# Reliability of the Thai Version of the Motion Sickness Susceptibility Questionnaire Short-Form

Thanin Asawavichienjinda; Saowaros Patarapak

**INTRODUCTION:** Motion sickness is a feeling of unwellness and introduces a significant safety risk. If a specific questionnaire to screen for motion sickness susceptibility is available, it would have benefit for susceptible people. This aimed at examining test-retest reliability and internal consistency of the Thai, non-English version Motion Sickness Susceptibility Questionnaire Short-Form (MSSQ-Short).

- **METHODS:** The original English-version MSSQ-Short was translated into Thai and then had a backward translation into English. The process of forward and backward translation was repeated until fulfillment of content and language equivalence between the backward translation and the original questionnaire. The Thai-version MSSQ-Short then was applied to people with history of motion sickness for two occasions with a 2-wk interval. The two questionnaires were examined for test-retest reliability and the first occasion was examined for internal consistency. MSSQ total raw score and percentile score between the first and second occasions were tested for correlation.
- **RESULTS:** The questionnaires were completed by 30 subjects. The weighted kappa values between the two occasions for the 18 subitems of the MSSQ ranged from 0.38 to 0.86, with most being in the higher range. The Pearson's correlation coefficient of the MSSQ raw score between the two occasions was 0.94. The internal consistency was 0.80.
- **CONCLUSION:** The Thai, non-English version MSSQ-Short had an acceptable value for reliability. Further studies should be conducted with a larger sample size and with other populations.
- **KEYWORDS:** prospective study, Thailand, MSSQ-Short, Thai-version, validity.

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otion sickness is a feeling of unwellness commonly provoked by vehicular motion, especially during traveling and virtual reality immersion.<sup>14,19</sup> Its main symptoms include autonomic reactions and a sopite syndrome (referring to a symptom-complex centered on drowsiness, lethargy, and persistent fatigue).<sup>14,19</sup> Patterns of the symptom development and expression depend on the nature of the exposure conditions, appropriate provocative motion, and on an individual's inherent susceptibility.<sup>18,19</sup> It can be, therefore, difficult to identify under nonlaboratory conditions when it does not involve prominent pallor or nausea.<sup>18</sup> This in turn may lead to under-recognition.<sup>14</sup> Motion sickness has been a persistent problem for the military in the air, on the sea, and in land vehicles where symptoms carry operational concerns.<sup>18</sup> It also has the capacity to significantly reduce work performance and can introduce both a significant health and safety risk.<sup>15</sup> As a result many scientists have therefore created a questionnaire approach to predict or screen for motion sickness susceptibility such as

the motion sickness questionnaire (MSQ) to predict motion sickness or flight training success by Kenedy,<sup>12</sup> the motion sickness questionnaire to elucidate sensory characteristics which influence motion sickness susceptibility by Reason<sup>17</sup> and Reason and Brand's Motion Sickness Questionnaire, and the Motion Sickness Susceptibility Questionnaire-Short (MSSQ-Short) by Golding<sup>4</sup> (derived from Reason and Brand's motion sickness questionnaire by simplifying the scoring system and condensing the survey from 54 to 18 items). The MSSQ-Short has overall demonstrated a high correlation with the long-form MSQ.<sup>5</sup>

