Research Article

Validity and Reliability of the Persian Version of the Motion Sickness Susceptibility Questionnaire-Short Form

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Short running title: Validity and Reliability of the Persian…

Highlights:

- MSSQ-Short translated into Persian and validated in university students
- P-MSSQ-Short shows high validity and reliability for Persian-speaking individuals
- Pilot students less susceptible to motion sickness compared to non-pilots

ABSTRACT

Background and Aim: Motion sickness is common during various forms of transportation. The Motion Sickness Susceptibility Questionnaire-Short form (MSSQ-Short) is a self-report tool designed to assess this problem. This study aimed to translate and evaluate the psychometric properties of the Persian version of MSSQ-Short.

Methods: The questionnaire was translated to Persian and culturally adapted as the P-MSSQ-Short. After confirming face validity, the P-MSSQ-Short was administered to 354 university students (274 non-pilots, 80 pilots). One hundred participants were categorized into low-, moderate-, and high-susceptibility groups based on their Numeric Rating Scale (NRS) scores. Construct, concurrent, and discriminant validity were assessed. Test-retest reliability was analyzed with 113 participants, along with measurements of Intraclass Correlation Coefficient (ICC), Standard Error of Measurement (SEM), and Smallest Detectable Change (SDC).

Results: The P-MSSQ-Short demonstrated good face validity. Total score showed strong correlations with sections A and B. Four factors were identified, with no ceiling effect but some floor effect observed. Scores significantly differed across NRS-based groups. The P-MSSQ-Short correlated strongly with NRS scores. Cronbach's α for the total questionnaire, and sections A and B were 0.93, 0.88, and 0.86, respectively. Strong test-retest correlation was noted. ICCs for total, and sections A and B were 0.82–0.84. SEMs were 2.48, 2.15, and 4.29 while SDCs were 4.43, 4.18, and 5.65 for sections A, B, and total scores, respectively. Pilot students were significantly less susceptible than non-pilots ($p<0.001$).
Conclusion: The P-MSSQ-Short exhibits high validity and reliability, making it a useful tool for predicting motion sickness susceptibility in Persian-speaking individuals.
Keywords: Vestibular system; Persian; motion sickness; questionnaire; validity; reliability

Introduction

Motion sickness typically occurs during unusual body movements and arises from conflicts among sensory-motor signals such as visual, vestibular, and proprioceptive inputs [1-3]. The incidence of motion sickness varies significantly, affecting 7% of sea travelers to 81% of aviation students [4-9]. Several studies have revealed that approximately 5–10% of people are highly susceptible to motion sickness, while many others exhibit moderate susceptibility [1-3]. Currently, there are no physiological tests with sufficient sensitivity and specificity to diagnose or predict individual susceptibility to motion sickness.

Scholars and physicians face challenges in assessing motion sickness due to individual differences, the limitations of tests in relatively controlled environments (land, sea, air, and space), and difficulty accessing expensive motion control equipment [4]. Therefore, utilizing a questionnaire to evaluate motion sickness susceptibility is a suitable method [5]. Questionnaires can collect information about sickness induced by various types of motion [6]. The Motion Sickness Susceptibility Questionnaire (MSSQ) was first designed by Reason and Brand in 1975 [7], revised by Golding in 1998 [8], and the short form (MSSQ-Short) was introduced in 2006. The MSSQ-Short assesses susceptibility to nine types of transportation based on individual experiences as a child or adult. It is a reliable and valid tool that is both time-efficient and cost-effective [4].

The MSSQ-Short has been translated into several languages, with studies demonstrating its good psychometric properties, including validity, reliability, and internal consistency [4-9]. However, there is no Persian version of this questionnaire available for the Persian-speaking population. Therefore, this study aimed to translate the MSSQ-Short into Persian and investigate its validity and reliability in a Persian-speaking population.

Methods

Questionnaire

The MSSQ-Short predicts individual susceptibility to motion sickness by recording subjects' perceptions of queasiness, nausea, or vomiting in two sections: childhood (Section A-MSA) and adulthood (Section B-MSB) experiences [4]. Each section has 9 items related to various transportation types, including car, train, and aircraft. Each item is rated on a 5-point Likert scale: not applicable/never traveled (no points), never felt sick (0 points), rarely felt sick (1 point), sometimes felt sick (2 points), and frequently felt sick (3 points). The total score of each section is calculated as (total sickness score)×(9)/(9–number of types not experienced), with a maximum score of 27 per section. The raw total score is the sum of the scores from MSA and MSB sections, ranging from 0 to 54.

