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Sleep Science

Validation of the Persian version of the Pittsburgh Sleep Quality Index in elderly population

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ABSTRACT

Objective: The purpose of this study is to determine the validity and reliability of the Persian version of the Pittsburgh Sleep Quality Index in the elderly population. **Material and Methods:** A methodological study was conducted as a confirmatory factor analysis. Totally, 598 elderly people were selected through cluster sampling. In addition to analyzing the three-factor structure of PSQI, internal consistency reliability, structural validity, and its concurrent validity were examined. The structural credibility of PSQI was examined using other similar tools such as Sleep Health, Epworth Sleepiness, Insomnia Severity, Global Sleep Assessment, and Berlin indices. Finally, the concurrent criterion validity of PSQI was evaluated through multivariable regression analysis and all statistical analyzes were performed using SPSS and AMOS software. **Results:** The reliability of the test according to Cronbach's alpha was 0.81. Confirmatory factor analysis indicators supported goodness of fit of the structural equation model. The confirmatory factor analysis showed that the ratio of χ^2 / DF was 2.66 for the three-factor structure of PSQI and the goodness of fit indices of model were acceptable for this structural model (RMSEA=0.053, CFI=0.98, TLI=0.96, NFI=0.97, GFI=0.99). In addition, the internal consistency of the PSQI was 0.81 and the scales correlation score ranged from 0.48 to 0.71. **Conclusion:** The results indicated that Persian version of Pittsburgh Sleep Quality Index had the required validity and reliability for the elderly population of Iran and it can be used as a useful tool by other studies.

Keywords: Sleep Quality Index; Pittsburgh; Validation; Persian; Geriatric.

INTRODUCTION

Sleep is one of the basic needs of man. Sleep patterns change over a lifetime[1] so that in the elderly, changes in circadian rhythm and consolidation of sleep lead to sleep disorders and poor sleep quality[2]. According to the World Health Organization's (WHO) estimate, the world's elderly population (aged 65 year or older) will be 1.5 billion (16% of the world's population) by 2050. About 71% of this population will be in less developed countries[3].

Changes in the quality of sleep and circadian rhythm with age cause sleep disorders in elderly people. Chronic insomnia is the most common sleep problem in the elderly, which is due to poor quality of sleep[4]. Sleep problems in the elderly are due to early sleep disorders, other mental disorders, general clinical disorders, and social and environmental factors[1,2]. The poor quality of sleep causes disturbances in emotions, thoughts, and motivation and increases risk of falling[5], depression, dementia[6], ischemic exacerbation, and heart attack[7]. Therefore, assessing the quality of sleep of the elderly is a prerequisite of improving it[2]. Pittsburgh Sleep Quality Index (PSQI) is a well-known and standard instrument for assessing sleep quality, which has been used in many studies around the world[8,9]. This tool includes sub-scales for assessing sleep quality[10]. It has been used in various studies in Iran and its reliability and validity have been confirmed for the Iranian population[11-13] and for other countries of the world[14-17].

By aging people experience a variety of physical and mental changes and the changes in the quantity and quality of sleep is one of them[18]. The sleep condition of the elderly people is different from that of younger people. They usually have no bed partner and their sleep is more likely controlled by family members[1]. Degradation of physical health and vital organs such as the cardiovascular system and the pulmonary system, as well as the prevalence of digestive problems, cause changes in the quality and quantity of sleep in the elderly[18]. With regard to the elderly's sleep situation, Landry believed that PSQI cannot be the best tool for assessing the quality of sleep in the elderly, and the validity of this tool in this age group should also be verified[19]. Therefore, the usability of this questionnaire to assess the sleep of the elderly should be verified beforehand. This research is an attempt to standardize and determine the validity and reliability of PSQI in the elderly population in Iran.

MATERIAL AND METHODS

This is a methodological study with the sample size determined based on cluster sampling. The subjects were selected from the elderly population of Kermanshah province, based on the statistics reported by the Welfare Organization of this province in 1396. For this purpose, eight cities were randomly selected out of the 14 cities of Kermanshah province. In the case of Kermanshah City, according to the health center's statistical data, 50 clusters were randomly selected from different parts of the city. The inclusion criteria for the elderly were age 60 year and older and willingness to participate in the study; and the exclusion criteria were substance abuse or substance addiction, use of sleeping drugs, and psychiatric disorder history.

The questionnaires were mostly completed by the elderly. The author would help in cases where the elderly needed help due to eyesight impairment and illiteracy. The time for completion of the questionnaires varied from 20 to 30 minutes.

