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## A COMPARISON OF MOTION SICKNESS PREVALENCE BETWEEN SEAFARERS AND NON-SEAFARERS ONBOARD NAVAL PLATFORMS

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### ABSTRACT

*Background:* Motion sickness may crucially affect the operational performance of soldiers at sea and this differs between individuals and environments.

*Objectives:* To report on the prevalence and understand the risk factors for motion sickness among Singaporean sailors (seafarers) and attached army servicemen (non-seafarers) onboard naval platforms.

*Methodology:* Cross sectional study using self-administered survey of 503 personnel over the monsoon period from January to April 2001.

*Results:* The prevalence of motion sickness was distinctly higher in the army (59.2%) personnel compared with the navy (38.3%) over a series of sea states. The most common symptoms were headache, nausea and dizziness. The Motion Sickness

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Susceptibility Questionnaire was used to score susceptibility and appeared to correlate better among non-seafarers rather than seafarers. The discomfort experienced in one's environment was perceived to contribute towards onset and smoking appeared to be protective against motion sickness. Regular sailing appears to be an important factor in minimising motion sickness.

*Conclusion:* While we understand motion sickness to be a continuum of physiological responses to the whole body vibration, it is especially apparent among the non-seafarers. Seafarers by themselves will become less susceptible with regular sailing and they are also more cognizant of the modalities available to alleviate symptoms.

*Keywords:* Motion sickness, navy, army, MSSQ, smoking, sea sickness

## BACKGROUND

Motion sickness is a physiological condition arising from oscillatory movements or whole body vibration such as those onboard sea vessels such as ships and boats, and may crucially affect the operational performance of soldiers at sea. A consortium of psychosocial and environmental factors contribute to the susceptibility risk of motion sickness and these risk factor profiles may vary between individuals due to differing neural mismatch composition.

Data relates primarily to Western populations. Epidemiological population studies around the world have reported a motion sickness rate of 28% for the Indian population,<sup>1</sup> and 25%-30% for Caucasian population in USA and UK respectively during calm seas.<sup>2</sup> Approximately 10-30% of British naval crew experienced sea sickness during commonly encountered sea conditions, while 50%-90% experienced sickness in the worst seas.<sup>3</sup> Ninety percent of the general population have experienced motion sickness at some point in their lives.<sup>4,5</sup>

## OBJECTIVES

To report on the prevalence and understand the risk factors for motion sickness among Singaporean sailors (seafarers) and attached army servicemen (non-seafarers) onboard naval platforms.

## MATERIALS AND METHODS

The study is a cross-sectional one employing a self-administered questionnaire survey. The subjects comprised of 503 servicemen (all Asian males) from the Singapore Armed Forces comprising of 196 (39.0%) from the army (attached and non-seafaring) and 307 (61.0%) from the navy (sea-faring) who were all travelling onboard naval vessels. All the navy personnel were onboard smaller platforms while the army personnel were on the much larger logistics platforms. The data was collected during the seasonal monsoon periods from January to April 2001 where the sea-states ranged from 1-4 (Beaufort Scale<sup>6</sup>).

Data collection: The questionnaire attempted to capture subjective symptoms experienced and the triggering factors for motion sickness. A positive case of motion sickness was defined as an individual who is “sensitive to or affected by” one or more of the symptoms of dizziness, cold sweating, dry mouth, blurred vision, uneasiness of stomach discomfort, headache, nausea and vomiting.<sup>7-9</sup> Conversely, the absence of all symptoms would be regarded as a negative case.

