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## **Psychosomatic aspects of motion and seasickness a literature review and evaluation according to QUADAS-2 tool**

**Zuzanna Podstawka<sup>1</sup>: 0000-0003-1688-8879, Grzegorz Zieliński<sup>1</sup>: 0000-0002-2849-0641,  
Piotr Gawda<sup>1</sup>: 0000-0003-0265-9960**

**Department of Sports Medicine. Medical University of Lublin, Poland**

**Corresponding author:**

Zuzanna Podstawka, Department of Sports Medicine, Address: Chodźki 7, 20-093 Lublin, Poland +48 81 448 67 60, [department.sports.medicine@umlub.pl](mailto:department.sports.medicine@umlub.pl)

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### **Conflict of interest**

The authors declare that they have no conflict of interest.

### **Abstract**

#### **Background**

Greater affluence and cheaper travelling have enabled a rapid increase in the number of people travelling around the world. About two thirds of travelers have experienced symptoms of motion sickness at least once. A known type of motion sickness is sea sickness.

In extreme situations can concern as many as 60 % of even an experienced crew and as many as from 60 to 90% inexperienced sailors. Growing number research of is linking this disease to a psychosomatic reaction. The aim of the study was to review the literature on psychosomatic aspects of motion and seasickness and to evaluate them according to QUADAS-2 tool.

### **Materials and methods**

Materials for this literature review were found by two authors using PubMed, ResearchGate, and Google Scholar databases. A combination of the keywords „seasickness”, „motion sickness”, „psychology” (according to Medical Subjects Headings- MeSH) was used to identify relevant studies. Finally, five publications were qualified for literature review. Each publication qualified for review was evaluated in accordance with the Quality Assessment Tool for Diagnostic Accuracy Testing (QUADAS-2).

### **Results**

The knowledge gained from 4 studies indicated that there is a relationship between the symptoms of motion- and seasickness and psychological conditions, and one of them suggests that these relationships are small.

According to the QUADAS-2 tool, there is low possibility of making mistakes in patient selection and test indexes, but the studies are at risk of bias in terms of time and flow.

### **Conclusions**

Considering all the reports on this subject, it is suggested that psychological factors related to personality traits, self-control and neuroticism have a significant impact on motion sickness, including seasickness. It is recommended to conduct further research on the subject.

**Key words:** seasickness; motion sickness; psychology.

### **Background**

The number of people travelling by car has increased. Greater affluence and cheaper travelling have enabled a rapid increase in the number of people travelling around the world (1). About two thirds of travelers have experienced symptoms of motion sickness at least once, especially when sitting in the back seat, and half of them have vomited (2).

A known type of motion sickness is sea sickness. In extreme situations can concern as many as 60 % of even an experienced crew and as many as from 60 to 90% inexperienced sailors(3). This is becoming a significant handicap in modern sailing, where small crews are

responsible for handling sensitive equipment (3). In any mode of transport, the disease affects the most people who are transported passively (2).

Sailing recreation among water sports related to maritime tourism is becoming increasingly interesting in coastal countries. There is a noticeable raise in the number of people interested in sailing sports and tourist destinations. Particularly, in recent times, it has been noticed that people prefer activities that relax physically, mentally and spiritually (4).

Seasickness is a combination of autonomic symptoms caused by inconsistent sensory impressions under conditions of motion. This disease manifests itself in cold sweats, pallor, nausea and vomiting. Growing number of research is linking this disease to a psychosomatic reaction associated with stress caused by movement (2). There are more and more connections between somatic reactions and the mental state of the person. Acute and chronic distress can result in disorders like pain, anxiety, hypertension, respiratory failure, gastrointestinal disturbance, migraine and tension headaches, dermatitis, fibromyalgia and peptic ulcer disease (5). In addition, studies indicate that diseases from other groups than mental disorders have a psychosomatic background. This could be bronchial asthma, atopic dermatitis (6), glaucoma (7) or psychogenic nonepileptic seizures (PNES) (8). Moreover, emotional and psychosomatic factors can lead to the development of breast cancer (9).

The aim of the study was to review the literature on psychosomatic aspects of motion and seasickness and to evaluate them according to QUADAS-2 tool.

