

## Factor Structure of the Pittsburgh Sleep Quality Index among Women Undergoing Infertility Treatment: A Confirmatory Factor Analysis

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### Abstract

**Background and Objective:** People that undergo assisted infertility treatments experience more sleep problems. Although Pittsburgh Sleep Quality Index (PSQI) frequently has been used as a sleep quality assessment scale in different clinical and non-clinical settings, different sample characteristics may account for different structures. The current study aimed to evaluate the factor structure of PSQI among women seeking infertility treatment in Iran.

**Materials and Methods:** Using a convenience sampling method, 157 infertile women or women whose husbands had infertility problems were included in a cross-sectional study in Royan Institute, a main referral infertility center in Tehran, Iran. The factor structure of PSQI was evaluated through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA).

**Results:** The Cronbach's alpha coefficient for PSQI was 0.65. A two-factor model was extracted by EFA; 56% of the total variance was accounted for by this model. The results of CFA indicated that extracted model obtained acceptable fit statistics [comparative fit index (CFI) = 0.942, standardized root mean square residual (SRMR) = 0.042, root mean square error of approximation (RMSEA) = 0.128,  $\chi^2 = 19.8$ , degree of freedom (df) = 12, P = 0.071] compared to other original single-factor or 3-factor models.

**Conclusion:** Our results revealed the limited usefulness of single-factor structure of PSQI. A two-factor model of Persian version of PSQI should be used to assess sleep problems among women seeking assisted infertility treatments.

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**Keywords:** Sleep; Factor analysis; Assisted reproductive techniques; Infertility

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### Introduction

About 30% of adults and 20% of women aged

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25-44 years have experienced sleep disturbances such as difficulty in falling asleep, maintaining sleep at night, and difficult morning awakening more frequently (1). These sleep problems have a significant adverse impact on individuals' daily function as well as their health (2). Frequency of women complaining of any sleep problem, includ-

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ing difficulty in falling asleep, maintaining sleep at night, and difficult morning awakening is more than men (1).

Moreover, women's life cycle including menstruation, pregnancy, childbirth, and work along with hormonal changes can easily lead to stress, irritability, and anger in them (3). Infertility is associated with specific emotional outcomes and stress for women (4). It can affect mental health, emotional relationships, sexual relations, and quality of life in infertile couples (5). Women with infertility that undergo assisted infertility treatments may experience more hormonal changes, leading to psychosomatic symptoms, psychological disturbances, and sleep problems. These women usually have a high level of psychological stress and somatic symptoms compared to other women (6-8).

Individuals with high level of psychological stress usually sleep a little, have poor sleep quality, and use sleeping aid medications (9). The prevalence of sleep problems seems to be high among infertile women undergoing in vitro fertilization (IVF) treatment, but few studies have investigated sleep quality in infertile people (10, 11). The Pittsburgh Sleep Quality Index (PSQI) was also evaluated in women undergoing IVF, and it indicated that 23% of women during the oocyte retrieval stage and 46% in embryo transfer (ET) had poor sleep quality (12). However, the findings of available studies are different (13).

The PSQI comprises 19 individual items in seven components of subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Each component is scored in a range of 0 to 3 based on Likert-scale. The sum of scores for these seven components yields one global score. The questionnaire is not considered for specific target community (14). The original PSQI was initiated as a single-factor structure and a total score (15), but sleep has a complex structure and the concept of poor sleeper is different in communities where the PSQI is used. It may display a set of different symptoms measured in terms of quality/sleep disturbance (15, 16).

Validation of the PSQI structure in different societies has led to the suggestion of various multi-factor structures (17). Some studies confirmed the original one-factor structure. In contrast, several studies that did not fit the one-factor structure suggested a two-factor structure or even a three-factor structure (18). Thus, to properly interpret the re-

sults of the questionnaire in different populations and settings, we examined the structure of the Persian version of the PSQI in an infertile population. To provide a better picture of the latent structure and factors, we validated the questionnaire using both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA).