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The MSSQ-Short by Golding<sup>4</sup> is mentioned for its universal applicability for all stimuli, including car-sickness, air-sickness, space-sickness, or sea-sickness. The questionnaire initially had two questions inquiring about susceptibility to motion sickness with five scales, including not applicable or never traveled denoted by t, never felt sick by zero (0), rarely felt sick by 1, sometimes felt sick by 2, and frequently felt sick by 3, and what motion(s) were most likely to cause motion sickness in childhood (Child, part A) and from adult experiences over the last 10 yr (Adult, part B).<sup>5</sup> The sorts of motion involved nine types of transportation, including cars, buses or coaches, trains, aircraft, small boats, ships, swings in playgrounds, roundabouts in playgrounds, and fun fare rides (e.g., big dippers).<sup>5</sup> The latest version is composed of four questions, including age, gender, and the previous two questions, childhood experience (question 3 or Child, part A) and adult experience over the last 10 yr (question 4 or Adult, part B). Scoring of question 3 or part A (MSA) and 4 or part B (MSB) is equal to total sickness score child and adult, respectively, for each type of transportation multiplied by 9 and divided by 9 (minus the number of type of transportation not experienced). Score t is counted as zero (0). The raw score of MSSQ-Short (MSSQ raw score) is equal to the summation of MSA and MSB scores. Percentile score of the raw score of MSSQ-Short is calculated according to the original questionnaire.

This questionnaire is also able to predict sensitivity to chemotherapy-related sickness and sickness from migraine.<sup>4</sup> Of the people who underwent chemotherapy and in those with migraine, those with sickness had a higher mean score in the MSSQ section in childhood than people without chemosickness and migraine without sickness, respectively.<sup>4</sup> Additionally, people with Meniere's disease showed significantly elevated motion sickness susceptibility.<sup>10</sup>

In Thailand, one of the South-East Asia countries, the official language is non-English and there has been no study to date on motion sickness susceptibility. This current study is aimed at examining test-retest reliability as a primary question, and internal consistency of the Thai, non-English version MSSQ-Short for secondary questions.

## **METHODS**

### Subjects

This was a prospective study conducted in 2015–2016 at an outpatient Otolaryngology, Head and Neck Surgery clinic, King Chulalongkorn Memorial Hospital, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand. The Institutional Review Board of the Faculty of Medicine, Chulalongkorn University, has approved this study in compliance with the international guidelines for human research protection such as the Declaration of Helsinki, The Belmont Report, and the CIOMS Guideline and International Conference on Harmonization in Good Clinical Practice (ICH-GCP). People who had history of motion sickness by self-report and gave informed consent to participate in this study at an out-patient Otolaryngology, Head and Neck Surgery clinic were recruited. There were 30 subjects who participated in this study.

#### Procedure

We received permission to use the original English-version MSSQ-Short by Golding. It was translated into Thai by the first author. The Thai, non-English version MSSQ-Short then had a backward translation into English by a native English lecturer who was proficient in Thai and blinded to the original version. The English version from backward translation and the original were compared. If the content looked different, corrections were made accordingly, repeating the forward and backward translation process until the English versions, the original, and the double-translated versions had identical content equivalence. The Thai, non-English version MSSQ-Short then was culturally modified by an active informant experienced with motion sickness to create the Thai wording for simple understanding and application to non-English speaking people.

The Thai, non-English version MSSQ-Short was applied to the subjects. After completing the Thai, non-English version MSSQ-Short on the first occasion, subjects were asked to visit the clinic in the next 2 wk to complete the questionnaire on a second occasion. Questionnaires from the first and second occasions of the Thai, non-English version MSSQ-Short were examined for test-retest reliability. The first occasion was also tested for internal consistency. MSA and MSB scores at the same occasion were compared. In addition, MSSQ total raw score and percentile score MSSQ-Short between the first and second occasions were compared. Scoring of the Thai, non-English version MSSQ-Short, including MSA, MSB, MSSQ raw score, and percentile score, was calculated according to the original version. In addition to completing the Thai, non-English version MSSQ-Short, other subject information was recorded, including education, occupation, onset of experienced motion sickness and other symptoms (including yawning, pallor, increased salivation, eye strain, etc.) accompanying motion sickness or nausea, family history of motion sickness, and whether or not motion sickness occurred during their menstrual cycle.

