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The prevalence of seasickness in a population of French civilian sailors

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ABSTRACT

Background: *Motion sickness, is the onset of a series of clinical signs when travelling in a means of locomotion. Boats are the most common source of kinetosis, causing seasickness. Although this condition is often benign, it can severely affect the quality of life of seafarers, as well as the quality of their work. The aim of this study is to focus on the point prevalence and characteristics of seasickness in a population of French civilian seafarers from all shipping sectors.*

Materials and methods: *During two months in 2023, we conducted a cross-sectional study based on a questionnaire containing 28 questions.*

Results: *One hundred nine men and 10 women completed the questionnaire. Of these, 34% said they were seasick. The main symptoms described by the sailors were nausea and cold sweats in 87.5% and 50% of cases, respectively. The prevalence of naupathy appears to be higher in women (60% compared with 31% in men). Women also seem to be less accustomed to the marine environment than men, with 71% of men and only 33% of women indicating that they get accustomed to life at sea. However, the symptoms of seasickness seem to disappear more slowly in men than in women. In terms of treatment, men (38%) were more likely to take medication than women (17%).*

Conclusions: *Our study shows a greater susceptibility to seasickness among women. This interpretation should be treated with caution given the small number of women who took part in the study. The relatively low point prevalence of seasickness (34%) could be due to under-reporting. Although ways of thinking are changing, seasickness is still a taboo subject for many sailors. Yet seasickness has major professional and personal repercussions. So it's important to raise the subject and discuss strategies for improving well-being at work.*

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Keywords: seasickness, seafarers, epidemiology, naval medicine

INTRODUCTION

CLINICAL PRESENTATION OF SEASICKNESS

Seasickness, also known as naupathy, can occur in anyone who sails, regardless of how often they sail. Its clinical presentation varies from one individual to another, but two phases are classically distinguished: the initial or prodromal phase (characterised by nausea, paleness, sweating, yawning, salivation and progressive disinterest in the environment) and the state phase (characterised by vomiting and prostration). In general, this reaction is completely

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benign and requires only symptomatic treatment. However, in rare cases, complications may arise, particularly in the most fragile individuals or in the event of particularly severe symptoms: acute dehydration, imbalance in a health condition linked to an interruption in treatment (inability to take medication or rejection through vomiting). Typically, the body becomes accustomed to the symptoms, and the symptoms subside after 2 to 3 days [1, 2].

ELEMENTS OF PHYSIOPATHOLOGY

The pathophysiology of seasickness is complex and is linked to the notion of equilibrium. This notion depends on three types of information supplied to the brain by the visual, somato-sensory and vestibular systems. At sea, the inner ear, and more specifically the vestibule, is subjected to complex stimulation, linked to the random movements of the swell. In addition to the movements associated with its own propulsion, a ship is also subject to the agitation of the waves [1].

The symptoms of seasickness will appear more or less quickly, depending on the frequency of the vertical oscillations. It is essentially the very low frequency vibrations, between 0 and 2 Hertz, that are most likely to cause naupathy [1].

Vestibular conflict can also be amplified when head movements are made in a vessel already subject to oscillations: this is the Coriolis effect [1, 2].

The visual system can have a protective effect. Several studies have shown that if you have a fixed point outside the boat, such as a horizon line, this visual landmark can slow down vestibular stimulation and reduce the symptoms of naupathy [1].

At sea, the neuro-sensory information provided by the visual system, the proprioceptive system and the vestibular system is transmitted to the medulla oblongata, but it is discordant. They are then processed and compared with patterns resulting from previous experiences in order to resolve these discrepancies in information and command an appropriate motor response to maintain equilibrium. This is the theory of Reason and Brand [3]. When the organism finds a solution to this sensory conflict, we say that the sailor get accustomed to life at sea. When the conflict persists the symptoms of naupathy appear.

Until now, published studies on seasickness have been based on highly targeted samples of seafarers. The aim of our study is to assess the prevalence and characteristics of seasickness in a population of French civilian seafarers from all shipping sectors.

