those relating to their health circumstances shall be recorded in the document intended for that purpose", therefore the need to record the seafarer's health circumstances is already mentioned ("*Ley 116/1969 art.10 .3, of 30 Diciembre"*), and RD 1414/1981 of 3 July attributes to the *ISM* the health care of seafarers and their beneficiaries within the national territory. On the other hand, the Order of 10 July 1984, of the Ministry of Labour and Social Security, created the Maritime Medicine Service, which was later renamed the Maritime Health Service, with the aim of developing and implementing a comprehensive preventive health care programme, entrusts the doctors assigned to this service with medical examinations prior to embarkation (*RD 1414/1981, de 3 Julio de 1981*).

- Subsequently, RD 2358/1982 of 27 August 1982, indicates the structure of the ISM, as well as the locations where it will be possible to carry out medical examinations in Spain and abroad (*RD 2358/1982, de 27 de agosto 1982*).

- "*Ley 14/1986 de 25 abril 1986*" establishes the obligation of the public administrations to develop actions for the protection, promotion and improvement of occupational health (*Ley 14/1986 of 25 abril 1986*).

- "*Ley 31/1995 de 8 Noviembre 1995"* on the Prevention of Occupational Risks makes it compulsory to carry out medical examinations of workers (*Ley 31/1995 de 8 noviembre 1995*).

- The Sixth Additional Provision of RD 39/1997 of 17 January 1997 approves the Regulations on Occupational Risk Prevention Services, and assigns the ISM the competence for medical examinations (*RD 39/1997 de 17 enero 1997*).

- RD 525/2002 of 14 June 2002 transposed into Council Directive 1999/63/EC of 21 June 1999, the purpose of which was to verify compliance by foreign merchant ships with the provisions of clauses 1 to 12 of the Agreement on the Organisation of Working Time of Seafarers. In addition, clause 13 of the agreement made it compulsory for all seafarers to hold a certificate attesting to their ability to perform the duties for which they were employed on board. The nature of the medical examinations to be undergone by seafarers, and the details to be contained in the medical certificates, were to be established after consultation with the shipowners' and seafarers' organisations concerned. Under these regulations, all seafarers will be required to undergo regular medical examinations. Seafarers on watchkeeping who were medically certified as suffering from health problems due to night work were, where possible, to be transferred to a suitable day shift. Medical check-ups were to be carried out free of charge and with respect for medical confidentiality and could be provided within the framework of national health systems (*RD 525/2002 de 14 junio 2002*).

- *"Ley 41/2002 de 14 Noviembre 2002",* among other rights of the person regarding their medical history, indicates that all users have the right to have all certificates on their state of health, and that these will be free of charge (*Ley 41/2002 de 14 noviembre 2002*).

- Article 1 of RD 1696/2007 of 14 December 2007 states that the purpose of medical examinations is to ensure that the applicant's psychophysical conditions are appropriate to the characteristics of the job and do not constitute a danger to the health and safety of the worker or the rest of the crew. These examinations, which will be free of charge for the worker, will be carried out by the doctors assigned to the Maritime Health Service. The period of validity of the medical examination shall be determined in each case by the doctor carrying out the examination, depending on the worker's state of health, age and the type of work to be assigned to him. The maximum validity shall be two years. The result of the medical examination, according to article 5, may be "suitable", "not suitable" or "suitable with restrictions". (*RD 1696/2007 de 14 diciembre 2007).*

- RD 973/2009 of 12 June 2009 states that, as a requirement for embarkation, the crew member must comply with physical fitness standards by means of a medical examination prior to embarkation (*RD 963/2009 de 12 junio 2009).*

There are no specific requirements on the detection of fatigue and/or stress in these regulations neither specific regulations to diagnose fatigue and stress among seafarers.

2. MATERIALS AND METHODS

For the purpose of this study, a survey of 34 questions was designed and distributed. Nearly all the questions in this survey are closed-ended, allowing the survey participant to select, from a series of predefined categories, the response that best fits or approximates their experience (López, 2023). Of the 34 questions comprising the survey, 14 are related to participant identification, 10 are directly related to the perception and diagnosis of stress, and 9 are related to fatigue. The survey was distributed between December 2017 and April 2018, in both English and Spanish, and a total of 236 valid responses were obtained, confirming the sample's representativeness. For the study and comparison of the different variables, the statistical analysis program SPSS and the spreadsheet EXCEL were used (López, 2023).

3.DEVELOPMENT

Since researcher Selye (1973) introduced this concept into the field of health, stress has been a difficult term to define, as it holds different meanings for different researchers. There are numerous references to this term and its consequences on people's behaviour, and likewise, many authors define stress and attempt to quantify it (Selye, 1973).

In general, stress has been conceptualized in three ways:

- As a set of stimuli.
- As a response.
- As a process involving both stressors and responses to them, including the interaction between the individual and the environment.

In the understanding of stress as a set of stimuli (Cannon, 1932;Holmes and Rahe, 1967), there are certain environmental conditions, called stressors, that elicit feelings of tension and/or are perceived as threatening or dangerous in individuals. This concept of stress as harmful stimulation received by the organism is easily linked to illness, health, and well-being. An advantage associated with this definition is the ability to objectively measure stress, therefore considering it as an independent variable.

Stress is a phenomenon with significant consequences and is becoming increasingly common, affecting both physical and psychological well-being and often deteriorating both individual and organizational health. It is a factor that impacts on health and, to a large extent, on the workplace, becoming a key aspect of occupational safety and health.

The current state of employment and the economy is increasingly giving rise to circumstances that pose challenges for workers. Stress-related problems are increasing because the nature of work has changed, transitioning from primarily physical tasks to tasks requiring significant mental effort, driven by the computerization of the production process. Additionally, the increase in the pace of work and the decrease in the number of workers contribute to increased job stress (Del Hoyo, 1997).

Fatigue is an indicator that something is not right and requires attention, whether at an individual level, regarding working conditions, or in connection with their organization. The consequence is that this can affect not only health but also safety, as fatigue brings about errors that can lead to accidents.

In the workplace, fatigue is associated with demotivation, increased absenteeism, and job turnover.