### **Statistical Analysis**

Baseline characteristics of subjects were summarized as mean (SD) for continuous data and as proportion for categorical data. Scoring the MSSQ-Short, including MSA and MSB, MSSQ total raw scores, and percentile scores, was summarized as a median with interquartile range (IQR) and also summarized as a mean with standard deviation. Statistical test for test-retest reliability and for internal consistency of the Thai, non-English version MSSQ-Short was applied by weighted kappa and Cronbach's alpha, respectively. In addition, correlation between MSA and MSB score at the same occasion and between MSSQ total score at the first occasion and the second occasion were tested by using Pearson's correlation coefficient. MSSQ raw scores and percentile scores on the MSSQ-Short between the first and second occasions were compared by using intraclass correlation coefficient to assess reliability. Sample size calculation for weighted kappa test-retest reliability was on the basis of the two-sided hypothesis test, power of 80%, type I error of 0.05, rating of 5  $\times$  5 ordered categories, minimally acceptable kappa coefficient value of 0.5, and a proposed kappa coefficient value for this study of 0.8, recommended by Bujang et al.<sup>2</sup> The minimum sample size was 28. Two subjects were added to the minimum sample size (N = 30) to account for drop-out during the second occasion of administration 2 wk later. This study did not calculate sample size for internal consistency and did not correct *P*-value for multiple analyses. Informed consent was given by 30 subjects with history of motion sickness by self-report who were then administered the first occasion questionnaire. The same subjects proceeded with the second occasion of the Thai, non-English version MSSQ-Short 2 wk later. No subjects dropped out of the study. On base-lines characteristics, most (90%) were women with a mean age of 34.4 yr (SD 8.7 yr), and 83% completed the first stage of ter-tiary education. All were working. On the history related to

# แบบสอบถามประเมินความไวต่อการเกิดอาการเมาจากการเคลื่อนไหว

(Motion Sickness Susceptibility Questionnaire Short-form; MSSQ-Short)

## RESULTS

During the process of completing the language equivalence for the Thai, non-English version MSSQ-Short as suggested by the active informant instructions, Questions 3 and 4 were combined to make them clearer and more understandable. The original instruction was: "Your childhood experience only (before 12 years of age) for each of the following types of transport or entertainment, please indicate:" and later in Question 3: "As a child (before age 12), how often did you feel sick or nauseated (tick boxes)." Respondents might not have responded correctly to Question 3 if they did not read the instructions before answering the question. To make Question 3 easier to understand for respondents, the question and instruction were combined to "as a child (before age 12) or from your childhood experience only (before 12 years of age), including how often did you feel sick or nauseated for each of the following types of transport or entertainment, please indicate (tick boxes)." Similarly, Question 4 was combined to "over the last 10 years or from your experience over the last 10 years (approximately), including how often did you feel sick or nauseated for each of the following types of transport or entertainment, please indicate (tick boxes)" (Fig. 1 and Fig. 2).

1. อายุ.....ปี

แบบสอบถามนี้ออกแบบมาเพื่อค้นหาการเกิดอาการเมาจากการเคลื่อนไหวว่าเกิดขึ้นง่ายหรือไม่ และการเคลื่อนไหว ชนิดใดที่ทำให้ท่านเกิดอาการไม่สบายมากที่สุด อาการไม่สบายในที่นี้หมายถึง รู้สึกผะอืดผะอม คลื่นไส้ หรืออาเจียน

3. ถามประสบการณ์ในวัยเด็ก (เมื่อท่านอายุน้อยกว่า 12 ปีเท่านั้น) ท่านมีอาการเมา ผะอืดผะอม คลื่นไส้หรือ

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	ไม่เคยเดินทาง ด้วยพาหนะหรือ เล่นเครื่องเล่น เหล่านี้	ไม่เคยมี อาการ	มีอาการ นาน ๆ ครั้ง	มีอาการบางครั้ง	มีอาการบ่อย ๆ
รถยนต์					
รถประจำทาง รถบัส รถเมล์ หรือ					
รถทัวร์					
รถไฟ					
เครื่องบิน					
เรือลำเล็ก หรือเรือแจว					
เรือลำใหญ่ เช่น เรือข้ามฟาก หรือ					
เรือโป๊ะ					
เครื่องเล่นชิงช้าในสนามเด็กเล่น					
ม้าหมุนในสนามเด็กเล่น					
รถไฟเหาะตีลังกา เครื่องผาดโผน					
ในสวนสนุก					
	t	0	1	2	3