MATERIALS AND METHODS

METHODOLOGY

We conducted a cross-sectional study using a specific questionnaire containing 28 questions. We chose to study the point prevalence, i.e. the number of cases of naupathy at a given time. All seafarers who had ever sailed and consulted the Brest Seafarers' Health Service between 26/01/2023 and 28/03/2023 were eligible to take part in the study. First-time registrants were excluded. Seafarers were informed of the study by means of a poster in the service's waiting room and by verbal information during consultations. The questionnaire was accessible by smartphone, using a QR code. A total of 119 civilian seafarers from all shipping sectors confirmed their consent and took part in the study. Responses to the questionnaire were collected online, by automatic transmission at the end of the questionnaire.

STATISTICAL ANALYSIS

Statistical analyses were conducted using "Excel" and "P-Value" software. We performed descriptive analyses on qualitative and quantitative demographic, occupational and pathology-related variables. We also performed a univariate analysis based on gender. Quantitative variables were described using the mean and standard deviations. Categorical variables were expressed as headcounts and percentages. Several statistical tests were used depending on the distribution of the variable: Welch, Fischer and Mann-Whitney. The significance threshold for the statistical tests was set at a p-value of 5%.

RESULTS

DATA RECOVERY

The source population consisted of 350 sailors who came in the medical centre for fitness examination. A total of 119 sailors, aged 16 to 72 years (109 men and 10 women) answered to the questionnaire. The average age was 41.8 years. The characteristics of the study population are shown in Table 1.

Table 2 summarises the characteristics of seasickness in the study population. It can be seen that 34% of the seafarers questioned said they felt seasick. On the other hand, very few sailors (19%) declared that they were homesick. In the vast majority of cases, symptoms appeared very early (after a few hours). As far as the social impact is concerned, more than half of sailors (52%) suffering from naupathy say they are embarrassed to be ill. This percentage is probably lower because several seafarers said they were not embarrassed to be ill and then gave reasons for being embarrassed at work. The main reasons given by seafarers were the discomfort of being ill in the workplace (46%) and the fear of being less productive at work, with an impact on collective work performance (59%). Treatment for seasickness does not seem to be widespread, with 65% of seafarers surveyed saying they do not take any medication.

Table 1. Characteristics of the study population

		Number (n)	Percentage (%)
Gender	Man	109	91.6
	Woman	10	8.4
Medical history	No	105	88
	Tinnitus	6	5
	Vision disorders	8	6.7
Type of navigation	Shellfish farming and small-scale fishing	11	9.2
	Offshore, inshore and deep-sea fishing	18	15.1
	Piloting, towing, national coastal shipping, mooring	38	31.9
	International cabotage, long distance	43	36.1
	Leisure	9	7.6
Type of ship	Trawler, dredger, troller, seiner, net boat, caseyeur	30	25.2
	Passenger ship	30	25.2
	Multi-purpose vessel, service vessel, patrol vessel	37	31.1
	Dry transport, liquid transport, hourglass vessels	11	9.2
	Sailing boat	10	8.4
	Aquaculture ship	1	0.8
Workplace	On the deck	41	34
	Multi-purpose	40	34
	Boat gangway	23	19
	Machine room	12	10
	Kitchen, cabins	3	2.5

Table 2. Characteristics of seasickness in the study population

		Nombre (n)	Percentage (%)
Are you seasick?	No never	79	66
	Yes	40	34
How often?	Rarely	26	65
	Regularly	12	30
	Systematically	2	5
When do the first symptoms appear?	After a few hours	31	78
	After one or several days	5	12
	From boarding	4	10
How long does it take for them to disappear?	After a few hours	17	42
	In one day	16	40
	In 2 to 3 days	4	10
	They persist throughout the mission	3	7.5
Have you suffered from seasickness in the past, with symptoms disappearing since?	No	85	71
	Yes	34	29