Triggers for motion sickness were derived from discussions with the military personnel. This was broadly classified into 2 groups: personal factors such as the lack of experience, fear of sailing, alcohol and diet; and environmental factors such as stuffy and noisy environment.<sup>10</sup>

We also utilised the MSSQ (Motion Sickness Susceptibility Questionnaire) scoring index, which we felt provided a more objective measure of motion sickness susceptibility.<sup>11</sup> The index reflected the motion sickness history susceptibility of individuals based on their travelling experience both as a child and as an adult and complemented the subjective definition of motion sickness used above. An extract of the questions used are shown in Table 1. The score is calculated as shown, and the higher the score, the more susceptible is the individual to motion sickness:

A represent objective measure of the childhood susceptibility scores to motion stimuli

B represent objective measure of the adult susceptibility scores to motion stimuli

$$\text{MSSQA (Child)} = 23.76 \times (\text{total sickness score child}) \times (\text{no of types experienced as a child})^{-1}$$

$$\text{MSSQB (Adult)} = 23.76 \times (\text{total sickness score adult}) \times (\text{no of types experienced as an adult})^{-1}$$

$$\text{MSSQ score} = \text{MSSQA (Child)} + \text{MSSQB (Adult)}$$

Table 1. Extract of questionnaire showing MSSQ section <sup>11</sup>

For the following questions, please grade your experiences in the following table with the coding system provided. \*

1. As a child (before age 12), have you **Travelled or Experienced** the following transportations.

**Coding for Question 1**

**0 (Never)**

**1 (1 to 4 trips)**  
**2 (5 to 10 trips)**  
**3 (11 or more trips)**

2. As a **child (before age 12)**, how often you **Felt Sick or Nauseated** when using the following transportations.

3. As a **child (before age 12)**, how often you **Vomited** when using the following transportations.

4. Over the **last 10 years**, how often you **Travelled or Experienced** the following transportations.

5. Over the **last 10 years**, how often you **Felt Sick or Nauseated** when using the following transportations.

6. Over the **last 10 years**, how often you **Vomited** when using the following transportations.

**Coding for Question 2—6**

**0 (Never)**

**1 (Rarely)**  
**2 (Sometimes)**  
**3 (Frequently)**  
**4 (Always)**

**Questions**

**1**  
**2**  
**3**  
**4**  
**5**  
**6**

**Cars**  
**Buses or coaches**  
**Trains**  
**Aircraft**  
**Small boats**  
**Ships eg. Ferries or cruise**  
**Swings**  
**Roundabouts: Playgrounds**  
**Big Dippers, Funfair Rides**

All the servicemen onboard filled the questionnaire approximately two hours before sailing and at every change of sea state (Beaufort Scale<sup>6</sup>); and completed questionnaires were collected before disembarkation. There was 100% response rate.

Data analysis: Sample statistics and odds ratios (OR) with 95% confidence intervals (95% CI) were computed to assess the relationships of study factors. Differences were considered significant if the p value was <0.05. MSSQ scores were calculated using formula provided by Golding et al.<sup>12</sup> All calculations were performed using the SPSS Win Version 11.0 statistical package (SPSS, Chicago, IL).

## RESULTS

The subjects comprised of 503 servicemen with a mean age (+SD) 25.6 (+3.8) years, mean weight 67.4 (+11.5) kilograms and mean height 1.72 (+0.12) metres. There was no significant difference between the navy and army personnel, and the demographics are comparable.

Motion Sickness prevalence: The prevalence of motion sickness was 38.3% (117/307) and 59.2% (116/196) among naval and army servicemen respectively. The comparison based upon sea states is shown in Table 2. Among the navy personnel, motion sickness prevalence was 38.4% (sea state 1-2) and 38.1% (sea state 3-4). There was no apparent difference attributed to sea states. Unfortunately, data for the army was not stratified as such.

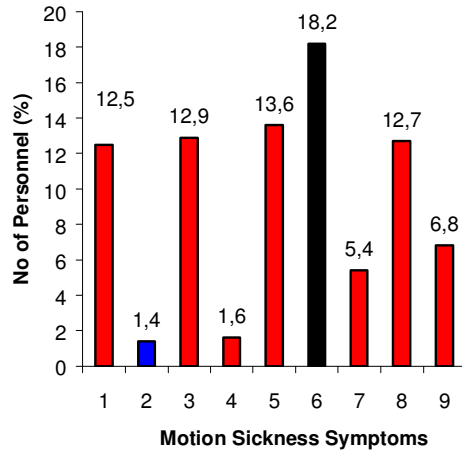
Table 2. Risk of motion sickness by sea states in naval personnel

Sea state	Motion sickness symptoms <sup>a</sup>		
	Negative <sup>b</sup>	Positive <sup>c</sup>	OR (95% CI)
1 to 2	189 (61.6)	118 (38.4)	
3 to 4	52 (61.9)	32 (38.1)	0.99 (0.60 – 1.62)

- a. Including dizziness, cold sweating, dry mouth, blurred vision, uneasiness of stomach, headache, feeling that your surrounding is spinning, feel like vomiting and vomited.
- b. Denotes subjects who do not exhibit any of the symptoms of motion sickness.
- a. Denotes subjects who exhibit one or more of the symptoms of motion sickness.

