Construct validity and factor structure of the Pittsburgh Sleep Quality Index (PSQI) among physicians in Jeddah, Kingdom of Saudi Arabia

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Abstract

Sleep disorders continue to rise and have been estimated to affect around half of the global population. Poor sleep quality and insomnia are also linked to various health issues in different populations. The Pittsburgh Sleep Quality Index (PSQI) is one of the most commonly used tool to assess sleep quality. It has been tested in various clinical and non-clinical settings and populations but mostly in developed world. Literature is limited from Arab region and further scarcity of studies is observed among health providers from the region. This study aimed to assess the construct validity and factor structure of PSQI among physicians in Jeddah, Kingdom of Saudi Arabia. This cross-sectional study used the PSQI tool with 19 items and 7 components on 330 physicians working in Jeddah. Data was entered and analyzed in IBM SPSS and AMOS version 22. Cronbach alpha was 0.745. Construct validity showed satisfactory results. Exploration of factor structure with Confirmatory factor analysis (CFA) showed 1-factor model as better fit. Among three models, 3-factor model showed least fit indices. The study findings showed some similarities as well as differences to comparable studies using PSQI in other settings that requires further as well as continuous exploration of the dynamic issue in similar and diverse settings.

Keywords: Sleep Quality, Pittsburgh Sleep Quality Index, Confirmatory Factor Analysis, Model Fit

1. Introduction

Sleep disorders continue to rise in both developed as well as developing parts of the world and have been estimated to affect around half of the global population (Lemma, Gelaye, Berhane, Worku, & Williams, 2012; Manzar, Zannat, Kaur, & Hussain, 2015; Mollayeva et al., 2016). It has also been attributed to salient factors over time such as increase in use of gadgets and changing work timings (Altevogt & Colten, 2006; Steptoe, Peacey, & Wardle, 2006; Stranges, Tigbe, Gómez-Olivé, Thorogood, & Kandala, 2012). Poor sleep quality and insomnia are also linked to various health issues in different populations such as cardiovascular problems, diabetes, cancers, obesity, psychiatric and cognitive matters (Akman, Yavuzsen, Sevgen, Ellidokuz, & Yilmaz, 2015; Altevogt & Colten, 2006; Lavie & Lavie, 2008; Nishiura, Tamura, Nagai, & Matsushima, 2015; Redeker, Pigeon, & Boudreau, 2015). In addition, it has also shown to affect quality of life and increase mortality (Altevogt & Colten, 2006; Lavie & Lavie, 2008). Consequently daytime sleepiness and fatigue have been associated with increased road traffic accidents, industrial hazards (Altevogt & Colten, 2006).

Different tools have been used to explore the sleep quality and its related issues in diverse populations. The Pittsburgh Sleep Quality Index (PSQI), established by (Buysse, Reynolds III, Monk, Berman, & Kupfer, 1989), is possibly one of the most commonly used tool in this context. It has 19 items with seven components. Its psychometric properties including reliability, validity and factor structure have also been tested in various settings including patients and healthy populations over the last few decades (Buysse et al., 1989; Manzar et al., 2015; Mollayeva et al., 2016). It has shown limitations in generalizability due to inconsistencies in findings among different populations around the world (Gelaye et al., 2014; Manzar et al., 2015). However in general, 1-factor (Buysse et al., 1989; Ho & Fong, 2014), 2-factor (Gelaye et al., 2014; Otte, Rand, Carpenter, Russell, & Champion, 2013) and 3-factor (Cole et al., 2006; Mariman et al., 2012) models, have been reported commonly. Such discrepancies suggest for farther exploration of the issue.