4. ถามประสบการณ์ในช่วงประมาณ 10 ปีที่ผ่านมา ท่านมีอาการเมา ผะอืดผะอม คลื่นไส้หรืออาเจียนบ่อย

เพียงใด เมื่อเดินทางด้วยพาหนะหรือเครื่องเล่นดังต่อไปนี้ [ทำเครื่องหมายถูก (V) ลงในช่อง]

	ไม่เคยเดินทาง ด้วยพวะบระเรือ	ไม่เคยมี ๑วกวร	มีอาการ	มีอาการบางครั้ง	มีอาการบ่อย ๆ
	ดเวยพาหนะหวอ	-61.11.1-3	12/12/9/930		
	เล่นเครื่องเล่น				
	เหล่านี้				
รถยนต์					
รถประจำทาง รถบัส รถเมล์ หรือ					
รถทัวร์					
รถไฟ					
เครื่องบิน					
เรือลำเล็ก หรือเรือแจว					
เรือลำใหญ่ เช่น เรือข้ามฟาก หรือ					
เรือโป๊ะ					
เครื่องเล่นชิงช้าในสนามเด็กเล่น					
ม้าหมุนในสนามเด็กเล่น					
รถไฟเหาะตีลังกา เครื่องผาดโผน					
ในสวนสนุก					
	t	0	1	2	3

หมายเหตุ แปลจาก MSSQ-Short : Golding JF. Predicting individual differences in motion sickness susceptibility by questionnaire. Personality and Individual Differences 2006;41:237-48. และจาก http://downloads.bbc.co.uk/scotland/tv/trustme/motion\_sickness\_susceptibility\_questionnaire.pdf

Fig. 1. The Thai-version MSSQ-Short.

13%. Almost half of the subjects (43%) had family history of

#### Motion sickness susceptibility questionnaire: MSSQ-short

- 1. Age.....years

This questionnaire is designed to find out how sensitive you are to motion sickness and what kind of movement causes the most sickness. Sickness means feeling queasiness, nauseating or vomiting.

3. This question asks about your childhood experience when you were less than 12 years old only. How often did you have motion sickness or nauseated when travelling or riding the following transportation or entertainment (tick boxes).

	Never travelled	Never	Rarely	Sometimes	Frequently
	or ridden these	Felt sick	Felt sick	Felt sick	Felt sick
	vehicles				
Cars					
Buses or Coaches					
Trains					
Airplanes					
Small boats					
Large ships e.g.					
ferries					
Swings in					
playgrounds					
Roundabouts in					
playgrounds					
Roller coasters,					
Funfair Rides					
	t	0	1	2	3

4. This question asks about your experience about the past 10 years. How often did you have motion sickness or nauseated when travelling or riding the following transportation or entertainment (tick boxes).

	Never travelled or ridden these vehicles	Never Felt sick	Rarely Felt sick	Sometimes Felt sick	Frequently Felt sick
Cars					
Coach or buses					
Trains					
Airplanes					
Small boats					
Large ships e.g.					
ferries					
Swings in					
playgrounds					
Roundabouts in					
playgrounds					
Roller coasters,					
Funfair Rides					
	t	0	1	2	3

Note: Translated from MSSQ-Short: Golding JF. Predicting individual differences in motion sickness susceptibility by questionnaire. Personality and Individual Differences 2006;41:237-48;

 $http://downloads.bbc.co.uk/scotland/tv/trustme/motion\_sickness\_susceptibility\_questionnaire.pdf and the state of the sta$ 

Fig. 2. The English-version, back translation from the Thai-version MSSQ-Short.

