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A Pilot Study of the Pittsburgh Sleep Quality Index Scale among Chinese University Student Population

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Abstract: Sleep quality is essential for physical and mental health, and poor sleep quality is a global public health problem. PSQI is a widely used questionnaire to assess sleep quality. This study focused on the sleep quality of Chinese university students and the reliability and validity of the Pittsburgh Sleep Quality Index (PSQI) scale in this population. The aim is to provide the basis for the effective evaluation and research of sleep quality of Chinese university students.

1. Introduction

1.1 Sleep

Since ancient times, people have been very interested in sleep, sleep has been the focus of many disciplines, especially neuroscience, medicine, physiology, psychology and other related disciplines.

At present, people's normal Sleep process is divided into two phases, namely Non-Rapid Eye Movement Sleep (NREM) and Rapid Eye Movement Sleep (REM).

NREM sleep, as well as REM sleep, alternates rhythmically throughout the night, known as the sleep cycle [1].The sleep cycle changes throughout a person's life, with the duration of the cycle and the distribution of sleep periods changing with age. The proportion of REM and NREM sleep varies with age, and the proportion of REM sleep in newborns is much higher than that in children and adults. The average sleep cycle for newborns is 60 minutes and 90 minutes for adolescents [2].

1.2. Sleep quality

Sleep quality is assessed based on changes in sleep cycle stability, subjective feelings, or objective measurements. Poor sleep quality, known as heteromorphic sleep or sleep disorders, can occur if a population's deep or light sleep time is too long or too short, and if their sleep cycle is too long or too short. Sleep disorders can be classified as insomnia, daytime sleepiness, sleep apnea, biological rhythm sleep disorders, and sleep-related exercise disorders.

To sum up, sleep quality is not a single concept that can be evaluated by a single index or score. It mainly includes sleep time, disturbance of sleep process (number or time of waking up at night, etc.),

sleep efficiency, subjective feeling of waking up early and many other aspects.

1.3. Sleep problems have become a global public health problem

The Centers for Disease and Prevention reports that nearly one-third of adults do not get seven hours of sleep [3].

Researchers in the field of psychology pay more attention to the correlation between sleep quality and mental health. Monroe et al. [4] found through investigation that people with higher sleep quality tend to show better physical adaptability and psychological state.

In conclusion, sleep quality is closely related to people's physical and mental health, which shows the importance of sleep research in the field of physical health.

1.4. Sleep quality of Chinese university students

In recent years, relevant studies in China have shown the seriousness of sleep problems among Chinese university students [5]. Long-term sleep deprivation or poor sleep quality has a negative impact on the body and mind, which may lead to the decline of memory and attention, and even lead to anxiety, depression and other psychological problems, and even lead to the decline of various immunity and resistance of the body [6]. Therefore, sleep quality has become one of the key problems threatening the physical and mental health of university students.

Therefore, clarifying sleep problems is helpful to carry out targeted intervention for university students with insomnia and other problems, so as to promote their physical and mental health and academic progress. It is of great significance to carry out effective evaluation and research on sleep quality of Chinese university students. Pittsburgh sleep quality index (PSQI) is widely used to investigate sleep quality in various groups. The reliability and validity of the Chinese version of PSQI have been preliminarily verified [7]. Although there have been researches on the use of PSQI scale to investigate the sleep status of Chinese university students in China, there is a lack of evidence on the reliability and validity of this scale in this population. In this study, an electronic version of PSQI was used to investigate the sleep quality of Chinese students in UTM. The reliability and validity of the scale in university students were analyzed.

2. Instrument

2.1. Introduction to the Pittsburgh Sleep Quality Index (PSQI)

The Pittsburgh Sleep Quality Index (PSQI) [8], a widely used self-reported questionnaire, is regarded as a generic instrument for assessing sleep quality in a variety of populations. The PSQI''s benefits include the ability to assess qualitative and quantitative data to identify patterns of sleep dysfunction over a one-month period and to generate a straightforward global score that reflects the number and severity of sleep problems. In addition, the PSQI is constructed in such a way that the items and component scores correspond to typical areas that clinicians typically concentrate on when patients report experiencing sleep problems.