## **Materials and methods**

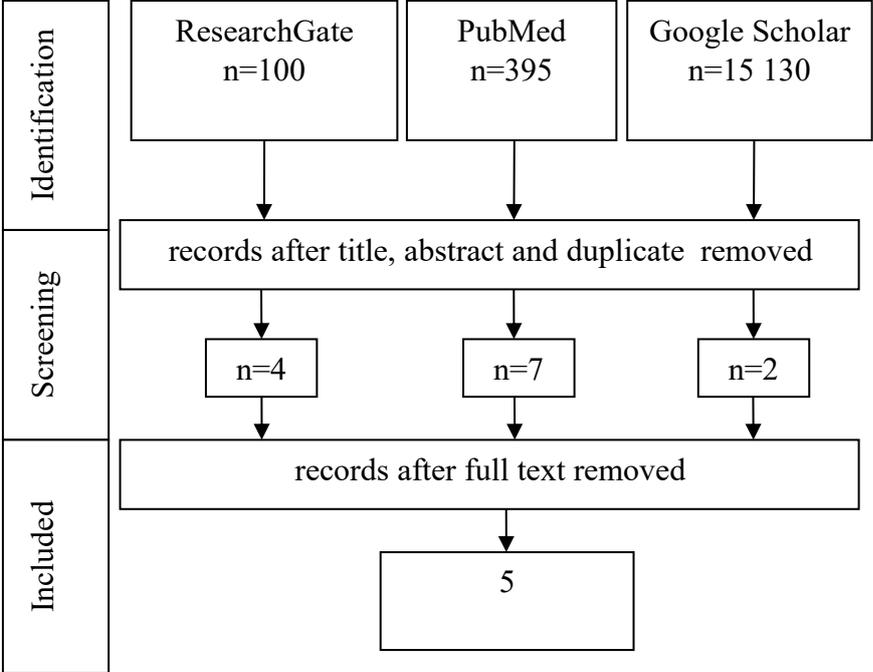
Material for this literature review was found by two authors using PubMed, ResearchGate and Google Scholar databases. A combination of the keywords „seasickness”, „motion sickness”, „psychology” (according to Medical Subject Headings- MeSH) was used to identify relevant studies.

The following exclusion criteria were applied: no Polish or English language version of the article, literature reviews, case descriptions, post- conference summaries.

The literature review consisted of 3 stages. In the first stage, the publication was searched by means of keywords. The second stage consisted in analyzing the titles and abstracts of the works in terms of their purpose and exclusion criteria. In the third stage, full versions of the articles were analyzed. Finally, five publications were qualified for the literature review - fig.1, tab.1 and tab. 2.

Each publication qualified for review has been evaluated in accordance with the QUADAS-2 tool- fig.2, tab.3. QUADAS- 2 (Quality Assessment of Diagnostic Accuracy Studies) is a tool for assess the diagnostic accuracy of tests in systematic reviews. It comprises four areas: patient selection, index test, reference standard and flow and timing. Each area is ranked in terms of risk of bias, and the first three domains are also considered in terms of concerns regarding applicability (10). Signalling questions are included in the tool to facilitate the assessment of the risk of bias. The QUADAS-2 tool was created by researchers from University of Bristol, Kleijnen Systematic Reviews, York, University of Oxford, University of Birmingham, University Medical Center Utrecht, University of Amsterdam and University of Bern (10).

**Figure 1 – flow diagram of data extraction from the literature search.**



**Table 1. Publications qualified for review.**

Author, year	Title	Aim, materials and methods
Rosenbaum M, Rolnick A. (11) 1983	Self-control behaviors and coping with seasickness	<p>Aim: to investigate the relations between subjects' general scope of self- control behaviors and their capacity to deal with seasickness</p> <p>Materials and methods:</p> <p>81 sailors of Israeli Navy divided into groups due to their experience with seasickness. Then these groups were divided into sailors with high self- control (HSC) and low self-control (LSC)</p> <p>Rosenbaum's Self-Control Schedule</p> <p>peer evaluation technique</p>
Bick P. A. (12) 1983	Physiological and psychological correlates of motion sickness	<p>Aim: assesing physiological and psychological relationships in motion sickness</p> <p>Materials and methods: 15 male and 15 female subjects in an age range 20 to 30 years</p> <p>test of field dependency; pure balance test; motion sickness questionnaire; body steadiness test; primary suggestibility test; resistance to disturbance test</p>
Eden D., Zuk Y. (13) 1995	Seasickness as a self-fulfilling prophecy: raising self-efficacy to boost performance at sea	<p>Aim: studying the effect of applying verbal intensification of efficacy on the perception of symptoms of seasickness</p> <p>Materials and methods: Naval cadets (N = 25) in the Israel Defense Forces</p> <p>self-fulfilling prophecy (SFP)</p>