Totally, 800 questionnaires were completed by the study population. A number of questionnaires were excluded and 598 questionnaires were finally evaluated.

In order to study the Concurrent validity of Sleep Quality Index, Sleep Health, Epworth Sleepiness, Insomnia Severity indices, Global Sleep Assessment Questionnaire (GSAQ), and Berlin Questionnaire were also used. Then, the correlation between questionnaires was calculated.

To test the reliability of PSQI questionnaire using test-retest Reliability, 10% of participants (60 people) completed PSQI questionnaire with 4-6 weeks interval.

Pittsburgh Sleep Quality Index

The questionnaire is designed to measure sleep quality and to identify the people with and without sleep problems[14]. This scale includes seven sub-scales containing: Subjective Sleep Quality (SSQ), Sleep Latency (SL), Sleep Duration (SDu), Habitual Sleep Efficiency (HSE), Sleep Disturbances (SD), Use of Sleeping Medication (USM), and Daytime Dysfunction (DD). Responses are graded from 0 to 3 and the range of scores is 0 to 21. A score above six, indicates a poor sleep quality. Validity and reliability of this questionnaire have been investigated in Iran ($\alpha = 0.83$ and correlation coefficient = 0.88)[6].

Sleep Health Index

Sleep Health Index (SHI) is a self-report index with 13 items and it is used to assess the environmental and behavioral variables that can cause low quality sleep. In this questionnaire, each question is scored in five scales (always, often, sometimes, rarely, and never). The Cronbach's alpha is 0.66 and test re-test value is 0.71 ($p<0.01$)[20]. Moreover, there is a positive correlation between this index and the Epworth Sleepiness Index (0.24) ($p<0.01$). Chehri et al.[11] reported a Cronbach alpha of 0.83 for this tool.

Epworth Sleepiness Scale (ESS)

This scale is designed to evaluate the rate of daytime sleepiness. There are eight different situations and the respondents should indicate the likelihood of sleepiness, dozing off, or falling asleep in these eight situations. Each item is scored from zero to three; so that score zero means that dozing off or falling asleep in that state never happens, and the score three means that there is a high probability of a napping or falling asleep in that situation. The total score of ten or more indicates excessive daytime sleepiness of the responder[14].

Insomnia Severity index

The Insomnia Severity Index (ISI) is a brief self-report instrument measuring patients' perception of the severity of insomnia. The ISI is comprised of seven items assessing the

perceived severity of difficulties of initiating sleep, staying asleep, early morning awakenings, satisfaction with current sleep pattern, and interference with daily functioning, noticeability of impairment attributed to the sleep problem, and the degree of distress or concern caused by the sleep problem. The questions are designed based on Likert's five-point scale (zero = never to 4 = very high). The overall score for this indicator is between zero and 28 and the higher scores mean more severe insomnia. Insomnia severity index is a sensitive indicator for measuring the efficacy of insomnia treatment. This index is a valid and reliable tool used in several studies.

The concurrent validity of this tool was reported with the registration dossier at the time of its development (r=0.65)[19].

With the registration dossier, Bastien et al.[21] reported the internal consistency validity, the concurrent validity, and the correlation of each question with the whole test equal to 0.74, 0.65, and 0.38-0.69, respectively. Bastien et al.[21] reported the internal consistency validity of the test through the calculation of Cronbach's alpha equal to 0.72. This questionnaire was evaluated by Sadeghniiat-Haghighi et al.[22] in Iran and its psychometric properties were determined. The researchers showed that the Persian version of the insomnia severity index had an acceptable internal consistency with Cronbach's alpha of 0.78. They also showed that the Persian version of the insomnia severity index had a sufficient differentiation power to diagnose patients from healthy people.

Global Sleep Assessment Questionnaire

The GSAQ is an 11-item tool that measures sleep behaviors based on a three-point scale of behaviors that never occur (score 0) to behaviors that always occur (score 2) (reference). The GSAQ score is the total scores of the 11 responses. The higher scores (the behaviors that always occur, as well as behaviors that sometimes occur) represent a higher risk of experiencing sleep disturbance. Reliability of the test-retest of this questionnaire is in the range of 0.51 to 0.92. According to the concurrent validity of GSAQ, with the evaluation of a clinical expert, this instrument has a desirable validity in detecting sleep disturbances[23].