Most relevant studies have been conducted in developed countries and literature has relatively limited contributions from the low and middle-income countries (Gelaye et al., 2014). Furthermore, scarcity of literature is observed in Arab region including Kingdom of Saudi Arabia (KSA) (Alshahrani, Baqays, Alenazi, AlAngari, & AlHadi, 2017). Health workers are considered to have a steering role in most societies to have effect on population health and overall health system functioning. Work related stress and round the clock demand also make their scenario more demanding but these factors potentially affect their sleep quality. The consequences of poor sleep quality among health workers not only may affect their health but can lead to occupational and medical errors that could be prevented (Altevogt & Colten, 2006).

Limited studies explored sleep quality and in particular for the reliability, validity and factor structure of PSQI among health workers in low and middle income countries (Dominguez, Grosso, Pagotto, Taliercio, & Allegri, 2009). Arab region and particularly KSA, despite investing a lot in healthcare and research is also having dearth of sleep quality information for its health workers (Alshahrani et al., 2017). The main objective of this part of the larger study was to assess the construct validity and factor structure of PSQI among physicians in Jeddah, Kingdom of Saudi Arabia.

Confirmatory factor analysis (CFA) is a multivariate statistical technique that is used to test how well the measured variables represent the number of constructs. Confirmatory factor analysis (CFA) is used to confirm or reject the measurement theory, the investigation is mainly done by estimating and evaluating the loading of each item used to tap aspects of the unobserved latent variable. Let y_i is the vector of observed responses predicted by the unobserved latent variable ξ, which is defined as:

$$Y = \Lambda\xi + \epsilon$$

Where Y is $p \times 1$ vector of observed random variables, ξ represents unobserved latent variables, and Λ is $p \times k$ matrix, k number of latent variables.

2. Methods

This cross-sectional study was conducted from August to November 2018 in Jeddah, Saudi Arabia. All physicians working in Jeddah health facilities were considered eligible. The sample size of 330 was determined based on common rule of thumb for determining sufficient sample size is to use the ratio (*20:1*) of overall sample size to the number of free parameter estimates (latent variable, indicator, variance, covariance or any regression estimates) included in the model (R. B. Kline, 2015). Simple random sampling was used. The PSQI prepared by (Buysse et al., 1989) was used after formal permission via email. It has 19 items that constitute 7 components including sleep quality, latency, duration, efficiency, disturbance, use of medicines and daytime dysfunction. First each of the 7 components produce a score ranging from 0 to 3 (with 3 showing higher problem) followed by summation of all 7 components to yield an overall sleep quality score also known as PSQI score (Buysse et al., 1989). This study consisted of two parts; 1) assessing sleep quality and its associated factors (findings of this part of the study is planned to be published elsewhere) and 2) assessing the reliability, validity and factor structure of PSQI among study population. The findings presented in this article are from second part of the study. Questionnaires were self-administered by research team. All research subjects voluntarily participated in this study. Data was collected after permission from the Ethics Committee of Rabigh Faculty of Medicine, King Abdul Aziz University was obtained. All respondents were briefed with the purpose of study. Informed consent was taken and their voluntary participation as well as confidentiality was communicated and maintained by research team.

PSQI scale was evaluated by Exploratory Factor Analysis (EFA) with varimax rotation using IBM-SPSS version 22 to determine the construct validity (Tabachnick & Fidell, 2001). Related items were grouped according to common themes. Scree tests and eigenvalues were measured in the selection of no. of factors (Tabachnick & Fidell, 2001; Watson, 1998). Correlation matrix factorability (R) was judged with Bartlett's test of sphericity and Kaiser-Meyer-Olkin's (KMO) measure of sampling adequacy. For items that cross-loaded on two or more factors, the background and meaning of the item and/or loading weight were used in factor assignment. Factor loadings greater than 0.30 were judged to be meaningful (Hair & Black, 2010; Polit & Beck, 2004). The internal reliability and consistency were explored using Cronbach's α. After conducting EFA, construct validity was further assessed by confirmatory factor analysis (CFA) using IBM-AMOS version 22 to confirm factor model. Modification indices were consulted to determine if there was an opportunity to improve the model. Commonly-used indices were observed to assess the goodness of the model.