Table 2 cont. Characteristics of seasickness in the study population

		Nombre (n)	Percentage (%)
Do you suffer from earth sickness?	No	96	81
	Yes	23	19
Do you get accustomed to life at sea ?	Yes	26	65
	No	14	35
How long does it take?	One day or less	28	90
	Two days	3	9.7
Are you embarrassed to be ill?	Yes	21	52
	No	19	48
If so, what are the reasons?	Discomfort at being less or no longer productive, with an impact on collective work performance	22	59
	Other reason	14	38
	Embarrassment at being ill at work	17	46
	Humiliating to vomit in front of work colleagues	2	5
If you are taking a treatment, what are you taking?	None	26	65
	Antiemetic	9	22
	Other: drinks, food, clove ?	2	5
	Antiemetic and patches	2	5
	Transdermal patches	1	2.5
If you are taking medication, do you bring your own medicine on board?	I don't take any medication	27	68
	Yes	10	25
	No	3	7.5
If you are taking one or more treatments, are they effective?	No treatment	29	72
	Yes	10	25
	No	1	2.5

CHARACTERISTICS OF SEASICKNESS ACCORDING TO GENDER

Table 3 compares the characteristics of seasickness according to gender. The results do not show any significant differences, but suggest a female predominance in terms of seasickness symptoms, with 60% of women and only 31% of men reporting seasickness. However, the symptoms of seasickness seem to disappear more quickly in women than in men. On the other hand, men seem to be more accustomed to the marine environment, with 71% of men and only 33% of women reporting that they get accustomed to life at sea. In addition, the discomfort of being ill does not seem to differ significantly according to gender. As far as treatment is concerned, the results seem to suggest that men tend to take treatment more frequently than women. In fact, 38% of men said they were taking medication, compared with 17% of women.

Table 4 lists the various symptoms of seasickness expressed by the sailors and their respective frequency. It can be seen that nausea and cold sweats are widely reported by sailors, in 87.5% and 50% of cases respectively.

DISCUSSION

COMPARISON OF OUR RESULTS WITH THE LITERATURE

The main objective of our study was to investigate the point prevalence and characteristics of seasickness in a large population of French seafarers. The results show a prevalence rate of seasickness of around 34%.

These results are similar to those found by Malek et al. [4] in a population of military at a naval base in Bangladesh. The prevalence rate of seasickness was 40.4%.Our results seem consistent, but lower than the study published in 2022 by Nanna Yr Arnardottir et al. [5]. These researchers looked at seasickness in a population of Icelandic sailors. Among them, the overwhelming majority (87.5%) said they had experienced symptoms of seasickness during their careers. Most experienced these symptoms after spending a long period ashore or on the first day of embarkation. Disembarkation sickness was also frequently reported by seafarers (in 85.8% of cases). According to the authors, this high prevalence of seasickness among Icelandic seafarers