Berlin questionnaire

The Berlin Questionnaire includes 10 items organized into three categories including snoring examination (questions 1 to 5), daytime sleepiness (questions 6 to 9), and blood pressure and body mass index (question 10). If the patient receives two or more points in the first and second category a positive case is concluded. The third category measures blood pressure and body mass index. According to the Berlin Questionnaire, patients are divided into two groups at high risk and at low risk of respiratory interruptions or sleep apnea. If the patient's points are positive in two or more categories, the patient is considered to be at high risk for respiratory interruptions or sleep apnea. The alpha Cronbach's reliability of the BQ categories in Amra et al.[24] study was 0.70 and 0.50 for category 1 and category 2, respectively.

Data analysis

Descriptive statistics indices such as frequency, percentage, mean, and standard deviation were used to describe the data. Cronbach's alpha coefficient was used to determine the PSQI internal consistency and reliability and the Pearson correlation coefficient was used to calculate the correlation between the variables and structural validity of PSQI questionnaire and other tools. To investigate the PSQI three-factor structures (perceived sleep quality, sleep efficiency, and daytime sleep disorder), Confirmatory Factor Analysis was used through Maximum Likelihood method using AMOS software (version 23).

Findings

The mean age of the participants in the study was 68.33 with a standard deviation of 8.75 and the age range of 60 to 85 years. Among the research units, 53.3% were female and 46.7% were male. In addition, 80.6% of them were married and 44.8% did not have a high school diploma (Table 1) and Mean and standard deviation of PSQI's sub-scales in research units are listed in Table 2.

In order to verify the reliability of PSQI, test-retest and internal consistency methods were used. Using Cronbach's alpha, the coefficient of reliability for the subscales of the

Table 1. Demographic characters of research units.

		N (%)
Sex	Female	319(53.3)
	Males	279(46.7)
Marital S.	Single	9(1.5)
	Married	482(80.6)
	Widow	107(17.9)
Graduate S.	Illiterate	203(33.9)
	Under Diploma	268(44.8)
	Diploma	85(14.2)
	Academic L.	42(7)
Job	House keeper	201(33.6)
	Retired	107(17.9)
	Other	290(48.5)

Table 2. Mean and standard deviation of PSQI's sub-scales in research units.

	Mean	SD
SSQ	1.31	0.823
SL	1.57	0.963
SDu	0.92	1.01
HSE	0.7	1.09
SD	1.5	0.61
USM	0.59	1.06
DD	1.08	0.86
TSQ	7.69	4.06

Abbreviations: SSQ= Subjective Sleep Quality, SL- Sleep Latency, SDu= Sleep Duration, HSE= Habitual Sleep Efficiency. SD= Sleep Disturbances, USM= Use of Sleeping Medication, DD= Daytime Dysfunction, TSQ= Total Sleep Quality.

questionnaire was obtained in the range 0.73-0.82. Therefore, the subscales have the required reliability for the measurement. On the other hand, the overall quality has a validity coefficient of 0.81 which indicates the appropriate reliability of the test. Based on the test-retest method, the PSQI reliability was 0.87 (p-value<0.001).

Spearman correlation coefficient was used to measure the internal reliability of subscales. Table 3 shows the correlation between Pittsburgh Sleep Quality Dimensions and its components. The correlation is significant at the level below 0.01. In order to evaluate the reliability of sleep quality instrument, 10% of the sample size (60 people) was screened for 4-7 weeks in terms of the Sleep Quality Index. The results of Spearman's correlation test showed that the correlation coefficient was 0.89 – i.e. acceptable reliability. The reliability of the dimensions varied from 0.76 to 0.84, which is desirable in terms of reliability. The correlation of PSQI with sleep health questionnaire was used to assess the criterion or concurrent validity. Therefore, the Spearman correlation coefficient between the sleep quality and the sleep health subscales were used to determine the normality of sleep scales and subscales. The results showed that there was a direct and significant correlation between sleep quality index and sleep health index (r=0.363, p-value=0.001). For the correlation and significance level of other subscales see Table 4.

PSQI had a direct and significant correlation with the total score of insomnia severity index (r=0.625, p=0.001), Epworth sleepiness index (r=0.139, p=0.001), Berlin Index (r=0.336, p=0.001), and the Global Sleep Assessment Index (r=0.634, p=0.001) (p<0.01).

Figure 1 shows the relationship between the PSQI scale and subscales, in which perceived sleep quality, sleep efficacy, and daytime sleep disorders factors are correlated with sleep quality.