The PSQI consists of 24 questions or items to be scored (0–3, for 20 items; 4 items are open-ended), 19 of which are self-reported, and 5 of which require second-hand feedback from a bed or roommate. The first four items are free-response questions that assess sleep duration. The remaining items are concerned with daytime dysfunction and sleep disturbances. Participants rate their overall sleep quality (0 = very good, 1 = fairly good, 2 = fairly bad, and 3 = very bad) on a 4-point Likert scale along with the frequency of each problem (0 = not during the past month, 1 = less than once a week, 2 = once or twice a week, and 3 = three or more times a week).

What's more, seven component scores are produced by the non-linear scoring of the items: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction, which provide references for clinical decisions. The scores for each component range from 0 to 3, and the sum of the component scores results in a global score (0 to 21), with a higher score indicating greater difficulty across all component domains. A global score of five or higher indicates poor sleep 88.

Note: In this study, a 4-point Likert scale (1-4) was used.

2.2. The reliability and validity of Pittsburgh Sleep Quality Index (PSQI)

When given to patients with physical illnesses and mental and sleep disorders, the PSQI exhibits acceptable reliability and validity. For instance, Shochat et al. [9] investigated the reliability and validity of the PSQI in Hebrew and discovered a Cronbach's alpha of 0.72. Beck et al. [10] also examined the psychometric properties of the PSQI on cancer patients and discovered satisfactory internal consistency and construct validity. Besides, Cole et al. [11] discovered the factor structure of the PSQI and concluded that a three-factor model outperforms both single-factor and two-factor models in terms of goodness of fit.

2.3. The Comparison Table of Components and specific items for the PSQI

PSQI divides the 10 items into 7 components, the details for each component are shown in Table 1.

Table 1: The Comparison Table of Components and specific items for the PSQI

Component	Number of Items	Specific Items
Subjective sleep quality	1	Q6
Sleep latency	2	Q2, Q5a
Sleep duration	1	Q4
Habitual sleep efficiency	2[a]	Q4/ (Q1- Q3)
Sleep disturbances	8	Q5b, Q5c, Q5d, Q5e, Q5f, Q5g, Q5h, Q5i
Daytime dysfunction	2	Q8, Q9

3. Adaptation and measurement process to the Pittsburgh Sleep Quality Index (PSQI)

3.1. Adaptation of the Pittsburgh Sleep Quality Index (PSQI)

As stated in the previous section, a self-report questionnaire called the Pittsburgh Sleep Quality Index (PSQI) measures various aspects of sleep over the course of a month[12], which has been used extensively in a variety of clinical populations. However, the subjects of the study are Chinese university students who study in UTM, so cross-cultural research on this instrument has led to various translation and adaptation in testing non-English speaking environment. Hence, the focus of current study is to translate and adapt the PSQI to be used among Chinese university students.

In the study, out of the 19 self-reported items, 3 items (including component 6 "Use of sleeping medication") were rephrased and deleted to make it suitable for applying it among Chinese university students. For more convenient calculation, the open-ended question Q5j "other reason(s), please describe" has deleted. Besides, considering the research subjects are Chinese university students, Q7

(Component 6 “Use of sleeping medication”) “During the past month, how often have you taken medicine (prescribed or “over the counter”) to help you sleep?” has also deleted. Furthermore, “driving” in Q8 has replaced to “studying”. What’s more, out of 5 items of which require secondary feedback from a room or bed partner, the open-ended question 11e has deleted. Once all the items were translated and adapted, a pilot study was conducted. The items were transferred into “Questionnaire Star” and distributed to Chinese university students study in UTM.

3.2. Process of the test

Quantitative analysis of the research questions will be carried out according to the process shown in Figure 1.

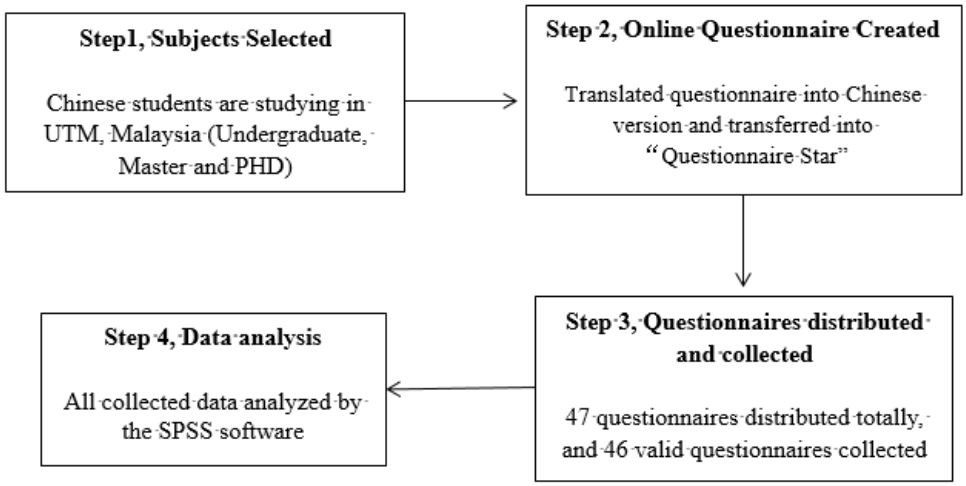

Figure 1: Process of the test.