The well-being of personnel, both physically and psychologically, is essential for the normal functioning of the ship. Individuals on board experience a series of psychological and physiological factors, both of which are interconnected. For instance, fatigue can lead to a lack of energy for physical exercise on board, a lack of exercise can lead to obesity due to excessive consumption, a lack of control over diet, and overweight can lead to a lack of ability to perform professional tasks, which could have psychological effects. Fatigue compromises the health and safety of life at sea, both personally and operationally, risking cargo and the ship itself. Therefore, knowledge of the determinants of fatigue is necessary to facilitate its prevention. Due to the unique work of a vessel, working hours and shifts are as important as regulating rest time. These have been analysed and regulated by current specific standards at both national and international levels. (Sargent et al, 2017).

3.1. Stress perception and diagnosis

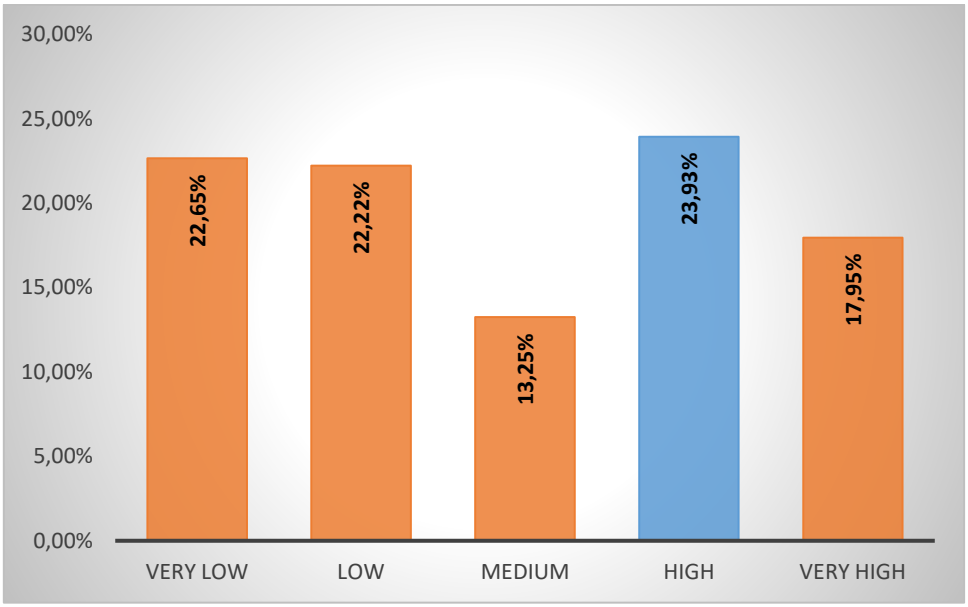
3.1.1 Stress level of the last campaign

Using a Likert scale, data on the perceived level of stress are obtained. As shown in Figure 1 (n=234), a grouping has been made where values of 0 and 1 correspond to a very low level, values 2 and 3 to a low level, values 4, 5, and 6 to a medium level of stress perception, values 7 and 8 correspond to a high level, and very high level to 9 and 10. After this difference, it is observed that 44.87% of the participants rated their level of stress during the last campaign as low, compared to 41.88% who considered their stress level to be high. However, within this latter group, the highest value is observed, with 23.93% attributing values of 7 and 8.

The survey results show that, 55.51% of the surveyed crew members (n=227) admit that stress diagnosis in pre-embarkation medical examinations is "always" necessary.

This highlights that crew members consider a benefit to add tests related to this set of pathological reactions before embarkation. The inclusion of this question in the questionnaire responds to the fact that, in pre-embarkation medical examinations, seafarers primarily undergo physical tests. However, it supports the idea that shipping companies should consider developing and implementing improvements to employee well-being (Nielsen et al,2013).

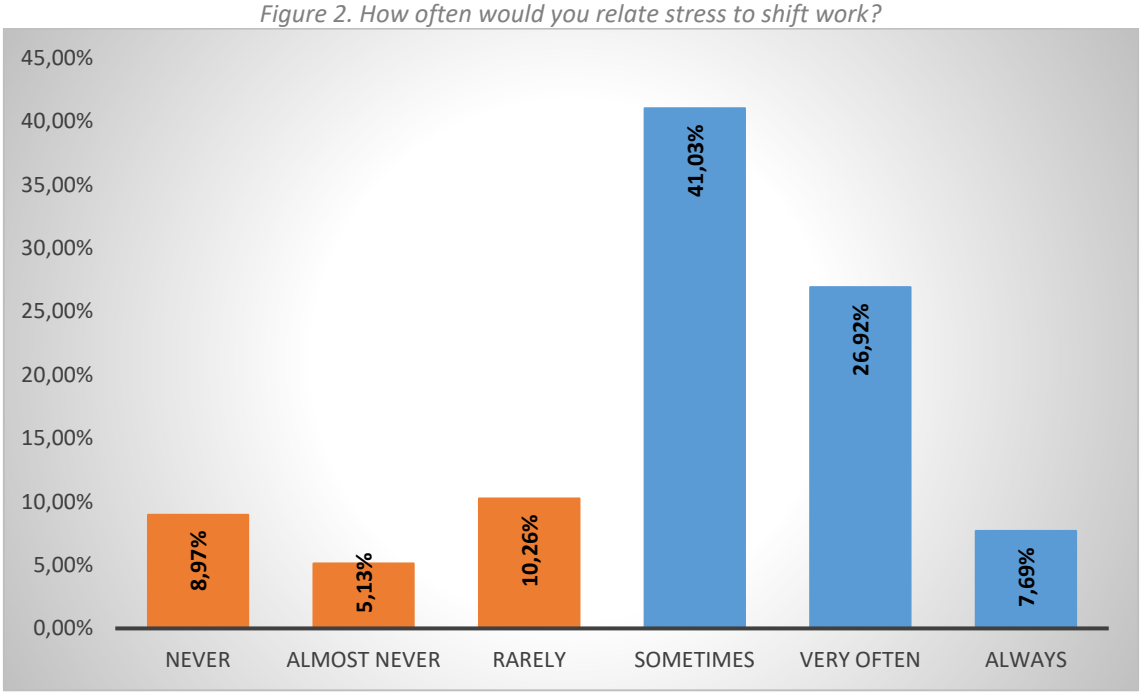
Figure 1. Rate your level of stress in the last campaign from 0 to 10 (0 rates not stressed at all and 10 rates very stressed).



3.1.2 Relationship between stress and work shift

In Figure 2 (n=234), 75.64% of the participants state or declare, to varying degrees, that stress is clearly related to shift work.

Figure 2. How often would you relate stress to shift work?