As listed in Table 5 the Chi square is equal to 2.66 and the degree of freedom is 8. The chi-square is the most important index of goodness of fit and it measures the difference between the observed and estimated matrices. This statistic is very sensitive to the sample size, so it is divided into degrees of freedom and the goodness of fit is confirmed if the result is less than five.

Another indicator is the Goodness of the Fit Index, which indicates whether or not the goodness of fit is acceptable and desirable. The Root Mean Square Error of Approximation (RMSEA) value of the goodness of fit was obtained equal to 0.053. Since it is less than 0.08, it is acceptable and the research model is supported.

According to the Goodness of Fit Index (GFI), values above 0.9 are acceptable. In the proposed model, GFI=0.99 indicates a goodness of fit of the model. The Confirmatory Fit Index (CFI) is a comparative fit index so that the closer it is to one the more acceptable is the model. According to the Normed Fit Index (NFI) or Bentler-Bonett Index, a minimum value of 0.9, represents a good fitness of the model.

According to The Tucker-Lewis Index (TLI) or the non-normed fitness index, the values between 0-1 and 0.95 indicate a good fitness of the model.

Table 3. PSQI Correlation Coefficients Matrix.

	1	2	3	4	5	6	7
SSQ	1						
SL	0.471**	1					
SDu	0.339**	0.362**	1				
HSE	0.308**	0.382**	0.579**	1			
SD	0.437**	0.292**	0.16**	0.162**	1		
USM	0.295**	0.213**	0.136**	0.131**	0.306**	1	
DD	0.388**	0.262**	0.157**	0.48**	0.458**	0.171**	1
TSQ	0.714**	0.676**	0.613**	0.607**	0.598**	0.484**	0.544**

Abbreviations: SSQ= Subjective Sleep Quality, SL- Sleep Latency, SDu= Sleep Duration, HSE= Habitual Sleep Efficiency. SD= Sleep Disturbances, USM= Use of Sleeping Medication, DD= Daytime Dysfunction, TSQ= Total Sleep Quality. *Significant in <0.05. **significant level in <0.01.

Table 4. Correlation between the sub-scales of PSQI and sleep health.

	The behaviors of sleep cycle and wake - up	Bedroom agents	Effective sleep behaviors	Whole Scores
SSQ	0.174**	0.144**	0.384**	0.345**
SL	0.181**	0.083*	0.267**	0.259**
SDu	0.043	0.04	0.169**	0.112**
HSE	0.117**	0.043	0.021	0.059
SD	0.209**	0.139**	0.389**	0.362**
USM	0.186**	0.15**	0.2**	0.258**
DD	0.165**	0.112**	0.342**	0.294**
TSQ	0.229**	0.138**	0.38**	0.363**

Abbreviations: SSQ= Subjective Sleep Quality, SL- Sleep Latency, SDu= Sleep Duration, HSE= Habitual Sleep Efficiency. SD= Sleep Disturbances, USM= Use of Sleeping Medication, DD= Daytime Dysfunction, TSQ= Total Sleep Quality. *Significant in <0.05. **Significant level in <0.01.

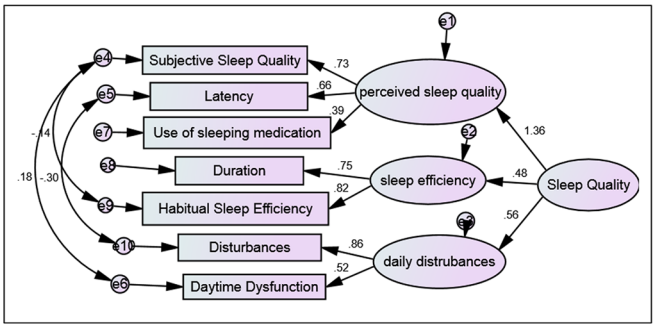

Figure 1. Three factors model of sleep quality and its subscales in the elderly.

Table 5. Elderly sleep quality model fitting indices.

Model fit index	Rate	Criterion	Interpretation
X^2	2.66	<5	Optimal fitting
Df	8	-	Optimal fitting
CFI	0.98	>0.9	Optimal fitting
NFI	0.97	>0.9	Optimal fitting
GFI	0.99	>0.9	Optimal fitting
TLI	0.96	>0.9	Optimal fitting
RMSEA	0.053	<0.08	Optimal fitting
R^2	0.99	Near to 1	Optimal fitting

In the case of root mean square of the estimation error or RMSEA index, values less than 0.05 are considered as acceptable fit and above 0.1 as weaknesses of the model. Here RMESA is equal to 0.053, which is at a confidence interval of 90% with a lower limit of 0.01 and an upper limit of 0.88-i.e. goodness of fit is supported.