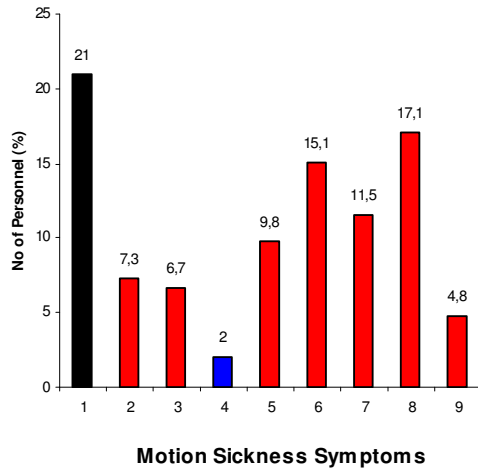
The most common symptoms of motion sickness experienced are shown in Figures 1 and 2 for the navy and army personnel respectively. The more common symptoms were headache, nausea (feel like vomiting/uneasiness of stomach) and dizziness. It was also found that 10.1% of the navy personnel used some form of medication (chemoprophylaxis or treatment) for motion sickness compared with only 1.5% for army. This may contribute to the difference in motion sickness prevalence.

Figure 1. Motion sickness in Navy personnel



Symptoms 1:Dizziness, 2: Cold Sweating, 3: Dry Mouth; 4: Blurred Vision; 5: Uneasiness of Stomach; 6: Headache; 7: Feel surrounding is spinning; 8: Feel like Vomiting; 9: Vomited.

Figure 2. Motion sickness in Army personnel



Symptoms 1:Dizziness, 2: Cold Sweating, 3: Dry Mouth; 4: Blurred Vision; 5: Uneasiness of Stomach; 6: Headache; 7: Feel surrounding is spinning; 8: Feel like Vomiting; 9: Vomited.

*MSSQ Score:* The MSSQ score was introduced to predict the crewmen motion sickness history susceptibility. Higher scores indicate a greater risk of individuals prone to motion sickness. The mean MSSQ score was higher among the army personnel (53.5) compared with navy (47.7). Differences for motion sickness and non-motion sickness personnel on mean MSSQ score is shown in Table 3; and we also compared the relative risks based upon quartiles of MSSQ score (Table 4 and 5). The MSSQ did not appear to be relevant in the navy personnel, but was a better predictor in army personnel.

Table 3. MSSQ Score between motion sickness and non-motion sickness personnel

Mean MSSQ score			
Naval vessel	All Personnel	Motion Sick Symptoms	No Motion Sickness Symptoms
Navy personnel	47.7	58.0	40.3
Army personnel	53.5	73.2*	24.4

\*p < 0.05 (t-test, two-tailed), when personnel who were “motion sick” were compared to those who were “non-motion sick”

Table 4. MSSQ score in relation to risk of motion sickness in navy personnel [n (%)]

Motion sickness symptoms			
MSSQ score	Negative	Positive	OR (95% CI)
25th percentiles			
< 17.82	20 (58.8)	14 (41.2)	
≥ 17.82	78 (54.9)	64 (45.1)	1.17 (0.55 – 2.50)
50th percentiles			
< 37.34	42 (60.0)	28 (40.0)	
≥ 37.34	56 (52.8)	50 (47.2)	1.34 (0.73 – 2.47)
75th percentiles			
< 87.12	57 (53.3)	50 (46.7)	
≥ 87.12	41 (59.4)	28 (40.6)	0.78 (0.42 – 1.44)