Translation and cross-cultural adaptation

With permission from Professor John F. Golding, the MSSQ-Short was translated into Persian following the international quality of life assessment guidelines [10]. First, two bilingual translators performed the forward translation. Then, a reconciled version was created after a meeting with the translators. A panel of 16 vestibular assessment experts reviewed the drafts to ensure clarity and cultural relevance, scoring each item on a 100-point scale. Words with low scores were replaced based on expert feedback. Finally, the Persian version was back-translated into English by two other bilingual translators and sent to Professor Golding for confirmation.

Participants

A total of 354 university students, consisting of 203 males (57.3%) and 151 females (42.7%), including 274 non-pilot students from the University of Tehran and Tehran University of Medical Sciences and 80 pilot students, were selected using convenience sampling. Their mean age was 22.98±2.93 years (range: 18–38 years). All participants were native Persian speakers without any balance, visual, neurologic, or gastrointestinal disorders. The exclusion criterion was unwillingness to continue participation.

Statistical analysis

Content validity of the Persian version of MSSQ-Short (P-MSSQ-Short) was assumed based on the original MSSQ-Short, which has been reported to have good content validity [4-9]. The content was not altered in the Persian version. Face validity was assessed based on feedback from 30 participants (mean age: 23.02±2.21 years) on item understandability, and 16 experts evaluated clarity, fluency, and cultural relevance using a Likert scale.

Construct validity was assessed using Pearson correlation to calculate correlations between items within and between sections and total scores. Confirmatory Factor Analysis (CFA) was used to compare the structure of the two sections. Floor and ceiling effects were examined by calculating the percentage of participants with the lowest (floor) and highest (ceiling) scores, with values over 20% indicating significant effects [11].

A subset of 100 non-pilot students was randomly selected to rate their susceptibility to motion sickness using a Numeric Rating Scale (NRS) from 0 (minimum susceptibility) to 10 (maximum susceptibility). They were categorized into low (score≤3), moderate (score 4–7), and high (score≥8) susceptibility groups. Spearman correlations were used to determine concurrent validity by measuring the correlation between P-MSSQ-Short and NRS scores.

Discriminant validity was assessed by comparing the total P-MSSQ-Short scores across the three NRS categories using one-way ANOVA.

Internal consistency was evaluated using Cronbach's α coefficient, with a value between 0.7 and 0.95 considered acceptable [12].

Test-retest reliability was assessed with 113 participants (79 non-pilot and 34 pilot students) who completed the P-MSSQ-Short twice, two weeks apart. Participants' health and vestibular conditions were assumed stable during this period. Intraclass Correlation Coefficient (ICC) was calculated using one-way ANOVA, with Smallest Detectable Change (SDC) and Standard Error Measurment (SEM) calculated as follows: $SDC=1.96\times\sqrt{(2\times SEM)}$, $SEM=SD\times\sqrt{(1-ICC)}$. An ICC>0.75 indicates excellent reliability, 0.6–0.75 indicates good reliability, and 0.4–0.59 indicates fair reliability [13].

Data were analyzed using SPSS v.17 (IBM SPSS software). Descriptive statistics (mean and standard deviation) were reported. The Kolmogorov-Smirnov test was used to assess the normality of data distribution.

Results

According to experts, most items in the back-translated version received high scores. Items with low scores were further discussed in a focus group session. Experts were first asked to add questions regarding participants' age and gender, explanations about the questionnaire's purpose, and instructions on completing the MSA and MSB sections. The purpose of the questionnaire received the lowest score, prompting us to use simpler and more understandable language. Items such as "Coaches", "Channel Ferries", "Roundabouts", and "Funfair Rides" were discussed to provide culturally adapted translations. Additionally, we simplified the scoring instructions, although they already received high scores from the experts.

The mean scores of the P-MSSQ-Short for the total scale, MSA, and MSB sections were 12.82±9.28 (range: 0–45), 7.61±6.21, and 5.34±5.38, respectively, across all participants.

Participants evaluated each item of the questionnaire for understandability and cultural adaptability. All items scored highly, and participants had no difficulty completing the questionnaire, confirming the face validity of the P-MSSQ-Short.