		<p>approach</p> <p>General Self-Efficacy(GSE) Scale</p> <p>SSE questionnaire</p>
<p>Collins W.E.</p> <p>Lentz J.M. (14)</p> <p>1977</p>	<p>Some psychological correlates of motion sickness susceptibility</p>	<p>Aim: Assessing the impact of personality on susceptibility to motion sickness</p> <p>Materials and methods:</p> <p>148 subjects in age from 18 to 39 years divided equally into four groups due to their sex and susceptibility to motion sickness</p> <p>motion sickness questionnaire (MSQ)</p> <p>Floor Ataxia Test Battery, State-Trait Anxiety Inventory, Menstrual Distress Questionnaire, Cornell Medical Index, Cornell Work Form, Eysenck Personality Inventory, Rotter Internal-External Locus of Control Scale, and the 16 Personality Factors test</p>
<p>Paillard, A.C.et al. (15)</p> <p>2013</p>	<p>Motion sickness susceptibility in healthy subjects and vestibular patients: Effects of gender, age and trait-anxiety</p>	<p>Aim: ranking motion sickness predisposition in healthy subjects and patients with chronic vestibular symptoms and studying its connection with gender, age and trait - anxiety</p> <p>Materials and methods: Healthy subjects (n=167) and chronic dizzy patients with various vestibulopathies (n=94), aged from 20 to 92 years old</p> <p>Motion Sickness Susceptibility questionnaire (MSSQ) and trait-anxiety questionnaire (STAI-B) evaluation</p>

**Table 2. Presentation of the results and conclusions of selected study.**

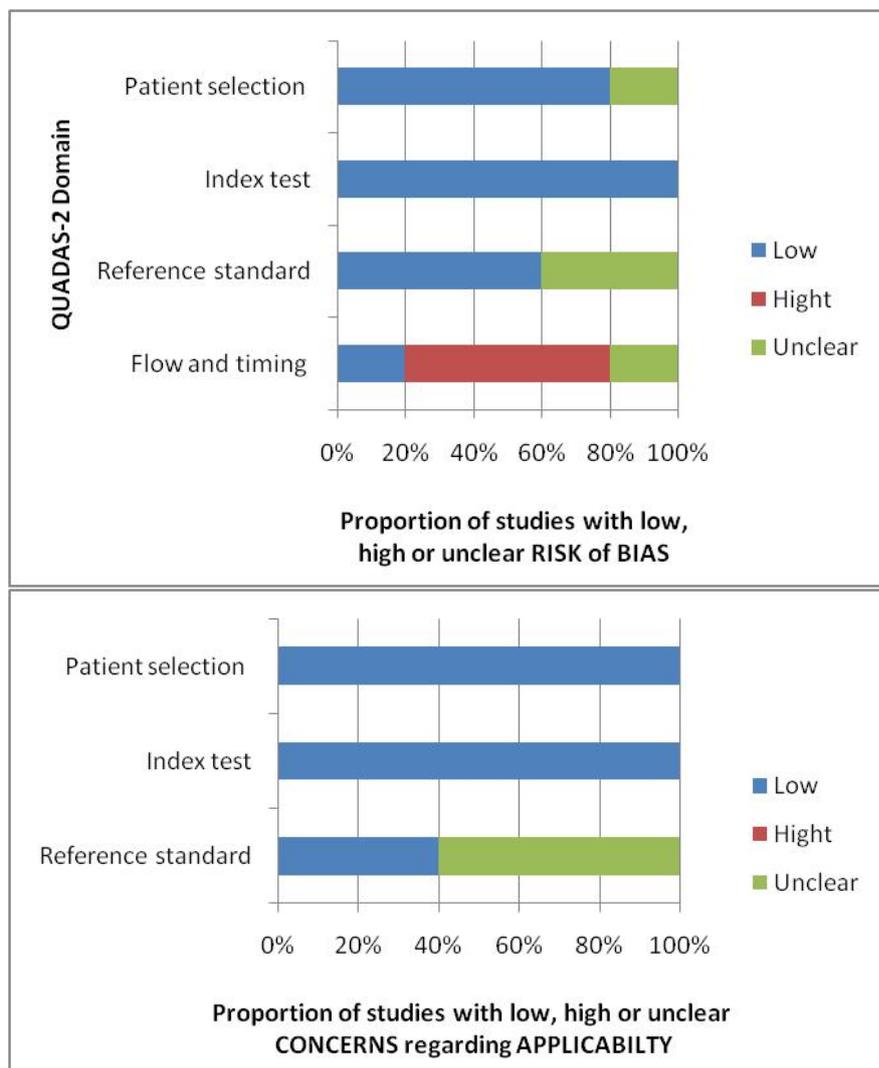
Authors	Results and conclusions
<p>Rosenbaum M., Rolnick A. (11)</p> <p>Self-control behaviors and coping with seasickness</p> <p>1983</p>	<p>a) High self-control was a factor that allowed questioned to have less symptoms of seasickness and be more efficient</p> <p>b) High self controllers suffering from seasickness coped better with sea sickness using self-control techniques than low self controllers with seasickness. Taking into account people who were not affected by seasickness, no differences were observed between low self controllers and high self controllers. Subjects with high self control were not more susceptible to seasickness than subjects with low self control.</p> <p>Cognitive skills have a significant role in dealing with physically stressful situations.</p>
<p>Bick P. A. (12)</p> <p>Physiological and psychological correlates of motion sickness</p> <p>1983</p>	<p>The examined factors are not affected by dependence on the perception field as defined by Witkin. For men, motion sickness and resistance to disturbance were on the same factor and were fundamentally related (<math>r = 0.83</math>, <math>P &lt; 0.001</math>; two-tailed test). The same connection in women was not significant (<math>r = 0.17</math>). For women, motion sickness and neuroticism were on the same factor and were fundamentally correlated (<math>r = 0.62</math>, <math>p &lt; 0.05</math>; two-tailed test). The same connection in men was not significant (<math>r = 0.06</math>).</p> <p>Motion sickness in women is related with neuroticism and in men it is associated with vestibular disorders.</p>
<p>Eden D., Zuk Y. (13)</p> <p>Seasickness as a self-fulfilling prophecy: raising self-efficacy to boost performance at sea</p> <p>1995</p>	<p>Cadets from the experimental group felt less seasick and have higher efficiency than cadets from control group. Among cadets with lower self-sufficiency there was an insignificant tendency to amplify experimental effects, which suggests behavioural plasticity.</p> <p>Reducing the symptoms of seasickness by verbal intensification of self-efficacy is observed as an application of „verbal placebo”. These findings extend the common notion of a self-fulfilling prophecy and suggest new areas of its practical application.</p>
<p>Collins W.E. Lentz J.M. (14)</p>	<p>Significant differences in sex were observed in the Floor ataxia battery test and Cornell Medical Index. The results of subjects susceptible to motion sickness in the Floor ataxia battery test did not differ from subjects who are</p>

