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Seasickness and its impact on researchers' work on board French oceanographic vessels

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ABSTRACT

Background: *Seasickness (SS) is an often hidden pathology, 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) report being seasick, either occasionally (69%) or at each boarding where there is female predominance (23.6% vs. 11.3% for men). The major symptoms are nausea (82%) and vomiting (56%). 60% of the workers think that SS has an influence on the success of their mission, by first affecting their mood (50%), relationship (23%), and increased risk of accidents such as falls, accidents on machines or in laboratories (40%). Antinaupathic treatments also produce deleterious effects on their workstation. Women have higher risk of developing SS (odds ratio [OR] 2.6; 95% confidence interval [CI] 1.03–6.6; p = 0.04), more frequently taking medicines when ill (OR 4.1; 95% CI 1.27–13.2; p = 0.004) and coming with her own tablets (OR 2.3; 95% CI 1.3–4.1; p = 0.04).*

Conclusions: *Gender is a trending factor of SS. Information on SS clinical signs, impact and therapeutics could be prone to prevent sickness and impact of it on workability.*

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Key words: maritime medicine, seasickness, onboard conditions

INTRODUCTION

On board a ship, in addition to its own movement related to its propulsion and like for all nonstable natural environment, the sea could induce various movements back and forth (pitch) and from right to left (roll). This complex and random system of very low frequency vibratory type, due to changing weather conditions, is variable in time, frequency and intensity. The main result is a vertical translational movement directly related to waves' height. The frequency of these vibrations is between 0.01 Hz in very calm condition and 1.5 Hz in bad weather and accelerations range from 0.01 to 0.8 g, sometimes even 1 g. At these frequencies, the body behaves like a single mass and the vibrations are fully transmitted in amplitude and acceleration (whole body vibrations) [1].

O'Hanlon and McCauley [2] have shown that, more than roll and pitch, which would ultimately play a secondary role, the primary cause of seasickness (SS) is above all the acceleration of the vertical component of the movements. An abacus drawn from the theory of these authors was modelled by Bos and Bles [1]. They compiled the frequency of the movement (in Hertz [Hz]), the acceleration (in m/s^2) and the motion sickness incidence (MSI = percentage of subjects presenting a vomiting within 2 h) [1]. Thus, the maximum MSI would be reached for a movement frequency of 0.16 Hz and an acceleration of 5.4 m/s^2. Lawther and Griffin [3] and after Davis and Hollowey [4] confirmed that the MSI was directly dependent on waves' height and proportional to the movements' vertical acceleration.

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Seasickness is a consequence of a body positioning information disorder, involving simultaneously three components: the vestibular system; the visual system, in particular tracking; and the proprioceptive and somatosensory system, in particular feet and nape of neck. The information produced by these three systems, transmitted to the brain centres, is compared with each other, but also compared with the information previously stored, to evaluate their coherence, which involves an adequate motor reaction of equilibration when they are coherent. In the case of SS, this information is conflicting and results in the appearance of clinical signs (sensory rearrangement theory of Reason and Brand [5]).

The chronology, number and intensity of the symptoms could be different in a very marked way according to the individual susceptibility of the individuals, the size of the ship, the nature, duration and importance of the movement and the environmental conditions (odours, heat, onboard places, position of the body and psychological conditions). We classically distinguish three phases: the beginning phase (anxiety, pallor, cold sweats, yawning, salivation, and drowsiness), the state phase (nausea, vomiting and prostration) and evolution (in general resolution of signs within a few hours). In rare cases, the process can lead to acute dehydration, imbalance of a preexisting health disorder such as diabetes, or disruption of treatment (not taking medication or rejection by vomiting).

Most studies and articles published in the field of motion sickness talked about road and air transport. Some also discussed about the mal du debarquement syndrome but SS in seafarers' population is rarely discuss. Few studies have been published on the influence of SS and time to get used to life at sea on the workability of workers on board vessels.

The objectives of this study were to test certain epidemiological data found in the SS literature (prevalence, differences in relation to sex, study of clinical signs) and above all to assess the medical, economic and relational impact of this pathology on the implementation of professional tasks on board, highlighting the possible differences between men and women.

We studied these questions in a population of oceanographic researchers from a French research centre.