Table 5. MSSQ score in relation to risk of motion sickness in army personnel [n (%)]

Motion sickness symptoms			
MSSQ score	Negative	Positive	OR (95% CI)
<b>25th percentiles</b>			
< 16.83	35 (74.5)	12 (25.5)	
≥ 16.83	31 (25.6)	90 (74.4)	8.47 (3.91 – 18.3)
<b>50th percentiles</b>			
< 41.25	49 (59.0)	34 (41.0)	
≥ 41.25	17 (20.0)	68 (80.0)	5.77 (2.90 – 11.5)
<b>75th percentiles</b>			
< 113.35	59 (46.8)	67 (53.2)	
≥ 113.35	7 (16.7)	35 (83.3)	4.40 (1.82 – 10.7)

*Perception of risk factors for motion sickness:* When asked for their perceived triggers for motion sickness, the Navy servicemen ranked highest the following factors: stuffy environment 48.2% (226), fear of developing sea sickness 30.0% (92) and no prior experience of sailing 30.0% (92). On the other hand, the army colleagues ranked: stuffy environment 29.8% (58), diesel smell 24.0% (47) and no prior experience 19.4% (38) (see Figures 3 and 4).

**Smoking and motion sickness:** There appeared to be fewer smokers among those who became motion sick compared with the non-affected in both the navy and army personnel. This is shown in Tables 6 and 7. Non-smokers appeared to have a 2-3 fold increased risk of motion sickness in the Navy group, although there was no significant difference for the army group.

Table 6. Risk of motion sickness by smoking status in navy personnel[n (%)]

Motion sickness symptoms			
	Negative	Positive	OR (95% CI)
<b>Sea state 1 to 2</b>			
Non-smokers	115 (56.4)	89 (43.6)	
Smokers	74 (71.8)	29 (28.2)	0.51 (0.30 – 0.84)
<b>Sea state 3 to 4</b>			
Non-smokers	27 (51.9)	25 (48.1)	
Smokers	25 (78.1)	7 (21.9)	0.30 (0.11 – 0.82)



Table 7. Risk of motion sickness by smoking status in army personnel [n (%)]

Motion sickness symptoms			
	Negative	Positive	OR (95% CI)
Smokers	38 (47.5)	42 (52.5)	0.63 (0.35 – 1.12)
Non-smokers	42 (36.2)	74 (63.8)	

## DISCUSSION

The study aimed to understand the responses to motion and the perceived risk factors between seafaring and non-seafaring individuals by comparing the responses between naval and army personnel. The prevalence of motion sickness was distinctly higher in the army personnel compared with the navy.

However we did not elicit the severity of the symptoms encountered. We also could not make a clear comparison with the various sea states and the latency of onset of symptoms following a particular sea state. It was also observed that more navy personnel took medication for motion sickness. Taking into account these limitations, it appears that the lack of sensitisation to shipboard whole body vibration of the non-seafaring group was the main contributing factor in this study.

The environment was perceived to contribute towards the onset of motion sickness symptoms and this was correlated to the amount of discomfort experienced. They include stuffiness and the obnoxious odour of diesel. Individual factors pertaining to fear and lack of sailing experience were also significant.

While the mean MSSQ score was higher among the army compared with the navy personnel, there was no statistically significant difference. It was also higher among those who had motion sickness compared with those who were not, but the difference was greater within the army personnel than the navy. This suggests that the MSSQ may be useful in predicting motion sickness susceptibility in a non-seafaring group rather than within a seafaring group, and hence could be considered during the medical selection process of seafarers. It may be that regular sailing would have reduced the number of motion sickness episodes within the adult stage and hence reduced the predictability in seafarers.

It is difficult to explain why smoking appears to have a protective effect and this was demonstrated in both groups. Perhaps the act of smoking takes the mind off the milder symptoms as well as the environmental factors such as diesel odours and stuffiness experienced.

## CONCLUSION

While we understand motion sickness to be a continuum of physiological responses to whole body vibration, it is especially among the non-seafarers. Seafarers by themselves will become less susceptible with regular sailing and they are also more cognizant of the modalities available to alleviate symptoms.

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