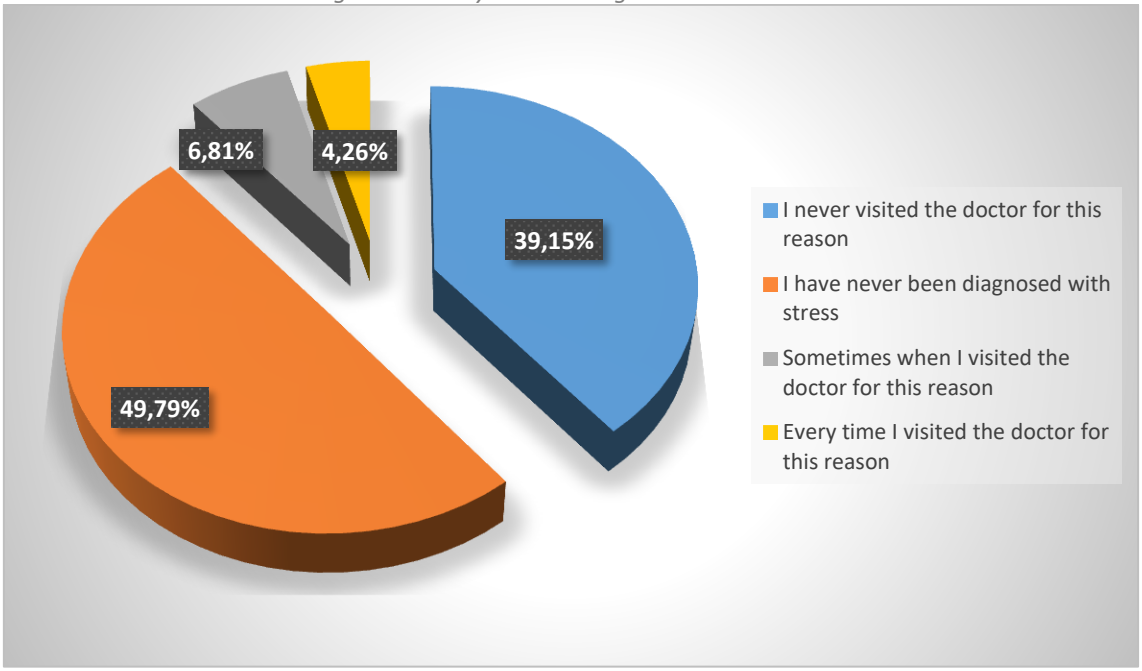


3.1.3 Diagnosis of stress

As shown in Figure 3, 49.79% of the participants claim to have never been diagnosed with stress, followed by those who state that they have never visited a doctor for stress, with 39.15%. It should be noted that not being diagnosed does not mean that one has not experienced it. As previously mentioned, there are no standardized tools for diagnosing stress in the population of seafarers (as discussed in the introductory

section). Furthermore, stress is not currently considered a work-related illness as such (RD 1299/2006, November 10), but rather as a trigger, although governments such as Spain's in 2018, in the "Non-Legislative Proposal for debate in the Employment and Social Security Commission, regarding the increase in work-related accidents in 2017" (PNL, 2018), attempted to include work-related stress in the list of occupational diseases covered by the Social Security system. In 2017, there were 618 deaths during the working day or commuting, increasing in 1.8% the results of the previous year, which is why the Labor Commission at that time presented a non-legislative proposal that includes measures to reduce work-related accidents. The text states that "practically one-third of deaths were caused by a heart attack or stroke," a factor that is cited as "the main cause of death at work." In addition, unions refer to "stress and work pressure have a high impact on this type of death," a cause that "remains the great forgotten in prevention plans." Article 157 of the Consolidated Text of the General Social Security Act defines occupational disease as "that contracted as a result of work performed for others in the activities specified in the table approved by the implementing and development provisions of this Act, and that is caused by the action of the elements or substances indicated in said table for each occupational disease. In such provisions, the procedure to be followed for the inclusion in said table of new occupational diseases that are deemed necessary shall be established. This procedure shall include, in any case, as a compulsory procedure, the report of the Ministry of Health, Social Services and Equality." The above refers to cases of work accidents in general, and therefore, it is applicable to the maritime sector.

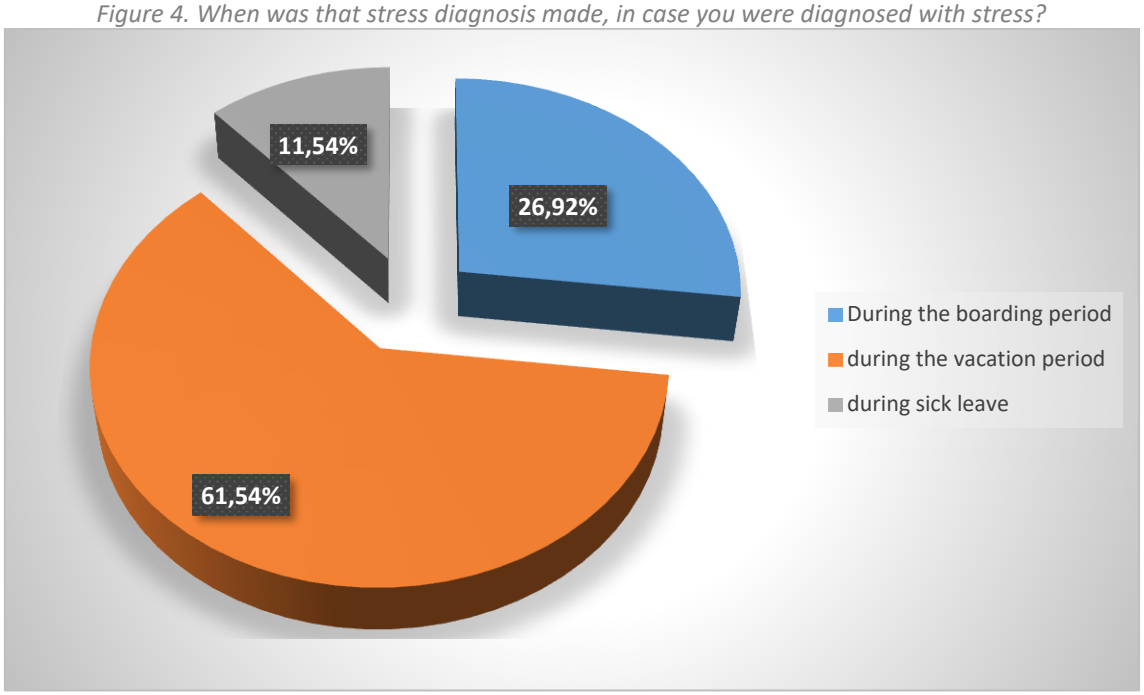
Figure 3. Have you been diagnosed with stress?