MATERIALS AND METHODS

SURVEY METHODOLOGY

This is cross-sectional questionnaire study was conducted on 250 oceanographers in 2015 during 3 months. Based on the "Bos seasickness susceptibility questionnaire" [6], we created a specific questionnaire with 49 questions. Before the survey and during an onboard mission, it was tested in a smaller population. A health unit with an occupational nurse and a physician was located in the research centre. According to the health policies of the occupational health service, all workers who had onboard worktimes had been referred to the health unit for annual medical examinations. In 2014, during examinations, employees of the health unit inform workers about the survey. In 2015, the questionnaires were sent individually by email. Workers had to send it back to the occupational health. They gave it in hand to hand to the nurse and confirm their consent. The inclusion criteria were: volunteer, being a researcher or a technician from the French research institute, regular onboard mission, fit at work and for navigation [7]. The onboard periods were either coastal or longer ocean-going missions.

STATISTICAL ANALYSIS

Statistical analysis was done by using Statistica software (TIBCO data sciences, Palo Alto California, USA). The quantitative variables were described using the usual position and standard deviations. Categorical variables were presented as numbers (percentage). When conditions applied, the t-test was used. When needed, the Shapiro-Wilk test was used to test for normal distribution of data. Where variables were not normally distributed, non-parametric test (Mann-Withney U test) were used, otherwise. Crude odds ratio (OR) including 95% confidence interval (CI) were calculated by binary regression. The alpha risk was set at 5% for all analyses.

RESULTS

DATA COLLECTION

The source population included 250 workers: oceanographers are researchers from different specialties (biologists, geologists, oceanographers, climatologists, physicists, chemists) who are interested in all aspects of the marine environment. We collected 223 questionnaire (151 men and 72 women), for a satisfactory response rate of 89.2%.

The population and missions characteristics are summarised in Table 1.

Frequency, characteristics of SS and environmental factors effects are listed in Table 2.

Table 1. Characteristics of population and onboard missions

	Number	Per cent
Men	151	67.7
Women	72	32.3
Coastal and offshore	136	61
Offshore	58	26
Coastal	29	13
1 to 2 missions	133	59.6
> 2 missions	90	40.9
Total	223	

Table 2. Frequency, characteristics and environmental factors effects on seasickness

		Number	Per cent
Seasickness	Yes	188	84.3
	Never	35	15.7
Frequency	Sometimes	154	81.9
	Every time	34	18.1
With sea conditions	Yes	166	89.2
	No	20	10.8
	Total	186	
Vertical movements of the ship	Yes	145	78.4
	No	36	19.5
	Total	185	
Roll movements of the ship	Yes	92	50
	No	74	40.2
When first symptoms begin	After some hours	167	88.8
	Immediately after embarkment	20	10.6
Do you need time for getting used to the sea	Yes	165	88.2
	No	22	11.8
When symptoms disappeared	2/3 days	81	44
	1 day	43	23.4
	Few hours	34	18.5
	Never	26	14.1
Symptoms are increased by	Smell of gasoil	136	88.9
	Smell of cooking	83	54.2
	Smell of tobacco	80	53.2
	Poor ventilation	54	35.2
Influence of menstruation period	Don't know	45	62.5
	No	20	27.8
	Yes	7	9.7

Vomiting is the highest stage of SS and allows patients to be counted on a common basis (MSI). The Tables 3 and 4 demonstrates respectively the SS symptoms, the impact of SS on workability and missions declared by workers.

When comparing two groups by gender, we find significant differences for SS (OR 2.6; 95% CI 1.03–6.6; p = 0.04), increased frequency in women for taking medicines when ill and coming with her own tablets (respectively OR 4.1; 95% CI 1.27–13.2; p = 0.004 and OR 2.3; 95% CI 1.3–4.1; p = 0.04) (Table 5).

Average boarding times were much lower for coastal missions (7.8 days) compared to offshore missions (25.7 days, p = 0.05).

FREQUENCY OF SEASICKNESS

The occurrence of SS was not related to the number of days on board (18 days for agents prone to SS and 21 days for the others, p = 0.1), age (p = 0.7) nor to the type of navigation (83.5% for offshore, 89.7% in coastal, p = 0.86).