In assessing construct validity, Pearson correlation results demonstrated moderate correlations among items in both MSA ($r=0.21–0.64$, $p<0.001$) and MSB ($r=0.21–0.69$, $p<0.01$) sections. Additionally, there was a good correlation between the two sections ($r=0.62$, $p<0.001$) and a strong correlation between the total score and MSA ($r=0.86$ to 0.91, $p<0.001$) and MSB ($r=0.86$ to 0.91, $p<0.001$) scores. CFA without rotation did not yield any detectable factors; however, with rotation, four factors explaining 71% of the variance were identified (Figure 1). One factor included items like "Roundabouts in playgrounds" and "Big Dippers," while another included items like "Cars", "Buses", and "Trains". The remaining items were loaded by the other two factors.

The mean NRS score was 3.56±2.84 (range: 0–10). For ceiling and floor effects, scores >80% (raw score>44 out of 54) and <20% (raw score<10.8 out of 54) of the total score were considered. Only four participants (1.1%) had raw scores above 44, indicating no ceiling effect. However, 50% of participants had raw scores below 10.8, indicating a floor effect.

Pearson correlation showed a strong correlation between the P-MSSQ-Short total score and NRS ($r=0.74$, $p<0.001$), confirming acceptable concurrent validity.

Mean scores for participants with low, moderate, and high susceptibility to motion sickness based on NRS were 6.06±7.32 (range: 0–25), 17.10±9.96 (range: 2–45), and 26.92±5.85 (range: 17.14–34.91), respectively. The MSSQ-Short scores differed significantly among the three susceptibility groups ($F_{(2,99)}=23.90$, $p<0.001$). Tukey's post-hoc test revealed significant differences between low and moderate susceptibility (mean difference=11.04, $p<0.001$), low and high susceptibility (mean difference=20.86, $p<0.001$), and moderate and high susceptibility (mean difference=9.81, $p<0.014$), confirming the discriminative validity of the P-MSSQ-Short.

Cronbach's alpha values for the total scale, MSA, and MSB were 0.93, 0.88, and 0.86, respectively, indicating high internal consistency of the P-MSSQ-Short. There was a high correlation between test and retest total scores ($r=0.86$, $p<0.001$), demonstrating high test-retest reliability for the total scale (ICC=0.84, 95% CI: 0.75–0.89, $p<0.001$), MSA (ICC=0.83), and MSB (ICC=0.82). Paired t-tests showed no significant difference between test and retest total scores ($p=0.071$). The SEM values were 4.29, 2.48, and 2.15 for the total scale, MSA, and MSB, respectively, indicating some variability over time for the same individual. The SDC values were 4.43, 4.18, and 5.65 for MSA, MSB, and the total scale, respectively, meaning that a change in participants' health condition should lead to at least a 5.65-unit change in the total P-MSSQ-Short score.

Analysis revealed significant differences in questionnaire scores between the two sections. The mean MSA score was significantly higher than the MSB score ($p<0.001$). Additionally, pilot students had significantly lower total, childhood subscale ($p=0.001$), and adulthood subscale ($p=0.007$) scores compared to non-pilot students ($p<0.001$).

Discussion

The purpose of this study was the development and validation of the Persian version of the MSSQ-Short. We found that the Persian version had acceptable validity and reliability, with psychometric properties in agreement with the original English version [4]. Experts and participants confirmed the fluency, understandability, and cultural adaptability of the Persian version, and participants had no difficulties completing the questionnaire, answering all items with no missing responses. There was no ceiling effect for the total score of the Persian version, assuring clinicians of its validity and reliability. The presence of a floor effect aligns with the results for the English version regarding the incidence rate of motion sickness among the studied population [4].

Construct validity of the Persian version was assessed by examining the correlation between MSA and MSB sections, with an obtained correlation value ($r=0.62$) consistent with the values reported for the English ($r=0.68$) and French ($r=0.67$) versions [4, 9], thus confirming construct validity. Different types of transportation experienced in childhood and adulthood may explain the reduced correlation between MSA and MSB. Limiting the items to the most commonly experienced transportations could improve this correlation.

The total P-MSSQ-Short scores of participants with low, moderate, and high susceptibility to motion sickness were significantly different, confirming the discriminant validity of the Persian version. The P-MSSQ-Short can distinguish between Persian-speaking participants with varying susceptibility to motion sickness. This validity was also confirmed by the ability of the Persian version to differentiate childhood and adulthood experiences, with higher MSA scores aligning with findings from the English and French versions [4, 9], which report greater susceptibility in childhood [2, 14, 15]. The subsequent reduction in susceptibility during adulthood likely suggests habituation. The correlation between the P-MSSQ-Short and NRS scores exceeded the acceptable value [11], indicating satisfactory concurrent validity.