3.1.4 Timing of stress diagnosis

As shown in Figure 4, 61.54% of the participants diagnosed with stress were diagnosed during the vacation period.

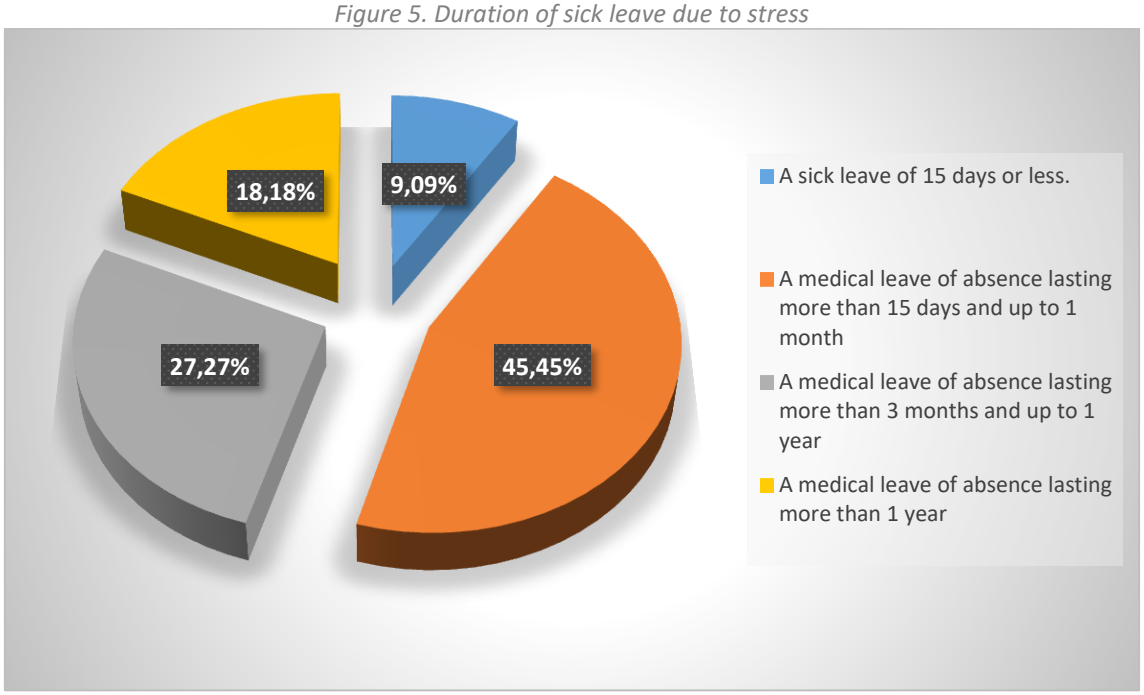
Figure 4. When was that stress diagnosis made, in case you were diagnosed with stress?



3.1.5 Sick leave due to stress

The survey results show that 95.32% of respondents have not taken sick leave due to stress, this figure is far from the data of INE (Spanish statistics National Institute) that indicate that, in 2018, the 30% of sick leave in Spain was caused by stress and anxiety. On the other hand, Figure 5 shows the duration of sick leave due to stress, with sick leave of more than 15 days to one month being the most common among those who did take sick leave due to stress (45.45%), followed by sick leave from three months to one year (27.27%).

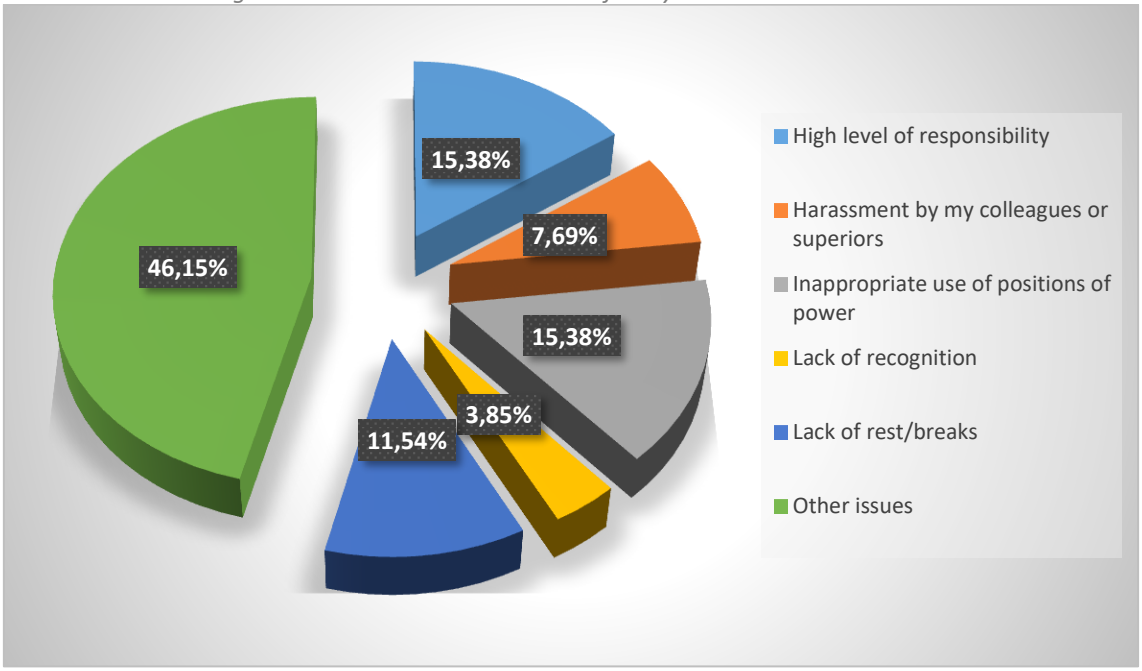
Figure 5. Duration of sick leave due to stress



3.1.6 Main reason for sick leave due to stress

In this section, participants are asked to state the reason for their sick leave due to stress. As shown in Figure 6, the highest percentage is 15.38% corresponding to "high level of responsibility" and "inappropriate use of positions of power." Reasons with a percentage below 3.85% were grouped under "Other issues".