4. Data Analysis

4.1. Reliability analysis

The model has a Cronbach's α coefficient value of 0.692, indicating that the questionnaire is generally reliable. This is shown in Table 2.

Table 2: Cronbach's α coefficient

Cronbach's α coefficient	Standardized Cronbach's α coefficients	The number of items	Number of samples
0.692	0.73	20	46

The results of the total statistics show that the overall correlation (CITC) after deleting Subjective_Sleep_Quality items and the α coefficient after deleting items perform well, and the scale questions cannot be corrected;The overall correlation (CITC) after deleting sleep_latencey items and the α coefficient after deleting items perform well, and the scale questions cannot be corrected;The overall correlation (CITC) after deleting Q5d items and the α coefficient after deleting items perform well, and the table questions cannot be corrected;The overall correlation (CITC) after deleting Q5e items and the α coefficient after deleting items perform well, and the scale questions cannot be corrected;The overall correlation (CITC) after deleting Q5f items and the α coefficient after deleting items perform well, and the scale questions cannot be corrected;The overall correlation (CITC) after deleting Q5g items and the α coefficient after deleting items perform well, and the scale questions cannot be corrected;The overall correlation (CITC) after deleting Q5h items and the α coefficient

after deleting items perform well, and the scale questions cannot be corrected;The overall correlation (CITC) after deleting Q5i items and the α coefficient after deleting items perform well, and the scale questions cannot be corrected, the value of the overall correlation between Q2 and the deletion is 0.29, which is less than the judgment standard of 0.3, and the item can be considered for deletion and re-analysis; the value of the overall correlation between Q4 and the deletion is 0.263, which is less than the judgment standard of 0.3, and the item can be considered for deletion and re-analysis; The overall correlation (CITC) after deleting Q5a term and the α coefficient after deleting the item perform well, and the scale questions cannot be corrected;The overall correlation (CITC) after deleting Q6 items and the α coefficient after deleting items perform well, and the scale questions cannot be corrected;The overall correlation (CITC) after deleting Q8 items and the α coefficient after deleting items perform well, and the scale questions cannot be corrected;The overall correlation (CITC) after deleting Q9 items and the α coefficient after deleting items perform well, and the scale questions cannot be corrected. The results of the total statistics show that the value of the deleted Habitual_sleep_efficiency and the overall correlation between the deleted item is -0.143, which is less than the judgment criterion of 0.3, and the item can be considered for deletion and re-analysis [13]. This is shown in Table 3.

Table 3: Delete the statistical summary of the analysis item.

	The average after deleting an item	Variance after deleting an item	The overall relevance of the deleted item to the item after it was deleted	Cronbach's α coefficient after removing the term
Q2	36.522	45.944	0.357	0.674
Q4	36.696	47.416	0.294	0.681
Q5a	36.196	43.45	0.402	0.666
Q5b	36.261	43.397	0.407	0.665
Q5c	36.543	47.898	0.067	0.705
Q5d	37.022	45	0.428	0.667
Q5e	36.457	42.876	0.418	0.663
Q5f	36.913	44.17	0.414	0.666
Q5g	36.609	44.288	0.384	0.669
Q5h	36.674	42.091	0.654	0.644
Q5i	37.065	46.507	0.449	0.673
Q6	36.261	45.13	0.541	0.663
Q8	36.239	41.253	0.542	0.647
Q9	36.217	44.618	0.432	0.666
Q10	36.174	54.369	-0.297	0.761
Q11a	35.717	49.141	0.049	0.698
Q11b	36.087	47.903	0.109	0.696
Q11c	36.109	46.632	0.213	0.686
Q11d	36.174	47.169	0.16	0.692
Habitual_sleep_efficiency	37.087	51.414	-0.172	0.713

4.2. Validity analysis

The results of the KMO test show that the value of KMO is 0.646, and the results of the Bartlett

spherical test show that the significance P value is 0.000***, which is significant at the level, rejects the null hypothesis, there is a correlation between the variables, the factor analysis is effective, and the degree is not very suitable. This is shown in Table 4.