Factor analysis suggested factors related to susceptibility to motion sickness from various types of transportation, such as funfair rides or land transport. These independent susceptibilities are consistent with the results of the original English version, which identified factors of land, sea, air, and funfair [4]. The fewer factors in the Persian version may be attributed to fewer experienced transport types among Persian-speaking participants.

The internal consistency of the Persian version was highly satisfactory ($\alpha=0.93$), surpassing that of the English and French versions (0.87) [4, 9], confirming the homogeneity of the items. The Persian version also demonstrated excellent test-retest reliability, similar to the English version [4], indicating that the interval

between the test and retest stages was appropriate. This period should not be too short or too long, as the health condition of individuals changes over time. The reported SDC values indicated that a change of at least 5.65 units in the total score of the Persian version reflects a real change in health condition and cannot be considered a measurement error.

Lower questionnaire scores among pilot students compared to non-pilot students in both total scores and childhood and adulthood subscales suggest that pilot students are less susceptible to motion sickness. Low exposure to flight among these pilot students and their low childhood subscale scores rule out the effect of habituation. Low susceptibility to motion sickness in pilot students may be related to their unique psychological characteristics that motivated them to become pilots. Another reason could be the extensive physical examinations, such as visual acuity and balance system tests, required to select the healthiest applicants, which are directly related to the incidence of motion sickness.

A limitation of this study was the lack of any standard similar questionnaire for motion sickness assessment in the Persian language to evaluate the psychometric dimensions of the P-MSSQ-Short more accurately. Future studies are recommended to validate the Persian version of other motion sickness assessment tools and use the Persian MSSQ-Short to assess their concurrent validity.

Conclusion

The Persian version of the motion sickness susceptibility questionnaire-short is a valid and reliable tool capable of distinguishing between individuals with varying degrees of susceptibility to motion sickness. It can be used in clinical practice and for research purposes in Persian-speaking populations.

Ethical Considerations

Compliance with ethical guidelines

This psychometric study has ethical approval from the Ethics Committee of Tehran University of Medical Sciences (Code: 36540).

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Authors' contributions

MH: Study design, acquisition of data, interpretation of the results, statistical analysis, and drafting the manuscript; SF: Study design and supervision; MAG: Study design and supervision, interpretation of the results, critical revision of the manuscript for important intellectual content; SJ: Statistical analysis; AK: Acquisition of data.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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References

1. Schmäl F. Neuronal mechanisms and the treatment of motion sickness. Pharmacology. 2013;91(3-4):229-41. [DOI:10.1159/000350185]
2. Turner M, Griffin MJ. Motion sickness in public road transport: passenger behavior and susceptibility. Ergonomics. 1999;42(3):444-61. [DOI:10.1080/001401399185586]
3. Antuñano MJ, Hernandez JM. Incidence of airsickness among military parachutists. Aviat Space Environ Med. 1989;60(8):792-7.
4. Golding JF. Predicting individual differences in motion sickness susceptibility by questionnaire. Personality and Individual differences. 2006;41(2):237-48. [DOI:10.1016/j.paid.2006.01.012]
5. Lackner JR, Dizio P. Space motion sickness. Exp Brain Res. 2006;175(3):377-99. [DOI:10.1007/s00221-006-0697-y]