3. Results

The most frequently observed category of Age was 23-30 (n = 108, 33%). Among study participants Males were around 56%, Saudis were around 66% and 73% were Married. Frequencies and percentages are presented in Table 1.

Table 1: Frequency Table for Socio-Demographic Variables

Variable	*n*	%
Age		
31-40	72	21.82
41-50	93	28.18
51-60	57	17.27
23-30	108	32.73
Gender		
Male	184	55.76
Female	146	44.24
Nationality		
Non-Saudi	113	34.24
Saudi	217	65.76
Marital		
Married	241	73.03
Single	78	23.64
Divorced/Widowed	11	3.33

Note. Due to rounding errors, percentages may not equal 100%.

Table 2: Spearman Correlation Matrix for Pittsburgh Sleep Quality Index (PSQI) components and descriptive statistics

	Mean (SD)	1	2	3	4	5	6	7	8
1. Duration of sleep	1.32(1.02)	1.00	.105	.095	.188**	.475**	.290**	-.047	.604**
2. Sleep disturbance	1.18(0.51)		1.00	.282**	.257**	.109*	.275**	.196**	.468**
3. Sleep latency	1.38(0.9)			1.00	.129*	.190**	.295**	.199**	.547**
4. Day dysfunction due to sleepiness	1.18(0.82)				1.00	.082	.535**	.182**	.603**
5. Sleep efficiency	0.53(0.85)					1.00	.169**	.030	.543**
6. Overall sleep quality	1.29(0.8)						1.00	.198**	.708**
7. Need meds to sleep	0.25(0.67)							1.00	.355**
8. Pittsburgh Sleep Quality Index	7.14(3.12)								1.00

* p < .05, ** p < .01, *** p < .001

Table 2 presents the results of the correlations and descriptive statistics of Pittsburgh Sleep Quality Index (PSQI) component. A significant positive correlation was observed between Sleep Duration and PSQI (rs = 0.60, p < .001). The correlation coefficient between Sleep Duration and PSQI was 0.60, indicating a large effect size. A significant positive correlation was observed between Sleep Latency and PSQI (rs = 0.55, p < .001). The correlation coefficient between Sleep Latency and PSQI was 0.55, indicating a large effect size. A significant positive correlation was observed between Sleep Disturbance and PSQI (rs = 0.47, p < .001). The correlation coefficient between Sleep Disturbance and PSQI was 0.47, indicating a moderate effect size. A significant positive correlation was observed between Day Dysfunction and PSQI (rs = 0.60, p < .001). The correlation coefficient between Day Dysfunction and PSQI was 0.60, indicating a large effect size.

A significant positive correlation was observed between Sleep Efficiency and PSQI (rs = 0.54, p < .001). The correlation coefficient between Sleep Efficiency and PSQI was 0.54, indicating a large effect size. A significant positive correlation was observed between Sleep Quality and PSQI (rs = 0.71, p < .001). The correlation coefficient between Sleep Quality and PSQI was 0.71, indicating a large effect size. A significant positive correlation was observed between Sleep Medication and PSQI (rs = 0.35, p < .001). The correlation coefficient between Sleep Medication and PSQI was 0.35, indicating a moderate effect size.

Results internal consistency of the data and Exploratory Factor Analysis (EFA) are shown in Table 3.

Table 3: Exploratory Factor Analysis of Pittsburg Sleep Quality Index (PSQI)

	Factor			
	1	**2**	**3**	**Uniqueness**
Q5a			0.356	0.753
Q5b			0.754	0.403
Q5c			0.379	0.706
Q5d		0.540		0.660
Q5e		0.564		0.678
Q5f		0.430		0.750
Q5g		0.470		0.757
Q5h		0.329		0.797
Q5i		0.364		0.786
Q5j	0.341			0.833
Q6	0.763			0.385
Q7	0.338			0.874
Q8	0.511			0.700
Q9	0.669			0.526