## Materials and Methods

**Participants:** The present study was a cross-sectional study. The study population was couples referred to the Royan Institute, a referral infertility center in Tehran, the capital of Iran. The participants recruited were a convenience sample of women as follows: one group was infertile women and the next one was women whose husbands had infertility problems, including primary or secondary infertility, or couples with unknown cause of infertility. They had no known psychological disorders. If they were satisfied, they would enter the study.

**Data collection and tools:** In this study, the Persian version of the PSQI was used. Participants' demographic information was also collected by a checklist. The Persian version of the PSQI has been investigated in several studies and its reliability and validity have been evaluated (19-21). Participants filled the questionnaire themselves in the presence of the questioner. Questions were explained by the questioner in cases where the participants were unable to complete the questionnaire due to illiteracy or misunderstandings.

**Ethical consideration:** We obtained the approval from Ethics Committee of Royan Institute. The anonymity of all participants' data was assured to all participants prior to the investigation.

**Statistical analysis:** The results were initially analyzed with descriptive statistics, such as the frequency, mean, and standard deviation (SD) for demographic variables. Scores of each of the seven components, the total score of the PSQI, and the Cronbach's alpha were calculated to study the psychometric characteristics of PSQI. Spearman's correlation coefficient was used to determine the correlation between the seven components and the total score of PSQI.

**Exploratory factor analysis (EFA):** To determine the best factor structure, EFA and CFA were performed. The Kaiser-Meyer-Olkin (KMO) test and the Bartlett's spherical test were used to verify the adequacy of sample data for factor analysis. The KMO index less than 0.49 was considered as unac-

ceptable, in the range of 0.50-5.59 as miserable, 0.66-0.69 as mediocre, 0.76-0.79 as middling, 0.80-0.89 as meritorious, and 0.90-1.00 as marvelous (22). Also, Bartlett's test examines the structure of the correlation matrix of the sample versus identity matrix; if meaningful, the sample data is suitable for factor analysis.

The principal component method was used for estimating factor loading. In this way, the scree plot, with the eigenvalues, was used to determine the number of factors that was sufficient, so factors that had eigenvalues above one remained in the model for rotation (22, 23). Then, with the assumption of correlation among the factors derived from the PSQI, oblimin rotation was used. Load  $\geq 0.4$  after rotation was used to specify the determinant items in each factor (22, 23).

**Confirmatory factor analysis (CFA):** To evaluate the goodness of fit of different factor structures and to select the best fitted structure, CFA was performed. In this way, in addition to the single-factor structural model suggested originally by the developers of the questionnaire (14), estimated factor structure by EFA for the current study and other factor structures suggested by other investigators (18, 24, 25) were evaluated by CFA and were compared with each other. The following diagnostic measures were used to assess the goodness of fit of the models: comparative fit index (CFI), the standardized root mean square residual (SRMR), and the root mean square error of approximation

(RMSEA). In current study, a model would be considered as a well-fitted model if the values were: CFI of 0.90 and more, SRMR of 0.08 and lower, and RMSEA of 0.60 and lower (22). For the best-fitted models related to CFA, the standardized coefficients have been displayed in the figures. In this study, diagnostic measures were used to evaluate and compare the goodness of fitting of different models. In this regard, a cut-point of 0.05 was considered for RMSEA. The range from 0.5 to 0.8 represented goodness of fit of model and RMSEA larger than 0.8 reflected poorly-fitting model. Values above 0.95 for CFI and less than 0.90 for SRMR were considered as good fit for models. Significant chi-square showed the unacceptable fit of the model. It means that the estimated variance-covariance matrix on the model has a significant difference with the observed variance-covariance matrix and therefore, the model fit is poor (26). All statistical analyses were performed using Stata software (Stata Corporation, College Station, TX, USA). All statistical tests were considered two-sided and the significance level was 0.05.

**Results**

A total of 157 women participated in this study. As participants filled in the questionnaires in the lab in sufficient amount of time, the response rate was relatively high (70%). Table 1 presents sociodemographic and global PSQI score of participants.