Table 3. Characteristics of seasickness according to gender

		Man (n = 109)	Woman (n = 10)	n	p	Test
Age		41.9 (10.9)	41.3 (13.3)	119	0.89	Welch
Are you seasick ?	No never	75 (69%)	4 (40%)	79	0.084	Fisher
	Yes	34 (31%)	6 (60%)	40	–	–
How often ?	Rarely	22 (65%)	4 (67%)	26	1	Fisher
	Regularly	10 (29%)	2 (33%)	12	–	–
	Systematically	2 (5.9%)	0 (0%)	2	–	–
When do the first symptoms appear?	After a few hours	26 (76%)	5 (83%)	31	1	Fisher
	After one or several days	4 (12%)	1 (17%)	5	–	–
	From boarding	4 (12%)	0 (0%)	4	–	–
How long does it take for them to disappear?	After a few hours	13 (38%)	4 (67%)	17	0.74	Fisher
	In one day	14 (41%)	2 (33%)	16	–	–
	In two to three days	4 (12%)	0 (0%)	4	–	–
	They persist throughout the mission	3 (8.8%)	0 (0%)	3	–	–
Medical history	No	97 (89%)	8 (80%)	105	0.21	Fisher
	Tinnitus	6 (5.5%)	0 (0%)	6	–	–
	Vision disorders	6 (5.5%)	2 (20%)	8	–	–
Have you suffered from seasickness in the past, with symptoms disappearing since?	No	80 (73%)	5 (50%)	85	0.15	Fisher
	Yes	29 (27%)	5 (50%)	34	–	–
Do you suffer from earth sickness?	No	89 (82%)	7 (70%)	96	0.4	Fisher
	Yes	20 (18%)	3 (30%)	23	–	–
Do you get accustomed to life at sea?	Yes	24 (71%)	2 (33%)	26	0.16	Fisher
	No	10 (29%)	4 (67%)	14	–	–
How long does it take?	One day or less	25 (89%)	3 (100%)	28	1	Fisher
	Two days	3 (11%)	0 (0%)	3	–	–
Are you embarrassed to be ill?	Yes	18 (53%)	3 (50%)	21	1	Fisher
	No	16 (47%)	3 (50%)	19	–	–
If so, what are the reasons?	Discomfort at being less or no longer productive, with an impact on collective work performance	19 (59%)	3 (60%)	22	0.9	Fisher
	Other reason	11 (34%)	3 (60%)	14	–	–
	Embarrassment at being ill at work	14 (44%)	3 (60%)	17	–	–
	Humiliating to vomit in front of work colleagues	2 (5.9%)	0 (0%)	2	–	–
If you are taking one or more treatments, are they effective?	No treatment	24 (71%)	5 (83%)	29	0.07	Fisher
	Yes	10 (29%)	0 (0%)	10	–	–
	No	0 (0%)	1 (17%)	1	–	–
Type of treatment	I don't take any treatment	21 (62%)	5 (83%)	26	1	Fisher
	Antiemetic	8 (24%)	1 (17%)	9	–	–
	Other: drinks, food, clove?	2 (5.9%)	0 (0%)	2	–	–
	Antiemetic and patches	2 (5.9%)	0 (0%)	2	–	–
	Transdermal patches	1 (2.9%)	0 (0%)	1	–	–

Table 3 cont. Characteristics of seasickness according to gender

		Man (n = 109)	Woman(n = 10)	n	p	Test
If you are taking medication, do you bring your own medicine on board?	I don't take any treatment	22 (65%)	5 (83%)	27	1	Fisher
	Yes	9 (26%)	1 (17%)	10	–	–
	No	3 (8.8%)	0 (0%)	3	–	–

Table 4. The different symptoms of seasickness and their frequency

Clinical sign	Number (n)	Percentage (%)
Nausea	35	87.5
Cold sweat	20	50
Yawns	17	42.5
Vomiting	16	40
Pallor	16	40
Drowsiness	10	25
Fatigue	10	25
Feeling of weakness, depression, sluggishness	9	22.5
Headache	6	15
Disinterest in work	5	12.5
Irritability	3	7.5
Dizziness	3	7.5
Withdrawal into oneself	2	5
Balance disorders	2	5

could be partly explained by a broader discourse on seasickness among Icelandic populations, as well as by the maritime weather conditions, which are said to be particularly harsh in Iceland.

This high prevalence was also noted by P. Spätgens [6] in a more specific population made up of Finnish merchant navy cadets.

In 2020, a study published by Jegaden et al. [7]but one that can significantly disrupt work on board. The aim of the study is to evaluate the influence of SS on the workability of workers on board vessels. MATERIALS AND METHODS: We performed a cross-sectional questionnaire study conducted on 250 oceanographers in 2015 during 3 months. Based on the \"Bos seasickness susceptibility questionnaire\", we created a specific questionnaire with 49 questions. RESULTS: 151 men and 72 women responded to the survey. 188 of them (91.7% of women and 80.8% of men also showed a higher prevalence rate of seasickness than our results. In fact, 84.3% of a population of French oceanographic researchers claimed to be seasick attributed to the sailors' rate. Indeed, missions are often spaced further apart and over shorter periods. In 2006, Gregory Chan et al. [8] carried out a comparative study looking at the prevalence of motion sickness in a population of Singapore Armed Forces personnel, divided into two groups : non-sailing personnel, and regularly sailing Navy personnel. The prevalence of motion sickness was 38.3% among naval personnel and 59.2% among those not used to sail. Headaches, nausea and dizziness were the main symptoms reported. These results suggest an habituation to maritime conditions among naval personnel, but this interpretation must be treated with caution, as it was found that 10.1% of naval personnel were taking prophylaxis or treatment for motion sickness, compared with only 1.5% of non-sailing personnel.