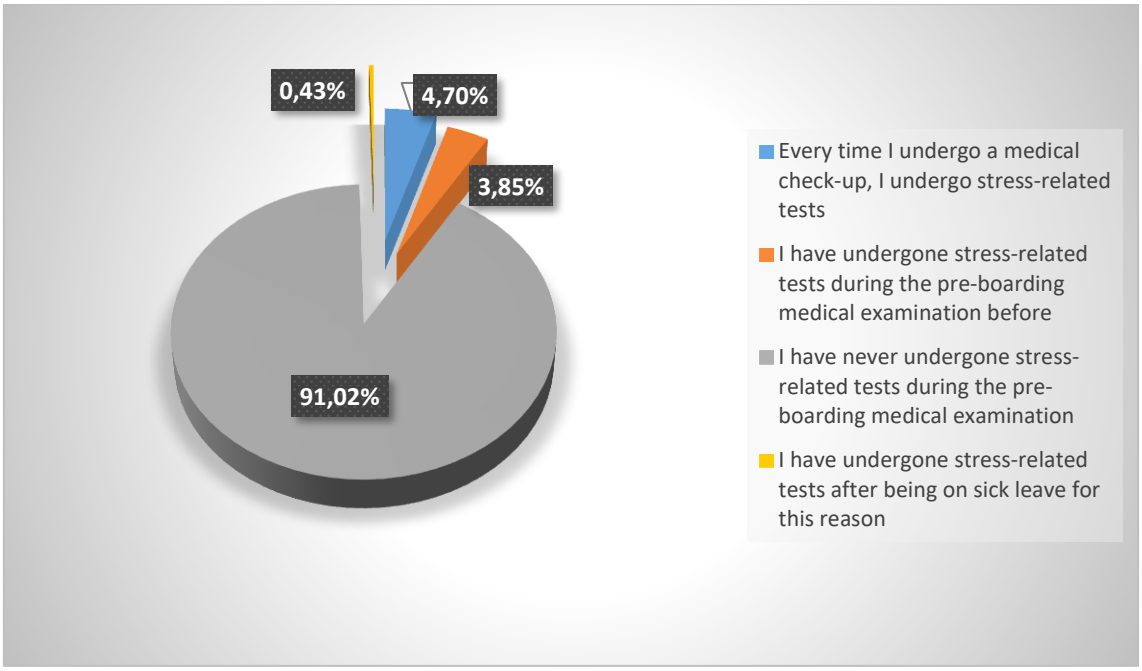
Figure 6. I consider the main reason for my sick leave due to stress



3.1.7 Stress-related tests in pre-embarkation medical examination

Figure 7 shows the results regarding stress-related tests in the pre-embarkation medical examination. 91.03% of the participants claim to have never undergone such tests.

Figure 7. In the pre-embarkation medical examination, indicate the response you would have experienced



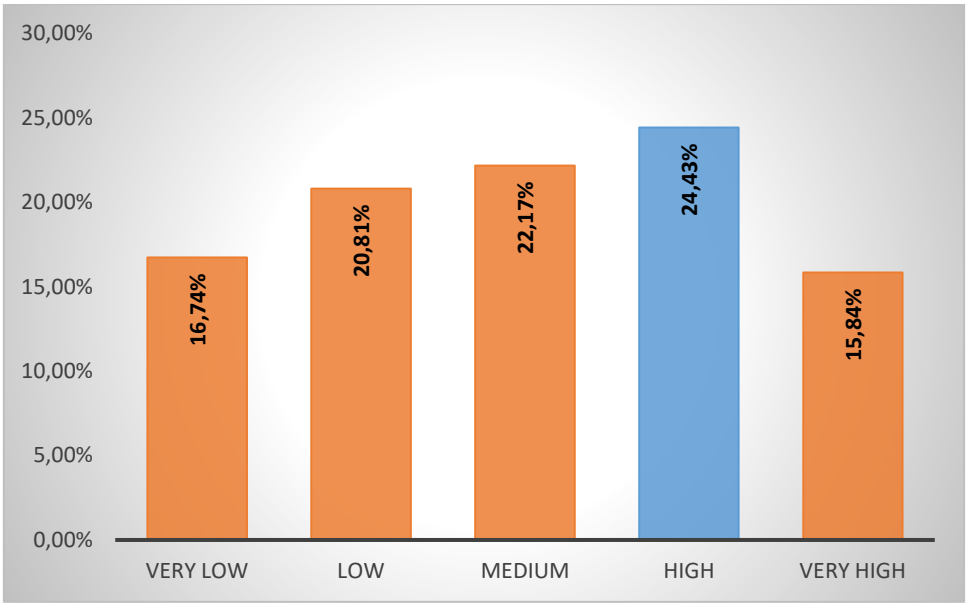
3.2. Fatigue perception and diagnosis

3.2.1 Level of fatigue in the last campaign

In order to obtain data regarding the perception of fatigue level, participants are asked about their level of fatigue in the last campaign using a Likert scale from 0 to 10 (where 0 means "not fatigued at all" and 10 means "very fatigued"). As shown in Figure 9 (n=221), a grouping has been done where very low fatigue level is considered for values 0 and 1, low level for values 2 and 3, medium level for values 4, 5, and 6, high level for values 7 and 8, and very high for values 9 and 10. 24.43% of participants consider themselves to have a high level of fatigue.

The survey results show 61.40% of the participants consider that diagnosing fatigue in the pre-embarkation examination is always necessary.