motion sickness, most subjects (93%) had a childhood onset experience of motion sickness, except one with an adulthood onset. All had other symptoms of motion sickness accompanied by motion sickness or nausea. Other common associated symptoms were stomach discomfort accounting for 57% followed by sweating (diaphoresis) (33%). Pallor was detected in only 30% and yawning about one-third (33%). Increased salivation was reported in about one-quarter (27%) and eye strain in second occasion was 12.5 (7.48) and 11.5 (6.05), respectively, with Pearson's correlation coefficient of 0.58. Median score and IQR of the MSSQ raw score between the first and second occasions were 22.5 (IQR 17.8) and 21.6 (IQR 13.6) with an intraclass correlation coefficient of 0.93. In addition, mean (SD) of the MSSQ total raw score at the first and the second occasion were 24.5 (11.04) and 24.0 (12.03), respectively, with Pearson's correlation coefficient of 0.94. Median percentile score and IQR

motion sickness: family members were parents in 23% and siblings in 20%. A few subjects (7%) had motion sickness during their menstrual cycle. The weighted kappa value (see Table I) for testretest reliability of Question 3 and 4 for each type of transportation or entertainment ranged from 0.38 to 0.86. In Question 3, some types of transportation or entertainment, including cars, buses or coaches, small boats, and swings at playgrounds had a weighted kappa value between 0.50 and 0.56. Some, including trains, aircraft, ships, roundabouts at playgrounds, and big dippers/ fun fair rides had a weighted kappa value between 0.67 and 0.86. In Question 4, some types of transportation or entertainment had the same levels of weighted kappa as in Question 3, such as aircraft, roundabouts at playgrounds, and big dippers/fun fair rides, but others had higher levels, including cars, buses or coaches, small boats, and swings at playgrounds. Those with lower levels of weighted kappa included trains and ships. A weighted kappa value of 0.38 was detected in ship transportation that was experienced in the last 10 yr. Median score and IQR of the MSA and MSB at the first and second occasions were 12.2 (IQR 11.3) and 10.7 (IQR 9.4), and 11.7 (IQR 10.2) and 10.1 (IQR 8.2), respectively. In addition, a mean and SD of the MSA and MSB score at the first occasion was 12.9 (6.83) and 11.5 (5.71), respectively, with Pearson's correlation coefficient of 0.55 and of the MSA and MSB score at the

**Table I.** Weighted Kappa Value for Test-Retest Reliability of Questions 3 and 4Between the First and Second Occasions for the Thai, non-English versionMSSQ-Short.

	WEIGHTED KAPPA	P-VALUE
Question 3		
Cars	0.54	< 0.001
Buses or Coaches	0.55	< 0.001
Trains	0.67	< 0.001
Aircraft	0.72	< 0.001
Small Boats	0.50	< 0.001
Ships, e.g., Channel Ferries	0.70	< 0.001
Swings in playgrounds	0.56	< 0.001
Roundabouts in playgrounds	0.75	< 0.001
Big Dippers, Funfair Rides	0.86	< 0.001
Question 4		
Cars	0.65	< 0.001
Buses or Coaches	0.70	< 0.001
Trains	0.52	< 0.001
Aircraft	0.69	< 0.001
Small Boats	0.62	< 0.001
Ships, e.g., Channel Ferries	0.38	< 0.001
Swings in playgrounds	0.61	< 0.001
Roundabouts in playgrounds	0.77	< 0.001
Big Dippers, Funfair Rides	0.81	< 0.001

of the MSSQ-Short between first and second occasions were 80.5 (IQR 31) and 79.5 (IQR 30.7) with intraclass correlation coefficient of 0.94. Internal consistency for the first occasion of the Thai, non-English version MSSQ-Short was 0.80.