Table 3. Declared symptoms of seasickness in percentage

Nausea	81.9%
Vomiting	55.9%
Pallor	43.1%
Yawning	42.6%
Cold sweats	40.4%
Drowsiness	38.3%
Fatigue	35.6%
Work disinterest	35.1%
Listlessness	17%
Withdrawal	16.5%
Headaches	16.5%
Dizziness	12.8%
Balance impairment	6.9%
Sopite syndrome	2.6%

Table 4. Impact of seasickness (SS) on workability

		Number	Per cent
Are you afraid of SS before embarkment	No	164	85.4
	Yes	28	14.6
Due to SS, have you refused a mission	No	183	95.8
	Yes	8	4.2
Does SS have an impact on your mission?	Yes	118	62.1
	No	72	37.9
What kind?	My own mood	86	75.4
	Economical	43	37.7
	Relationship with colleagues	33	28.9
	Hard relationship with head of mission	5	4.4
In case of SS what do you do?	Go on deck	106	56.4
	Stay in my cabin	99	52.7
	Take medicines	79	42
	Nothing special	25	13.3
Type of medication	Nothing	85	45.9
	Mercalm	53	28.6
	Scopolamine patches	40	21.6
	Other: homeopathy, food and beverages	18	9.7
	Stugeron	3	1.6
Do you feel embarrassed by SS	No	119	64
	Yes	67	36
What is the most embarrassing?	Less reactive and active at work	61	88.4
	To be sick in professional place	29	42
	My colleagues could see me vomiting	18	26.1
Is SS have an impact on your time at workplace	Yes	95	50.8
	No	92	49.2

Table 5. Comparison by gender

	Man	Woman	Odds ratio	P
Seasickness* (yes)	122 (80.8%)	66 (91.7%)	2.6 [1.03–6.6]	0.004
Coastal missions	19 (12.6%)	10 (13.9%)	2.2 [0.86–5.4]	0.09
Coastal and offshore	105 (69.5%)	31 (43.1%)	0.56 [0.23–1.33]	0.18
Symptoms				
Stop after few hours	17 (14.3%)	17 (26.2%)	2.3 [0.9–5.88]	0.08
Stop after 2 days	58 (45.7%)	23 (35.4%)	0.91 [0.4–2]	0.8
Never stop	14 (11.8%)	12 (18.5%)	1.97 [0.72–5.42]	0.18
Afraid before mission (yes)	14 (11.3%)	14 (20.6%)	2.03 [0.9–4.57]	0.08
Take medicines* (yes)	44 (35.8%)	35 (53.8%)	4.1 [1.27–13.2]	0.001
Come with my own medicines (yes)*	52 (36.4%)	41 (53.9%)	2.3 [1.3–4.1]	0.004
No embarkation because of SS (yes)	4 (3.2%)	4 (6%)	0.52 [0.12–2.1]	0.37
Does SS have an impact on your mission? (no)	45 (36.6%)	27 (40.3%)	1.17 [0.63–2.15]	0.61
Concentration at work (no)	65 (52.8%)	30 (46.9%)	1.27 [0.69–2.32]	0.4
Do you feel embarrassed by SS	41 (33.3%)	26 (41.3%)	1.4 [0.75–2.62]	0.28

*$p < 0.05$

Table 6. Medicines

	Man	Woman	Total
Dimenhydrinate	18.5%	34.7%	23.8%
Cinnarizine	2%	0%	1.4%
Scopolamine's patch	13.3%	27.8%	17.9%
Other (acupuncture, homeopathy)	7.3%	9.7%	8.1%
Are medicines efficient yes	75%	84%	79%

TAKING ANTI-SICKNESS TREATMENT

Table 6 summarises the behaviours implemented during the occurrence of a naupathy. The most widely used conventional treatments were dimenhydrinate and cinnarizine (only 1% for the latter molecule because it is not marketed in France, despite its recognized effectiveness) for treatments in tablets and scopolamine per patch [6, 7].

DISCUSSION

The high level in response rate allows us to discuss our results.

We found, consistently to literature on the subject, gender susceptibility for SS and mostly gastrointestinal disorders. Due to SS, women are also more anxious before mission and taken medicines, but they less declared than men impact on work (concentration at work, psychological disorders).