<p>Some psychological correlates of motion sickness susceptibility</p> <p>1977</p>	<p>less susceptible to motion sickness, but the results differed significantly in all personality tests except the Menstrual Distress Questionnaire (addressed only to women) and the Rotter scale.</p> <p>On the whole, results are likely to reflect the selection elements used to define the groups of subjects; some personality traits are associated with a high degree of susceptibility to motion sickness.</p>
<p>Paillard, A.C. et al. (15)</p> <p>Motion sickness susceptibility in healthy subjects and vestibular patients: Effects of gender, age and trait-anxiety</p> <p>2013</p>	<p>Taking into account the division into patients who had vestibular loss (n=51) and patients without vestibular loss (n= 43), the MSSQ results (mean <math>\pm</math> SD) for patients with vestibular loss(18,8 <math>\pm</math> 30,9) were lower than healthy subjects (36,4 <math>\pm</math> 34,8), who were lower than patients with vestibular problems without vestibular loss(59,0 <math>\pm</math> 39,7).</p> <p>The studies presented do not indicate that these differences can be influenced by gender, age, trait-anxiety, or mutual interactions. Women had higher motion sickness susceptibility than men, and motion sickness susceptibility declined with age for healthy subjects and vestibular patients. These results confirm the conclusion that the vestibular system is heavily involved in motion sickness susceptibility and that trait-anxiety can have significance in motion sickness susceptibility but only in healthy subjects.</p>

**Table 3. Tabular presentation of QUADAS-2 results**

Study	Risk of bias				Applicability		
	patient selection	index test	reference standard	flow and timing	patient selection	index test	reference standard
Rosenbaum M., Rolnick A. (11)	+	+	+	-	+	+	+
Bick P. A. (12)	+	+	+	-	+	+	?
Eden D., Zuk Y. (13)	+	+	?	+	+	+	?
Collins W.E. Lentz J.M. (14)	+	+	?	-	+	+	?
Paillard, A.C. et al. (15)	-	+	+	?	+	+	+
„+” low risk, „-” high risk, „?” unclear							

**Fig. 2 Graphical Display for QUADAS-2 results**



## Results

Despite the various research methods, the works of Rosenbaum et al., Bick, Eden et al. and Collins et al. indicate that there is a relationship between the symptoms of motion- and seasickness and psychological factors (11–14). Paillard et al. suggested that anxiety traits may play a minor role in the predisposition to motion sickness and this statement applies only to healthy subjects (15). According to the QUADAS-2 tool, there is a low possibility of making mistakes in patient selection and index test, but studies has a risk of bias in terms of flow and timing.