In our study, the main symptoms were nausea and cold sweats, in 87.5% and 50% of cases respectively. Most often, these symptoms appeared very early (in the first few hours after boarding). These symptoms are in line with the data in the literature. In the study by Nanna Yr Arnardottir et al. [5], nausea, dizziness and sweating were the main symptoms expressed by Icelandic seafarers. The high prevalence of neurovegetative and digestive symptoms were found in the studies by Spätgens [6] and De Martin [9] respectively, with frequencies of 36 to 30% for pallor, 41 to 43% for fatigue and 36 to 30% for cold sweats. In the study by Jegaden et al. [7]but one that can significantly disrupt work on board. The aim of the study is to evaluate the influence of SS on the workability of workers on board vessels. MATERIALS AND METHODS: We performed a cross-sectional questionnaire study conducted on 250 oceanographers in 2015 during 3 months. Based on the \"Bos seasickness susceptibility questionnaire\", we created a specific questionnaire with 49 questions. RESULTS: 151 men and 72 women responded to the survey. 188 of them (91.7% of women and 80.8% of men, in 2020, the main symptoms found were also nausea and vomiting, in 81.9% and 55.9% of cases respectively. Symptoms could appear either occasionally (in 69% of cases) or each time they embarked (with a predominance of women, 23.6% for women compared with 11.3% for men). In our study, more than half of seafarers (52%) suffering from naupathy said they were embarrassed to be ill. This percentage is probably lower because several seafarers said they were not bothered by being ill and then gave reasons for being bothered at work. The main reasons given by seafarers were the inconvenience of being ill in the workplace (46%) and the fear of being less productive at work, with an impact

on collective work performance (59%). These findings may highlight the persistence of a kind of taboo according to which a seafarer should not suffer from seasickness.

When focusing on gender, the results of our study tend to suggest that women are more sensitive to seasickness than men. They are also less accustomed to maritime conditions, which favours the development of seasickness. On the other hand, the symptoms of seasickness seem to disappear more slowly in men than in women. However, the social impact of seasickness does not seem to differ significantly according to gender. As far as treatment is concerned, the results seem to suggest that men take treatment more frequently than women. Indeed, 38% of men reported taking a treatment, compared with 17% of women.

In the study conducted by Jegaden et al. [7], 10.6% of women reported greater sensitivity to seasickness during the menstrual period. According to Cuomo-Granston and Drummond [10], this could be explained, at least in part, by female sex hormones, which contribute to the development of migraines and seasickness. Bos and Bles [11] described a trend towards a gradual attenuation of sex-related differences in terms of naupathy. No significant sex-related differences were noted after the age of 35.

EPIDEMIOLOGICAL FACTORS IN SEASICKNESS

Seasickness therefore has a physical, psychological and social impact. In order to offer better care to sailors, a case-control study conducted by Daphnée Martinez in 2018 looked at the epidemiological factors of naupathy in comparable groups of sailors from the French Navy in Brest [12]. The study also found that women were more sensitive to seasickness, although the intensity of symptoms was comparable to that of men. In terms of on-board workplaces, this study found that cooks and mechanics were less susceptible to seasickness. This could be explained by the fact that these people work in areas close to the boat's centre of gravity. The practice of a sporting activity involving a high degree of proprioceptive involvement and a history of sailing experience in childhood also appear to be protective factors against naupathy. On the other hand, cooking smells, hypoglycaemia, avoidance reactions, acrophobia and claustrophobia seem to increase susceptibility to seasickness. However, it is important to note that acrophobia and claustrophobia only affected a small number of sailors.

In 2022, Chan-Young Park et al. [13] were interested in the potential link between depression, susceptibility to seasickness and possible capacity to adapt to seasickness. In a population of military sailors who had never sailed before, they found that mild to moderate depression was associated with a poor ability to adapt to seasickness. However, the authors found no significant link between depression and initial susceptibility to seasickness.