Table 4: KMO test and Bartlett's test.

KMO test and Bartlett's test		
KMO value		0.646
Bartlett sphericity test	Approximate chi-square	236.049
	df	105
	P	0.000***
Note: ***, ****, * represent the significance levels of 1%, 5% and 10%, respectively		

In the ANOVA table, when the number of principal components is selected as 6, the feature root of the variable interpretation is lower than 1, and the contribution rate of the variable explanation reaches 73.1%. This is shown in Table 5.

Table 5: Explain the total variance

Total variance interpretation						
ingredients	Feature root			Variance interpretation rate after rotation		
	Feature root	Variance Explanation Rate (%)	Cumulative % (%)	Feature root	Variance Explanation Rate (%)	Cumulative % (%)
1	4.323	28.799999999999997	28.799999999999997	3.114	20.8	20.8
2	2.077	13.8	42.699999999999996	1.996	13.3	34.1
3	1.417	9.4	52.1	1.704	11.4	45.4
4	1.296	8.6	60.699999999999996	1.566	10.4	55.900000000000006
5	0.941	6.3	67	1.307	8.7	64.60000000000001
6	0.919	6.1	73.1	1.285	8.6	73.1
7	0.795	5.3	78.4			
8	0.756	5	83.5			
9	0.679	4.5	88			
10	0.527	3.5000000000000004	91.5			
11	0.402	2.7	94.19999999999999			
12	0.292	1.9	96.1			
13	0.241	1.6	97.7			
14	0.191	1.3	99			
15	0.146	1	100			

The gravel plot is plotted based on the degree of interpretation of the variation of the data by each principal component. Its function is to confirm the number of factor principal components to be selected according to the slope of the decreasing feature value, and the combination of the variance explanation table can be used to confirm or adjust the number of factor principal components.

Each principal component is a point, and the number of principal components is extracted through the unknown judgment of "the slope tends to be flat". For example, the data after the third principal component tends to flatten, so we think we can raise the weight of the first 2 principal components [14]. This is shown in Figure 2.

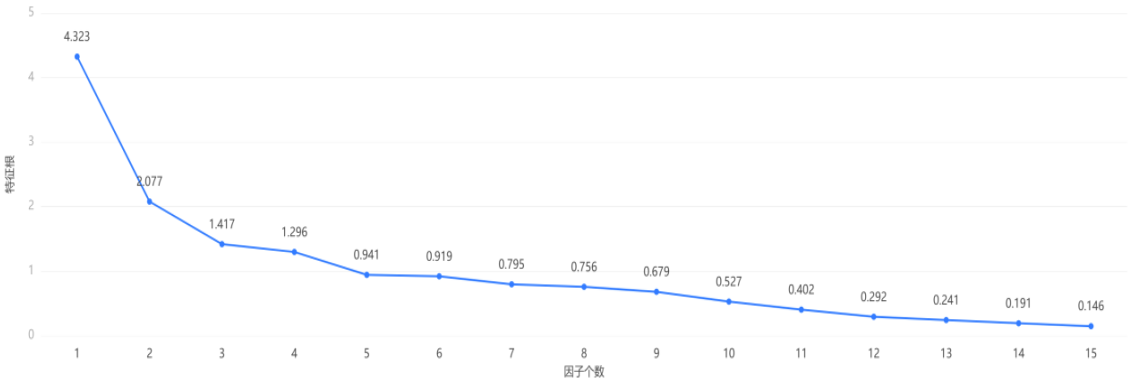

Figure 2: Gravel plot.

The above table is a table of factor load factors, which can analyze the importance of hidden variables in each principal component.

The above table of factor loading coefficients shows a new pattern of factor loading coefficients for each item in different dimensions, and the following table clearly compares the rotationally loaded dimensions with the original dimensions of the scale. This is shown in Table 6.

Table 6: Factor load factor table.