# DISCUSSION

This is a study of a non-English MSSQ-Short motion sickness assessment. Another non-English MSSQ-Short previously published was a French language version.9 Most subjects with a history of motion sickness by self-report were female, with a female to male preponderance of 9:1. According to the National Statistical Office in Thailand in 2016,<sup>3</sup> the total population in Thailand was 65,931,550 with a female to male ratio of 1.03:1, possibly implying that motion sickness has gender difference susceptibility as previously mentioned in the literature.<sup>6,13</sup> However, other factors might have come in to play as well, such as sampling self-selection, women more willing to participate in the survey, or higher female to male patient ratio in the hospital, as males tend not to visit the hospital unless very sick. Most subjects had a history of childhood onset motion sickness. Only one in this study had adulthood onset motion sickness that on clinical grounds might require the need to search for a structural lesion or a more specific etiology.<sup>7</sup> All had other symptoms accompanying their nausea, confirming that motion sickness is comprised of a much broader syndrome "more than nausea and vomiting."14 Pallor in this study (as mentioned by the subjects) was revealed in only 30%. Lackner has mentioned that if pallor was not prominent, it was difficult to identify motion sickness under nonlaboratory conditions.<sup>13</sup> Yawning, a potential behavioral marker of mild motion sickness and sopite syndrome,<sup>16</sup> was detected in about one-third. This might also confirm that some Thais had mild motion sickness that was difficult to identify. Eye strain and other symptoms of motion sickness were found in 13% of subjects, which has not been reported in previous studies. It has, however, been reported previously in an article by Golding.<sup>6</sup> Almost 50% of the subjects had family history of motion sickness (in parents and siblings), possibly confirming some genetic contribution to motion sickness.<sup>6,19</sup> Only 7% of subjects had motion sickness during their menstrual cycle. Some evidence supports that motion sickness has higher incidence or susceptibility during the menstrual period than in the nonmenstrual period,<sup>8,11</sup> but some studies have not supported this finding.<sup>13</sup> To confirm this relationship, studies with larger sample sizes are needed.

Test-retest reliability of the Thai, non-English version MSSQ-Short assessed by weighted kappa values for Questions 3 and 4 was moderate (weighted kappa of 0.41-0.60), good (weighted kappa of 0.61-0.80), and very good (weighted kappa of 0.81-1.00) in agreement except in Question 4 with ship transportation having a fair (weighted kappa of 0.21-0.40) agreement according to Altman's proposal.<sup>1</sup> Sample size for this study was calculated on the basis of a minimally acceptable kappa coefficient value of 0.5 and a proposed kappa coefficient value of 0.8. Results demonstrated that all elements were above minimally acceptable kappa values, excepting transportation on ships, while only two elements were over the proposed kappa value. This could due to the slightly small sample size for this study. The mean MSA and MSB score at the same occasions and the first and second occasion had high correlation with the assessment by Pearson's correlation coefficient. The median and mean MSSQ raw scores and percentile scores of the Thai, non-English version MSSQ-Short had excellent reliability between the two occasions where the questionnaire was provided. The internal consistency was acceptable. Interestingly, mean (SD) and median score (IQR) of the MSSQ raw score in this study was quite high, 24.5 (11.04) and 22.5 (IQR 17.8) for the first occasion, and 24.0 (12.03) and 21.6 (IQR 13.6) for the second occasion compared to the normative values from other studies;<sup>5</sup> this might be due to selection bias of the susceptible subjects who had history of motion sickness not being representative of the general population and who might also have vestibular disorders.

There were some limitations in this study, including selected susceptible subjects who were not representative of the general population causing a high MSSQ score, the sample size for testretest reliability of the Thai, non-English version MSSQ-Short due to over anticipating the proposed kappa value, and no sample size calculation for internal consistency.

In conclusion, this Thai, non-English version MSSQ-Short had moderate to very good agreement for test-retest reliability except in one element, ship transportation in Question 4. There was excellent reliability for the MSSQ raw and percentile scores and acceptable internal consistency. Further studies with larger sample sizes should be conducted to reevaluate test-retest reliability and screen for other populations such as people with migraine.

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