Due to extreme variability of its occurrence' conditions it is hard to collect quantitative data on the incidence and prevalence of this pathology. Indeed, the weather, sea conditions and number of patients during each mission are various. The estimated prevalence ranged from 25% to 30% of American and British white populations in calm sea, increasing between 50% and 90% in heavy sea [8]. A recent publication on sailors from the French Merchant Navy gives a figure of 55% of sailors who would not be affected by SS at all [9]. In our study we found respectively a prevalence of 84% and 69% for "occasionally or systematically" and "occasionally" SS suffering. Lower frequency and duration of onboard mission in researchers could explain it. Consistent with our results, gastrointestinal symptoms were more frequently declared with nausea (61%) and vomiting (48%) followed by yawning and drowsiness (30%) in the study involved by Turner and Griffin [10] or incidence of vomiting of 40% in 4915 passengers during 17 trips [8, 10]. Various percentages for apathy, fatigue and cold sweats are described [10]. But data in literature is based either on a calculation of the MSI in specific conditions [10]. In 1976, Graybiel and Knepton [11] isolated a particular type of motion sickness, sopite syndrome, associating drowsiness, yawning, disinterest in work, mood disorders, sleep disorders, but without digestive signs. We can classify in this syndrome only 5 people (2 men and 3 women).

Confirmed by our study, it is generally accepted that women are more often affected by SS than men [12, 13]. Our results shed particular light on this point by showing significant differences with an OR at 2.6. Moreover, some studies show a relationship between menstrual period and SS [14]. In our results, only 10.6% of women expressed greater sensitivity to SS during menstruation, 30% reported none. According to Cuomo-Granston and Drummond [15] female sex hormones may, at least in part, predispose individuals susceptible to motion sickness and migraine.

In addition, adaptation to maritime conditions plays a role here. Sailors regularly on board are generally less prone to SS than passengers, since they incorporate movement patterns conforming to the theory of Reason and Brand [5]. Like described by Bos and Bles [1] the effect of gender on SS susceptibility decreased inversely with age and no differences after 35 years were noted.

Seasickness first poses a problem of self-esteem and relationships with others. In popular imagination, a seafarer is not (or should not be) prone to SS and, therefore, is prone to easily mock passengers affected by SS. The sick person therefore feels in a situation of psychological inferiority vis-à-vis those who are not or who do not want to admit it. In our population, 17% find it humiliating to be forced to vomit in front of work colleagues and 20% declared having their relationship disrupted. It could also explain why women significantly come with their own medicines against SS and taken it more frequently than men who have to be "stronger" against SS.

Seasickness and susceptibility to SS have a direct and indirect impact on workability. When they were ill, onboard workers went on deck or stayed in their cabin and daily time at work decrease. Indeed, most of workers declared that SS have an impact on their work tasks, concentration at work and own mood. Pisula et al. [16] have showed that vertical accelerations can cause cognitive impairment. Matsangas and McCauley [17] believe that the stress caused by SS and sopite syndrome is, in part, responsible for the deterioration of cognitive performance. Valk mentions the fatigue and sleep disturbances caused by SS in the decline in performance rather than the movements of the ship itself [18]. The causes of SS accidents are in the risk of falling

(especially overboard while vomiting). But, whether in falls or in accidents at work such as accidents on machine tools or launching devices, or even jets of chemicals, it is mainly the movements of the ship, by bad time, which carry the risk, more than SS. In his thesis on 61 Finnish sailors, Spätgens [19] notes that 10% of them had SS at some point which prevented them from carrying out their usual tasks on board, 11% could only do light work, 38% had moderate discomfort in their work station and 42% were able to fully perform their tasks.

Side effects of drugs taken for SS could impact work capacities. Gordon [20] has shown that dimenhydrinate disrupts reaction and memorisation tests like digit span, which is not the case with cinnarizine and scopolamine. Also drowsiness and blurred vision have been noticed with such medicines.

To prevent impact of SS on work non-drug treatments such as optokinetic rehabilitation could be discussed. It gives good lasting results over time, and which can be proposed for subjects with uncontrollable SS [20, 21]. This treatment requires 20 sessions over a period of 3 months in a specialised environment. According to the authors, 71% of reeducated subjects are improved, compared to 12.5% of subjects subjected to placebo treatment [22]. It allows you to be less prone to SS and not taking medication during the mission. This therapy could also benefit to workers who declared higher susceptibility to SS.

Our study is a self-declared study by questionnaire. A healthy worker effect is a possible bias with a population of selected oceanographers who regularly embarked. Indeed, in popular imagination, a seafarer is not (or should not be) prone to SS and, therefore, is prone to easily mock passengers affected by SS. The sick person therefore feels in a situation of psychological inferiority and do not declared it.

CONCLUSIONS

Seasickness is an often hidden pathology, but one that can significantly disrupt work on board. Gender is a trending factor of SS. Information on SS clinical signs, impact and therapeutics could be prone to prevent sickness, other diseases linked to or imbalanced by SS and impact of it on workability.

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