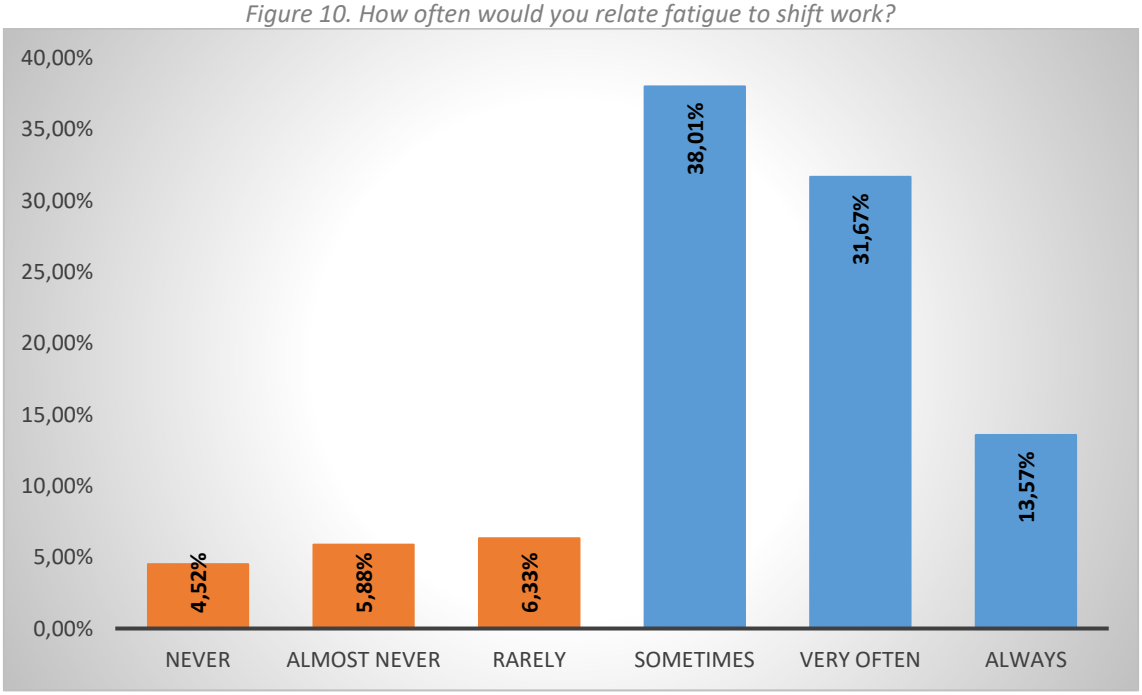
Figure 9. Rate your level of fatigue in the last campaign from 0 to 10 (where 0 means not fatigued at all and 10 means very fatigued)



3.2.2 Relationship between fatigue and shift work

In Figure 10 (n=221), it is shown that 83.25% of the participants affirm, to some extent, that fatigue is clearly related to shift work.

Figure 10. How often would you relate fatigue to shift work?



3.2.3 Diagnosis of fatigue

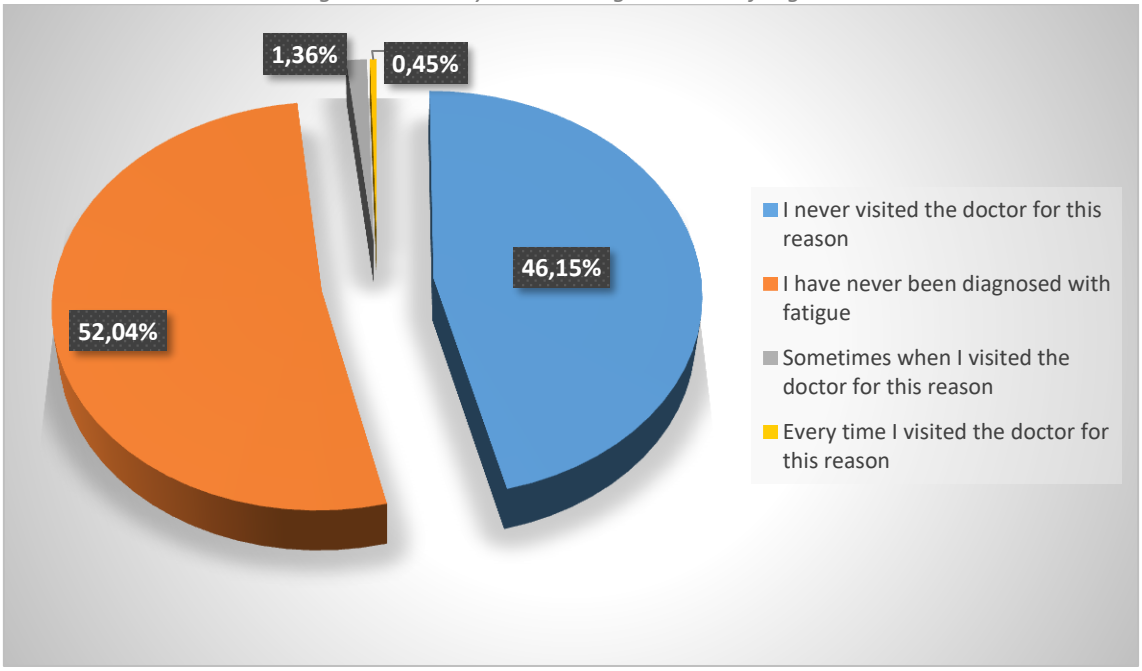
Díaz (2009) defines work-related fatigue as "a depletion of the individual, at the nervous, psychological, muscular, intellectual, or sensory level, most likely caused by the continuity of a task without adequate rest or compensation, resulting in effects such as loss of functional capacity, lack of resistance, feelings of helplessness, and discomfort." According to Quevedo et al. (2005), work-related fatigue can negatively impact the worker's health, leading to specific symptoms due to exposure to conditions that do not occur in the same way in everyday life.

Work-related fatigue alone is not considered an occupational disease in Spanish legislation (RD 1299/2006, November 10). Work-related fatigue is a consequence of excessive activity and monotonous work, which can be alleviated with reasonable schedules, adequate rest periods, and sufficient time for sleep, recreation, and eating. Therefore, fatigue manifests as a decreasing ability to perform work. Long working hours are inevitably associated with fatigue; in these cases, the sense of fatigue acts as a protective mechanism for the body, preventing total exhaustion. This is the reason for including these questions in the survey.

Work-related fatigue originates from the person-job relationship (UCM, 2013). Factors arising from work and the conditions under which it is carried out have a significant influence on the body and mind, shaping the types of fatigue.

Figure 11 shows that 52.04% of the participants have never been diagnosed with fatigue, while 0.45% of the participants have been diagnosed with fatigue every time they visited the doctor for this reason.