SEASICKNESS AND ITS IMPACT ON THE WORK OF SEAFARERS

Seasickness is a condition that is often hidden. Its clinical presentation can considerably impair a seafarer's ability to work. In 2016, Spätgens [6] conducted a study on a population of Finnish merchant navy cadets. 58% of them said that seasickness had a negative impact on their performance at work, and of these, 10% said that seasickness was so intense that it prevented them from carrying out their usual duties. In 2020, Jegaden et al. [7] studied seasickness and its impact on the work of researchers on board French oceanographic vessels. In this study, the impact of seasickness was significant. Indeed, 60% of the researchers linked seasickness to an influence on the success of their mission, affecting their mood (50%), their interpersonal skills (23%) and increasing the risk of accidents such as falls, accidents on machinery or in laboratories (40%).

THERAPEUTIC STRATEGIES FOR SEASICKNESS

Given the multiple repercussions of naupathy, therapies have been studied. In 2022, Maffert et al. [14] conducted an initial study evaluating the effectiveness of a non-medicinal treatment for seasickness, the Nausicaa system. After 10 rehabilitation sessions using this system, the results showed a significant reduction in the average intensity of seasickness in seafarers (from 8.96 to 4.5) as well as a reduction in the inability to hold one's position (from 8.36 to 3.07). The Graybiel and Miller score was significantly improved (reduction of 2 to 3 grades) in 62% of patients, and partially improved (reduction of one grade) in 20% of seafarers. In the entire population studied, 82% of rehabilitated patients experienced an improvement thanks to the treatment, with no side-effects. When compared with other series, the results seemed to show a slight superiority of the Nausicaa system over optokinetic rehabilitation or visual simulator alone.

In 2013, Jarisch et al. [15] studied the impact of oral vitamin C intake on histamine levels and seasickness. The results suggested an impact of vitamin C on symptoms' severity.

STRENGTHS AND LIMITATIONS OF OUR STUDY

Our study has two main strengths. Firstly, the study population is made up of seafarers from all shipping sectors, which is interesting because, until now, the data in the literature have been based on very targeted samples of seafarers. Secondly, the questionnaires were completed during consultations at the SSGM, ensuring greater reliability of the responses as the seafarers were able to ask any questions they might have, thus limiting response bias.

On the other hand, given the small size of our sample and inclusion of only one centre in France, the population

is not representative of all seafarers and the statistical power is therefore limited. Our study may be subject to classification bias because the questionnaire was given to the seafarers during their medical check-up. Despite the anonymity of their answers, some of them may have feared losing their jobs if they declared they were seasick. We cannot therefore expect the answers to correspond completely to reality. In addition, interpretations of potential gender differences must remain cautious as only a small proportion of women took part in the study.

CONCLUSIONS

Our study shows a relatively low prevalence rate of seasickness compared with the literature. It may be explained by a probable under-reporting, linked to a social taboo, and by the relatively small population studied made up of seafarers from all shipping sectors: certain sailing areas are calmer and less likely to cause naupathy. It would be interesting to repeat this study on a larger population of seafarers, possibly using the same questionnaire, in order to obtain more representative results. A question could also be added to explore more precisely the impact of seasickness on continued employment. Naupathy has a significant impact on well-being at work. It would be relevant to look at the benefits and durability of this desensitization when seafarers return to work.

ARTICLE INFORMATION AND DECLARATIONS

Data availability statement: The data are available by asking to corresponding author.

Ethics statement: This study was approved by French national commission for informatic and liberty number 2233005.

Author contributions: Study design: Maroussia Jan Le Cloarec, Dominique Jegaden, David Lucas; Data analysis: David Lucas; Manuscript draft version: Maroussia Jan Le Cloarec, Dominique Jegaden, David Lucas, Alexis Maffert, Brice Loddé, Richard Pougnet. All authors accept Final version of the manuscript. The paper and data have not been published before, is not under consideration for publication elsewhere, and has been approved by all co-authors.

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