Table of factor load factors after rotation							Co-commonality (common factor variance)
	Factor load factor after rotation						
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	
Q2	0.122	0.042	0.237	0.41	0.622	0.305	0.72
Q4	0.002	0.195	0.077	0.853	0.098	-0.105	0.793
Component 4	0.008	-0.104	-0.098	-0.064	0.807	-0.291	0.76
Q5a	0.046	0.215	0.862	0.073	0.1	0.178	0.838
Q5b	-0.062	0.685	0.466	0.05	-0.022	0.179	0.726
Q5c	0.015	0.028	0.093	-0.1	-0.122	0.894	0.834
Q5d	0.595	0.497	-0.154	-0.288	0.109	0.18	0.752
Q5e	0.631	0.079	0.054	0.102	-0.104	-0.024	0.429
Q5f	0.842	-0.033	-0.084	0.076	0.051	0.029	0.726
Q5g	0.642	-0.004	0.439	-0.114	-0.164	-0.256	0.71
Q5h	0.668	-0.005	0.311	0.342	0.000	0.327	0.768
Q5i	0.686	0.12	0.06	-0.049	0.194	-0.01	0.529
Q6	0.256	0.456	0.562	0.333	-0.281	-0.147	0.801
Q8	0.479	0.509	0.013	0.498	-0.254	0.011	0.802
Q9	0.095	0.832	0.144	0.239	-0.037	-0.074	0.786

After comparison, it can be found that there are differences between the rotated loadings and the original dimensions in some aspects. From the statistical point of view, the possible reasons include: the small number of sample size does not represent the overall characteristics of the population under study; in addition, cultural differences may also cause expressive errors in the translation of the scale, or the subjects cannot correctly understand the meaning of the questions. The solution is to expand the sample size, balance the proportion of men and women in the sample, the proportion of education levels, invite experts to translate each other, etc. This is shown in Table 7.

Table 7: Comparison table.

Component	Original factors		Factors after rotated matrics	
	Number of items	Specific items	Number of items	Specific items
1	1	Q6	2	Q5a, Q6
2	2	Q2, Q5a	2	Q2, Component 4
3	1	Q4	1	Q4
4	2[a]	Q4/(Q3-Q1)	1	Q5c
5	8	Q5b, Q5c, Q5d, Q5e, Q5f, Q5g, Q5h, Q5i	6	Q5d, Q5e, Q5f, Q5g, Q5h, Q5i
6	2	Q8, Q9	3	Q5b, Q8, Q9
a，the 2 items are combined to calculate component core;				

5. Strengths and weaknesses

The Chinese version of PSQI, as a short subjective sleep assessment scale, can quickly assess the sleep quality of subjects quantitatively, and its reliability and validity meet the measurement requirements, so it can be used as a measurement tool for subjective sleep quality of university students in China. To some extent, this study has improved and extended the measurement tools for the assessment of sleep quality among Chinese university students and provided a certain basis for research in the field of sleep quality among university students in China. From a scientific point of view, any study requires continuous improvement and continuous follow-up, so this study still has insurmountable difficulties and will certainly have certain shortcomings.

5.1. Strengths

First, the reliability and validity of the questionnaire in the Chinese university student population are good providing an objective measurement tool for the current study of university students' sleep quality.

Second, in order to make the scale more relevant, we revised the questionnaire to address the language habits and life situations characteristic of the population.

Third, based on the results of data analysis, items with low loadings were removed, and the scale items were streamlined and optimized to make the assessment process of the questionnaire easier and faster.

5.2. Weaknesses

First, in the survey research stage, the use of network sampling, not balanced with regional, gender and other factors due to the conditions, failed to use random whole group sampling for questionnaire survey, so it may make the study has a certain sampling bias, the sample representation has certain limitations, and does not represent the situation of all university students in China. Due to the cross-sectional research design, the results of this study failed to reveal the development trend of sleep quality among the university students in China.

Second, subjective reports may cause bias in subjects' reports of their sleep time and sleep latency compared with sleep conditions recorded by objective instruments, so the data collected are somewhat subjective.

Third, the sleep patterns of university students may be influenced by factors such as whether they need to attend classes early in the morning, and future studies may consider asking students to record a weekly sleep diary to examine students' sleep patterns and sleep rhythms.

6. Conclusion

This study investigated 47 university students studying abroad in UTM and collected 46 valid questionnaires. The Cronbach's α coefficient of PSQI scale in this population was 0.692, and the reliability coefficient was normal and acceptable. As the survey objects of this study are only UTM international students, there are certain limitations. To sum up, PSQI scale has acceptable reliability and validity in evaluating sleep quality among university students, but in practical application, individual items should be adjusted according to the characteristics of Chinese university students to obtain better results.

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