**Table 1.** Comparison of demographic characteristics and Pittsburgh Sleep Quality Index (PSQI) score of the participants according to infertility cause

Characteristics	Infertility cause					P-value*
	Total	Female factor	Male factor	Both	Undetermined	
Age (year) [n (mean ± SD)]	150 (29.70 ± 4.90)	29 (31.10 ± 5.60)	56 (29.40 ± 4.50)	23 (28.60 ± 5.08)	42 (29.60 ± 4.60)	0.233
BMI (kg/m <sup>2</sup> ) [n (mean ± SD)]	147 (26.10 ± 4.20)	29 (27.90 ± 3.70)	54 (24.40 ± 3.70)	22 (26.60 ± 4.50)	42 (26.80 ± 4.60)	0.001
Marriage duration (year) [n (mean ± SD)]	150 (6.80 ± 4.07)	30 (7.80 ± 5.00)	55 (3.30 ± 6.50)	23 (4.80 ± 7.80)	42 (3.50 ± 6.00)	0.170
Infertility duration (year) [n (mean ± SD)]	142 (3.50 ± 4.60)	28 (4.40 ± 3.50)	55 (4.80 ± 2.90)	22 (6.30 ± 4.50)	37 (4.40 ± 3.60)	0.195
PSQI score [n (mean ± SD)]	151 (5.80 ± 2.30)	30 (5.60 ± 2.30)	56 (6.07 ± 2.30)	23 (5.30 ± 2.40)	42 (5.80 ± 2.30)	<0.001
Any drug consumption during one week ago [n (%)]						
Yes	92	19 (20.6)	30 (32.6)	15 (16.3)	28 (30.4)	0.561
No	57	11 (19.3)	25 (43.8)	7 (12.2)	14 (24.5)	
Job type [n (%)]						
Self-employment	18	3 (16.6)	7 (38.8)	3 (16.6)	5 (27.7)	0.665
Employee	17	5 (29.4)	6 (35.2)	0 (0)	6 (35.2)	
Housekeeper	117	21 (19.8)	55 (37.6)	21 (14.3)	41 (28.0)	
Education level [n (%)]						
≤ Diploma	86	15 (17.4)	30 (34.8)	13 (15.1)	28 (32.5)	0.406
Bachelor's degree and higher	62	13 (20.9)	28 (45.1)	6 (9.6)	15 (24.1)	

\*One-way analysis of variance (ANOVA), chi-square test, and Fisher's exact test  
 BMI: Body mass index; PSQI: Pittsburgh Sleep Quality Index; SD: Standard deviation

**Table 2.** Pittsburgh Sleep Quality Index (PSQI) components' correlations and descriptive statistics

	1	2	3	4	5	6	7
Subjective sleep quality	1						
Sleep latency	0.35*	1					
Sleep duration	0.25*	0.09	1				
Habitual sleep efficiency	0.22*	0.17*	0.48*	1			
Sleep disturbances	0.39*	0.23*	0.16*	0.14	1		
Use of sleep medication	0.04	0.07	-0.03	-0.07	0.10	1	
Daytime disturbances	0.32*	0.30*	0.15	0.05	0.46*	0.04	1
Mean $\pm$ SD	1.11 $\pm$ 0.72	1.57 $\pm$ 0.86	0.29 $\pm$ 0.66	0.01 $\pm$ 0.11	1.39 $\pm$ 0.59	0.06 $\pm$ 0.28	1.46 $\pm$ 0.83
Median	1	2	0	0	1	0	1
IQR	1-1	1-2	0-0	0-0	1-2	0-0	1-2

IQR: Interquartile range; SD: Standard deviation

\*P-value &lt; 0.05 with no multiple comparison adjustment for descriptive purpose (correlation is significant, two-tailed)

The global PSQI score ranged from 0-12 with a mean of  $5.8 \pm 2.3$ . All characteristics were compared across infertility categories. Nearly the distribution of the global PSQI score and other characteristics were the same for the categories of infertility causes.

Table 2 provides inter-correlations between the seven components of the PSQI for each of the seven components separately. The correlation coefficients were low between a large number of domains; the lowest correlation coefficient was between "use of sleep medication" and "sleep duration" ( $r = -0.03$ ), and the highest correlation coefficient was observed between the "habitual sleep efficiency" and "sleep duration" ( $r = 0.48$ ).