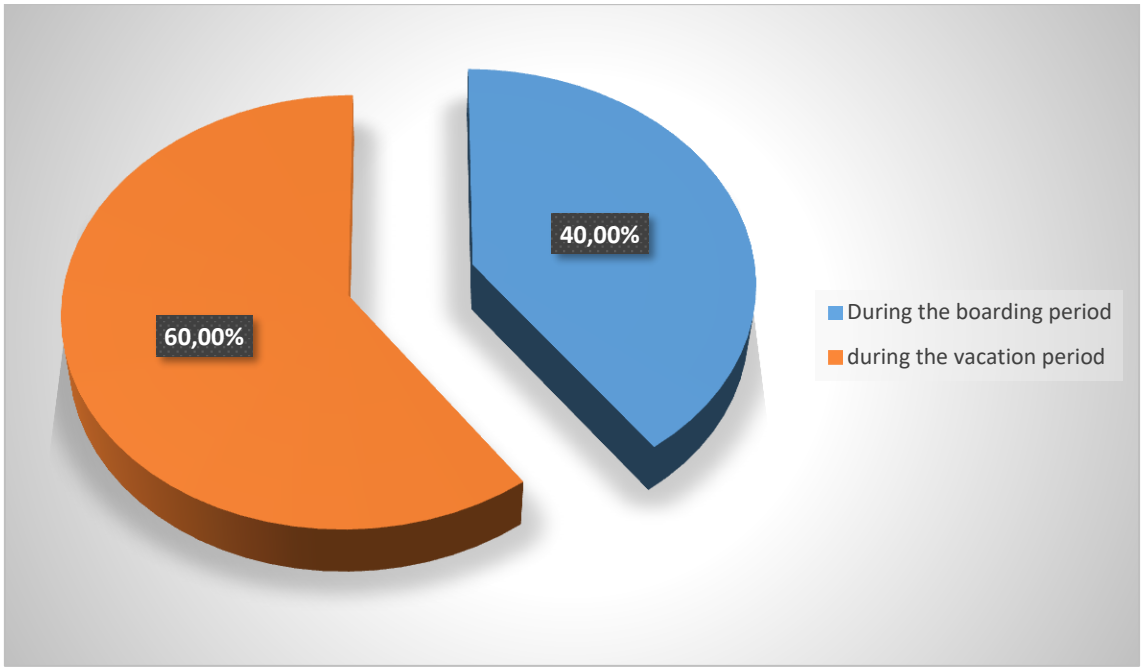
Figure 11. Have you been diagnosed with fatigue?



3.2.4 Timing of fatigue diagnosis

Figure 12 shows that among the participants diagnosed with fatigue, 60% were diagnosed during the vacation period.

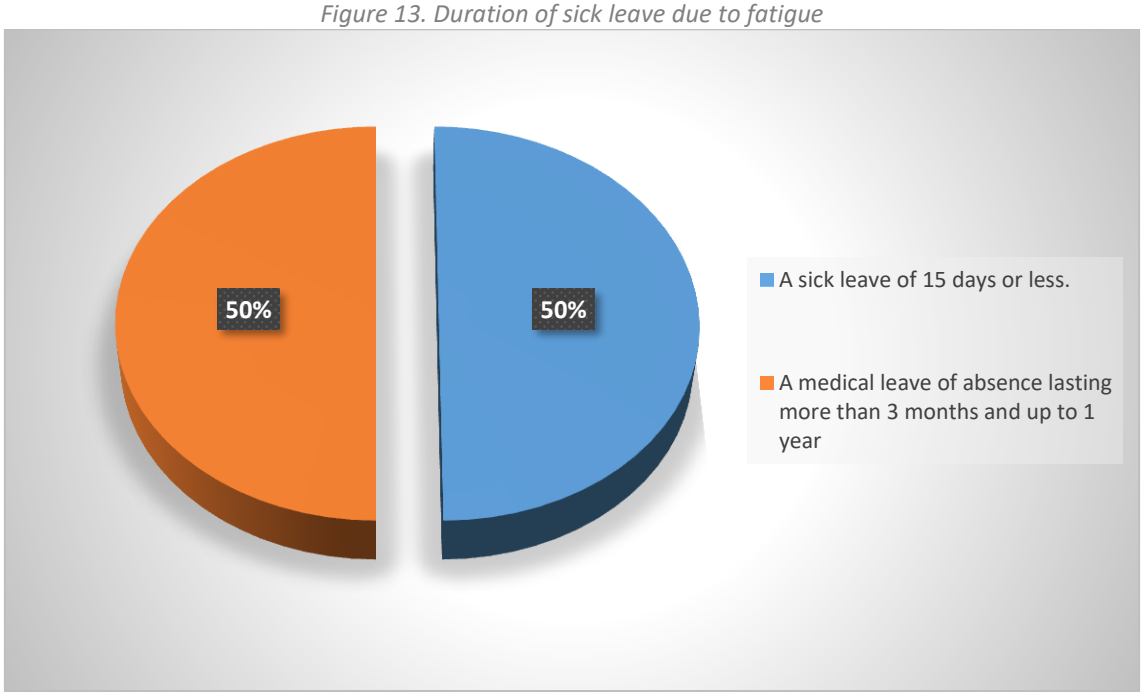
Figure 12. If diagnosed with fatigue, when was the diagnosis made?



3.2.5 Sick leave due to fatigue

The survey results show that 99.10% of the participants have not taken sick leave due to fatigue. On the other hand, the duration of this sick leave is analysed. Figure 13 shows that in 50% of cases, sick leave has been for more than 15 days to a month, while in the other 50%, it has been from 3 months to a year.

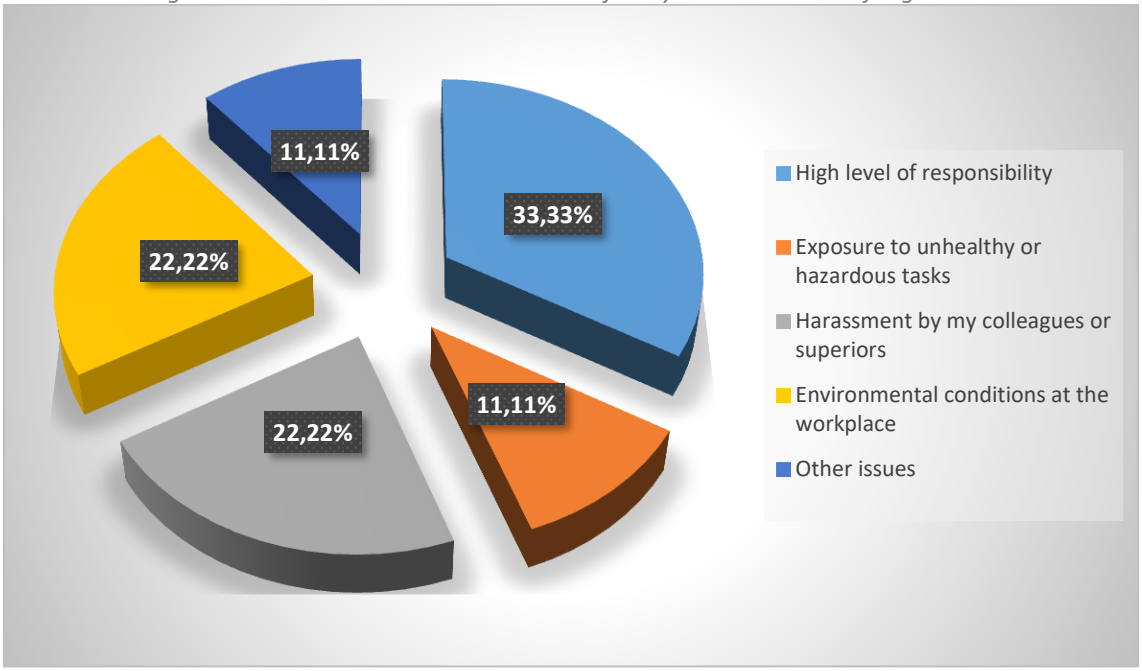
Figure 13. Duration of sick leave due to fatigue