Note. 'Minimum residual' extraction method was used in combination with a 'varimax' rotation Bartlett's Test of Sphericity p<0.001, KMO Measure of Sampling Adequacy (KMO)=0.771, Cronbach (α) =0.745

A Normed Chi-square goodness of fit test was conducted to determine if the CFA model fits the data adequately as shown in figure 1. One factor and two factor models suggesting adequate fit (Normed - $\chi 2 < 3$) while three factor model suggesting poor fit (R. Kline, 2005). Along with normed chi-square other fit indices was checked. The RMSEA index was between 0.08 and 0.10 for all three models suggesting good fit, however RMSEA for 3-Factor model is on upper side which is indicative of mediocre model fit. CFI index for 1-Factor and 2-Factor model was above 0.95 suggesting that model fit the data well however for 3-Factor model CFI = 0.91, suggesting that the model is not mis-specified, and the fit is acceptable. SRMR for all three models < 0.08, which implies that the model fits the data adequately (Hooper, Coughlan, & Mullen, 2008). The fit indices are presented in Table 4 and Node diagrams along with loadings of 1-Factor, 2- Factor and 3-Factor CFA models are given in Figure 1.

Table 4: Fit Indices for the CFA model

CFA Model	NFI (>0.95)	TLI (>0.95)	CFI (>0.95)	RMSEA (0.06-0.09)	SRMR (<0.08)	Normed - χ^2 (<3)
Three Factor	0.88	0.83	0.91	0.09	0.06	3.56
Two Factor	0.93	0.91	0.96	0.06	0.05	2.29
One Factor	0.93	0.93	0.96	0.06	0.04	2.118