DISCUSSION

The PSQI is used to diagnose sleep disorders and assess the quality of sleep. Verifying the validity and reliability of this questionnaire for the target community is necessary to ensure the accuracy of the obtained information. The validity and reliability of the Persian version of the PSQI in the elderly population were determined. The results showed that the PSQI had an acceptable validity and reliability in Iranian elderly people.

One of the objectives of this study was to determine the validity of the PSQI factor structure using confirmatory factor analysis. The results showed that a three-factor model had a good fitness.

This three-factor model has been also used in other researches[14,15,25,26]. These three factors were investigated according to previous studies and confirmatory factor analysis. Finally, a good fitness was obtained with a three-factor model.

Different models were examined based on literature review and a three-factor model with 19 items was approved. The indices obtained in this model were compared with the values obtained by previous studies. Cole et al.[15] reported a three-factor model and supported its goodness of fit (GFI=0.95; RMSEA=0.06; CFI=0.9). Burkhalter et al.[26] also confirmed a three-factor model with 19 items using confirmatory factor analysis. The reported goodness of fit indices in the present and the mentioned study are as follows (CFI=0.99; RMSEA=0.06; DF=8; x^2=11.85).

Becker and Jesus[25] studied the compatibility of the three-factor model of sleep scale with the help of confirmatory factor analysis. Several models were fitted and ultimately the final 3-factor model was approved by deleting "the use of sleeping drugs" item. The reported goodness of fit indices in the present and the mentioned study are as follows (CFI=0.98; GFI=0.99; RMSEA=0.46; DF=6; x^2=1.21).

The reliability of PSQI was determined using internal consistency (Cronbach's alpha). The results indicated that this index has a high internal consistency.

Cronbach's alpha coefficient for the total scale was 0.81 and for the subscales of this questionnaire ranged from 0.73 to 0.82. In Becker and Jesus[25] study, the Cronbach's alpha coefficient was 0.69 with a three-factor model; however, by deleting "the use of sleeping drugs" item, it increased to 0.70, which is lower than that of the present study. None of the items were removed in this study. The range of correlation coefficients varied from 0.12 to 0.52, which was in line with the results of Becker and Jesus[25]. In Sohn et al.[27] study, the Cronbach's alpha coefficient for internal consistency was 0.84 – i.e. a high reliability – which is consistent with our findings.

Salahuddin et al.[28] reported a Cronbach's alpha equal to 59.0. In Spira et al.[29] study, the internal reliability was 69.0, which is lower than the present study. It also indicates a high degree of internal consistency, which is consistent with the results of this study.

Based on test-retest method, the Sleep Quality Index had a good reliability in the elderly population. In Tzeng et al.[30] study, the reliability of the Taiwanese version of the PSQI for cancer patients was 91.0, which is consistent with the present study.

Another objective of this study was to determine the validity of PSQI with other questionnaires using the concurrent method. The results showed that the Sleep Quality Index had a good criterion validity with other questionnaires to assess sleep disorders. Del Rio Joao et al.[16] reported that the correlation coefficients of the seven PSQI components and the total score of GSAQ were ≥ 0.46. In Takacs et al.[31] study, the correlation between components scores and global scores was high, and the calculated range was 0.59 to 0.88. Moreover, there was a significant correlation between Pittsburgh Sleep Quality Index and Epworth sleepiness index. The results of Spira et al.[29] study showed a significant correlation between the Pittsburgh Sleep Quality Index and Epworth sleepiness index.

The results of the present paper are in a good agreement with the majority of studies mentioned above. It can be said that the Pittsburgh questionnaire is a standard and widely applicable questionnaire that has the same characteristics in the majority of studies in different populations. Although, the results of this study are in a good agreement with the results of previous studies, the cultural factors should be taken into account in using and reviewing the questionnaire.

CONCLUSION

The Persian version of Pittsburgh Sleep Quality Index has the required validity and reliability in the Iranian elderly population and can be used as a useful tool in relevant researches.

Ethics approval and consent to participate: In this research, the ethical considerations including the principles of confidentiality of information, obtaining written informed consent for participating in study, publication and having the right to withdraw from the research at any time were observed. This study was approved by research committee (Grant No. 3005693) and ethical committee of

Consent to publication: not applicable.

Availability of data and materials: the datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: the authors declare that they have no conflict of interest about this work.

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