3.2.6 Main reason for sick leave due to fatigue

As shown in Figure 14, 33.33% of those diagnosed consider that the main reason for their sick leave due to fatigue has been the high level of responsibility.

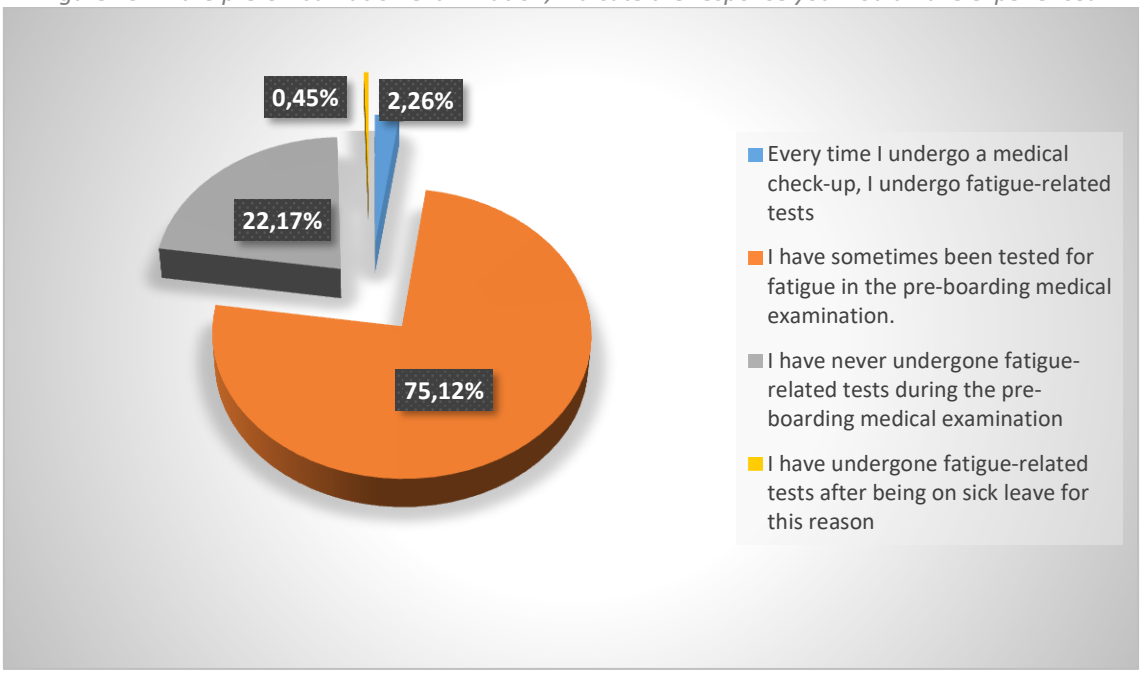
Figure 14. I consider that the main reason for my sick leave due to fatigue was



3.2.7 Tests related to fatigue in medical examinations.

Figure 15 shows the results regarding tests related to fatigue in pre-embarkation medical examinations. 75.11% of the participants say they have sometimes been tested for fatigue in the pre-boarding medical examination, while 0.45% declare they have undergone fatigue-related tests after being on sick leave for this reason. It is worth noting that the 22.17% state that they have never undergone fatigue-related tests during the pre-boarding medical examination.

Figure 15. In the pre-embarkation examination, indicate the response you would have experienced



4. CONCLUSIONS

As part of the work leading to this article, the responses of the participating seafarers in the survey on stress and fatigue experienced during their last onboard campaign have been analysed, focusing on pre-embarkation medical examinations. The majority of participants agree that they have not undergone specific tests for the detection of stress,in the case of fatigue, although 75% have ever been tested for fatigue in the medical examination, more than 22% admit that they have never been tested for fatigue in the pre-boarding examination, despite the fact that the vast majority acknowledge experiencing both stress and fatigue without being diagnosed with them.

After analysing the existing Spanish regulations regarding medical examinations, we observed the obligation to conduct these examinations and that they should be carried out by duly qualified personnel, in addition to determining the duration of the fitness to work on a ship. With the aim of avoinding endanger maritime navigation, medical examinations focus on the psychophysical abilities of seafarers prior to embarkation, but do not address stress and/or fatigue in depth, as specific protocols for addressing these issues have not been found. Furthermore, the respondents largely agree on the need to conduct tests related to both stress and fatigue in pre-embarkation examinations.

An interesting action would be to include tests on stress and fatigue experienced onboard in medical examinations. Based on the survey findings, it is observed that seafarers who have taken sick leave due to stress and fatigue, or have been diagnosed with these conditions, receive treatment and follow-up. However, none of them would have participated in a pre-diagnostic test for fatigue and stress, which could have facilitated early detection of symptoms and appropriate action accordingly.

On the other hand, up to 2 years may elapse between two consecutive medical examinations, during which time the seafarer may have engaged in numerous onboard campaigns, assumed various positions of responsibility, collaborated with different colleagues, served on vessels with varying routes, and possibly even switched companies.

Companies and competent authorities are urged to invest in research and work on prevention and training, as well as the detection and recognition of both stress and fatigue. This is because among the reasons outlined in this article, the signs and symptoms of these problems could be mistaken by the individual onboard.

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