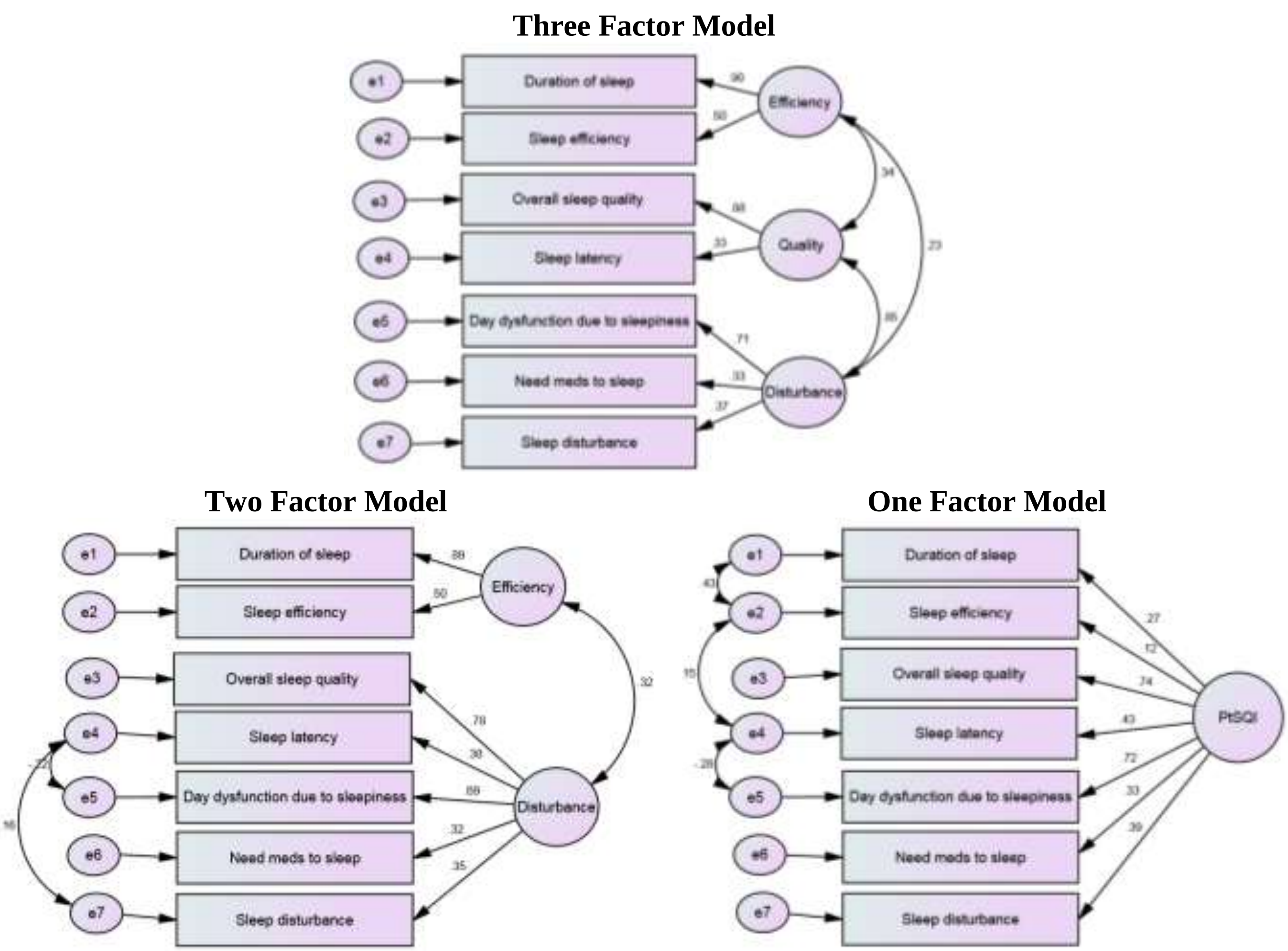

Figure 1: Confirmatory Factor Analysis for one-factor, two-factor and 3-factor models of PSQI

4. Discussion

This study explored sleep quality measurement using PSQI tool that has shown multidimensionality in different populations. One-factor, 2-factor and 3-factor models were assessed with commonly used indices to observe models fit. Exploration of factor structure with Confirmatory factor analysis (CFA) showed 1-factor model as better fit. Among three models, 3-factor model showed least fit indices. The PSQI demonstrated acceptable sub-scale-total correlations. Overall, results of these analyses are consistent with some previous reports analyzing a one, two and three factor models of sleep quality. Reliability and EFA findings were found satisfactory as shown in most of other studies (Manzar et al., 2018; Mollayeva et al., 2016).

One-factor model (Sleep Quality) showed better fit. This finding is similar to is aligned with the original study findings (Buysse et al., 1989) and few other studies (Ho & Fong, 2014; Manzar et al., 2016; Yunus et al., 2017). Two-factor model (Sleep efficiency and Perceived Sleep Quality) was also observed to be adequately fit. This finding is aligned few studies including a study conducted on cancer patients (Kotronoulas, Papadopoulou, Papapetrou, & Patiraki, 2011) and in particular on breast cancer patients (Otte et al., 2013). Students population have also shown 2-factor model as better fit (Beavers et al., 2013; Williams, Onsman, & Brown, 2010). Three-factor model (Sleep efficiency, Perceived sleep quality and Sleep disturbances) was found to be least fit. It is in contrast to findings from few studies on older adults in US (Cole et al., 2006), renal transplant recipients in Switzerland (Burkhalter et al., 2010) and university students in Nigeria (Aloba, Adewuya, Ola, & Mapayi, 2007).

Sample size range among different studies can be one of the salient factor in this context. However different results in diverse populations and sample sizes suggests for further exploration of the issue in detail and how PSQI can be tested as also suggested in few other studies (Gelaye et al., 2014; Otte et al., 2013; Otte et al., 2015). However, the data findings in this analysis are limited to physicians working in Jeddah, KSA limiting generalizability to other settings and populations. Such diversity in findings confirm the multidimensional aspects of PSQI tool and can be attributed to many factors. It could be suggested that assessing patient’s sleep quality requires appraisal of sleep as a continuous assessment of single or multiple factors in the PSQI.

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