## Discussion

The aim of this review was to determine the importance of psychosomatics in motion and seasickness, and to evaluate publications according to the QUADAS- 2 tool. In the analyzed five publications, there was found a relationship between psychological factors and motion and seasickness (11–14), one of the studies suggested that the aforementioned factors may be of low predisposition to the disease in question (15). The evaluation according to the QUADAS-2 tool indicates low possibility of making mistakes in patient selection and index tests, however there is a risk of bias in terms of flow and timing (16).

The results obtained by Rosenbaum et al., Bick, Eden et al. and Collins et al. can be explained by the stress associated with travelling as well as changing the living environment (11–14).

The study by Wise and Balon (17) indicates that emotional factors are still associated with the medical conditions and susceptibility to diseases in 21st century medicine. The authors reports depression as a risk factor for death after myocardial infarction (17). Results of the studies in the field of neuroscience shows that the reduction of telomere length by anxiety and stress causes faster aging and potential bigger morbidity (17). Hufner and Sperner-Unterweger (18) have evidence that PPPD (Persistant Postural Perceptual Dizziness), or central nervous system dizziness, contrary to popular beliefs, are psychosomatic disorders, although this condition appears to be typically neurological. The authors find that psychological factors, especially chronic stress, play a significant role in susceptibility to this disease, course and results (18). There are many studies on the subject how stress impact on somatic health. Satsangi et al. mention that acute and chronic stress can affect such diseases as pain, anxiety, hypertension, respiratory distress gastrointestinal disorders, migraine and tension headaches, dermatitis, fibromyalgia and peptic ulcer disease(5). Migraine and headaches are associated with a predisposition to seasickness (19).

Social and environmental changes have been recognized in the work by Song et al. (20). The research in question analyzed the environmental impact on changes in physical parameters. In their study their noticed that the environment influences lower heart rate, higher parasympathetic nerve activity and lower sympathetic nerve activity (20). Moreover, the results obtained by Peters (21) shows that the psychosocial and somatic basis are equivalent in their pathogenetic significance, and should therefore be taken into account both in models of dermatological illnesses and in appropriate therapeutic attitudes (21). According to the author, in case of skin damage, for reason of chronic disease such as atopic dermatitis, there is faster and more serious exacerbation of skin disease due to psychosocial stress (21).

Illnesses conditioned by psychological factors covers virtually all human organ systems. The results obtained by Ettlin and Kischka (22), symptoms of psychosomatic diseases can reveal in organ systems such as the nervous system, musculoskeletal system, circulatory system, respiratory system, digestive system and skin (22). Very often psychosomatic disorders are the cause of gastrointestinal diseases. A study by Romascenko et al. (23) demonstrated that 72 % of patients suffering from Crohn disease, had affective mental disorders. Taking into account other areas of medicine, the results obtained by Brumm and Schnell (24) confirm that training course in basic psychosomatic attention, should be included in the specialist training of ophthalmologists (24). A study by Jochum et al.(25) produced findings that also typical dental diseases such as bruxism and myoarthrophathy may have a psychosomatic background and both medical and psychosomatic aspects must be taken into account in order to treat patients effectively (25).

The above discussion shows how the psyche can influence the somatic aspects of health. The study by Hufner and Sperner- Unterweger (18) evidenced that one type of neurological disorder is caused by a mental disorder. The study by Wise and Balon (17) points out that emotional factors are still associated with the medical conditions and susceptibility to diseases in 21st century medicine. Three publications by Rosenbaum et al., Bick, Eden et al. and Collins et al. show that there is the relationship between the symptoms of motion sickness and psychological conditions (11–14). The study by Paillard et al. suggests that trait-anxiety may play an insignificant role in the predisposition to motion sickness (15).

The limitation of the study may be the age of the literature and the risk of bias in terms of flow and timing according to QUADAS-2 tool. This shows the need for new research on the discussed etiology of the disease, due to increasing access to public transport and maritime travel.

## **Conclusions**

Considering all the reports on this subject, it is suggested that psychological factors associated with personality traits, self-control skills and neuroticism have a significant impact on motion sickness, including seasickness. It is recommended to conduct further research on the subject.

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