6. Shupak A, Gordon CR. Motion sickness: advances in pathogenesis, prediction, prevention, and treatment. Aviat Space Environ Med. 2006;77(12):1213-23.
7. Reason JT, Brand JJ. Motion sickness. vii 310 pp. Oxford: Academic press; 1975.
8. Golding JF. Motion sickness susceptibility questionnaire revised and its relationship to other forms of sickness. Brain Res Bull. 1998;47(5):507-16. [DOI:10.1016/s0361-9230(98)00091-4]
9. Paillard AC, Quarck G, Paolino F, Denise P, Paolino M, Golding JF, et al. Motion sickness susceptibility in healthy subjects and vestibular patients: effects of gender, age and trait-anxiety. J Vestib Res. 2013;23(4-5):203-9. [DOI:10.3233/VES-130501]
10. Bullinger M, Alonso J, Apolone G, Leplège A, Sullivan M, Wood-Dauphinee S, et al. Translating health status questionnaires and evaluating their quality: the IQOLA Project approach. International Quality of Life Assessment. J Clin Epidemiol. 1998;51(11):913-23. [DOI:10.1016/s0895-4356(98)00082-1]
11. Terwee CB, Bot SD, de Boer MR, van der Windt DA, Knol DL, Dekker J, et al. Quality criteria were proposed for measurement properties of health status questionnaires. J Clin Epidemiol. 2007;60(1):34-42. [DOI:10.1016/j.jclinepi.2006.03.012]
12. Santos JRA. Chronbach's Alpha: A Tool for Assessing the Reliability of Scales. J Ext. 1999;37(2):1.
13. Fleiss JL, Levin B, Paik MC. Statistical Methods for Rates and Proportions. 3rd ed. New York, NY: John Wiley & Sons; 2013.
14. Dobie T, McBride D, Dobie T Jr, May J. The effects of age and sex on susceptibility to motion sickness. Aviat Space Environ Med. 2001;72(1):13-20.
15. Park AH. Age differences in self-reported susceptibility to motion sickness. Percept Mot Skills. 1998;87(3 Pt 2):1202. [DOI:10.2466/pms.1998.87.3f.1202]

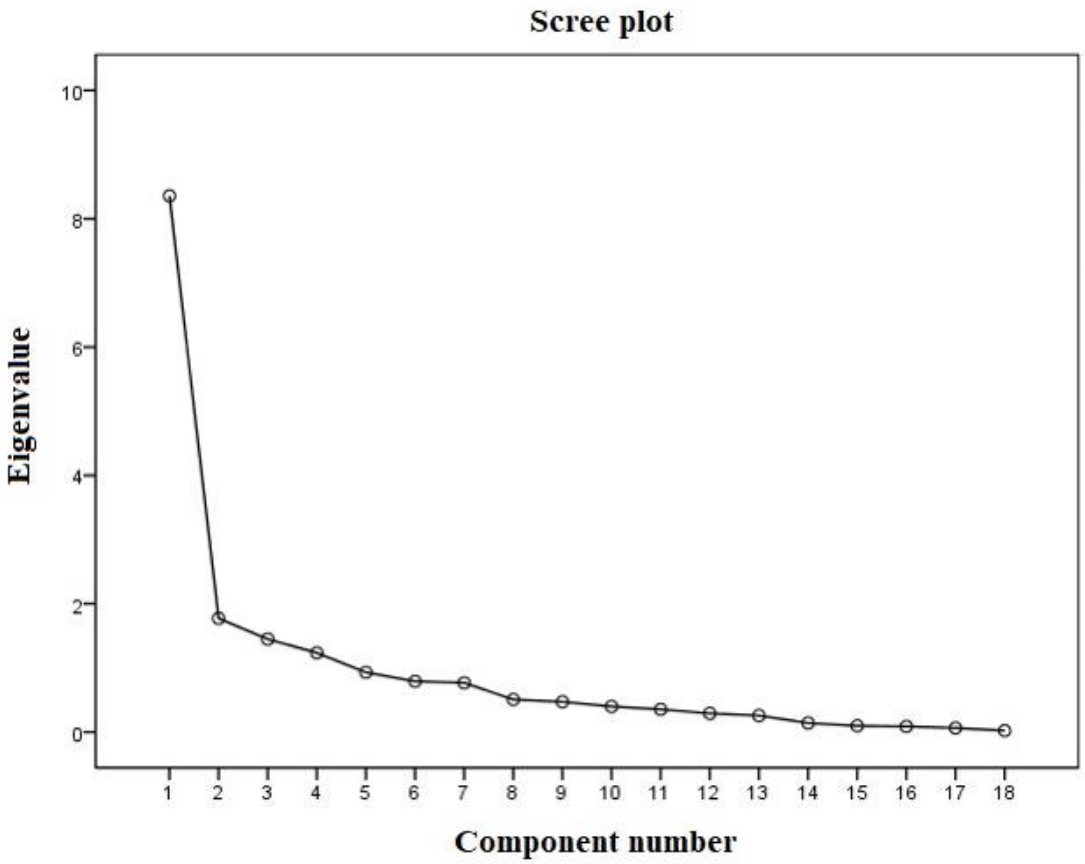

Figure 1. Scree plot of factors of the Persian version of motion sickness susceptibility questionnaire-short-form