**Reliability and internal homogeneity of the PSQI:** Table 2 depicts the reliability and internal homogeneity of the PSQI score. The evaluation of internal consistency test revealed a Cronbach's alpha of 0.63 for the PSQI. Cronbach's alpha values were also increased by 0.65% by eliminating "use of sleep medication" component. Internal homogeneity, which is the correlation coefficients between each component and the total score of the questionnaire, ranged from 0.15 to 0.68 (Table 3). Highest correlation was revealed between "subjective sleep quality" and total score.

**The adequacy of data to perform factor analysis:** The results of the Bartlett's test revealed that sample correlation matrix of seven components was significantly different from identity matrix ( $P < 0.001$ ). Also, the KMO test (global coefficient: 0.65) was mediocre based on the guideline (25) and indicated the sufficient adequacy of sample data to perform factor analysis (Table 3).

**Extracted factors:** Comparing eigenvalues, factor loadings, and the scree plot for PSQI subscales, a two-factor model was extracted (Table 4). Factor 1 was labeled as "sleep quality" and the components of "subjective sleep quality", "sleep latency", "sleep disturbances", and "daytime disturbances" had the highest correlation with this factor. Factor 2 was labeled as "sleep efficiency", and the components of "sleep duration" and "habitual sleep efficiency" had the highest correlation with it. In total, 56% of the total variance was accounted for by two extracted factors. The use of sleep medication showed poor loading with any of the two factors. Furthermore, there were no significant differences between the two factors with the saturated correlation matrix. **Findings of CFA:** Table 5 provides the goodness of fit indicators for the various examined models. According to the fit statistics, the single-factor model did not fit well.

**Table 3.** Item-total correlation, alpha if item deleted, of the Persian version of the Pittsburgh Sleep Quality Index (PSQI) among women undergoing infertility treatment ( $n = 157$ ).

Components	N	Component-to-global PSQI score correlations	Item-rest correlation	Alpha if item deleted
Subjective sleep quality	157	0.68	0.50	0.54
Sleep latency	157	0.61	0.36	0.59
Sleep duration	157	0.55	0.35	0.59
Habitual sleep efficiency	157	0.59	0.31	0.61
Sleep disturbances	157	0.59	0.42	0.57
Use of sleep medication	157	0.15	0.05	0.65
Daytime disturbances	157	0.62	0.37	0.58
Total PSQI score	157			0.63*

\*Overall Cronbach's alpha

PSQI: Pittsburgh Sleep Quality Index

**Table 4.** The factor loading in exploratory factor analysis (EFA) of the Persian version of the Pittsburgh Sleep Quality Index (PSQI) among women undergoing infertility treatment (n = 157)

Components	KMO index	Factor loading	
		Factor 1 (sleep quality) (31%)	Factor 2 (sleep efficiency) (25%)
Subjective sleep quality	0.74	0.62	0.20
Sleep latency	0.72	0.64	-0.03
Sleep duration	0.58	0.00	0.79
Habitual sleep efficiency	0.56	-0.04	0.85
Sleep disturbances	0.69	0.76	-0.08
Use of sleep medication	0.60	0.46	-0.48
Daytime disturbances	0.63	0.75	-0.10
Overall KMO	0.65		

Bold entries indicate the outstanding components in factor 1 or factor 2 in the exploratory factor analysis (EFA)  
KMO: Kaiser-Meyer-Olkin

The second model that entered components of "subjective sleep quality", "sleep latency", "sleep disturbances", and "daytime disturbances" together in the factor 1 and components of "sleep duration" and "habitual sleep efficiency" in the factor 2 had the acceptable goodness of fit statistics [CFI = 0.942, SRMR = 0.042, RMSEA = 0.128,  $\chi^2 = 19.8$ , degree of freedom (df) = 12, P = 0.071] compared to other fitted models.

**Discussion**

This study is the first study that examined the structure of PSQI scores in Iranian women with infertility. Buysse et al. suggested that the seven main components of the PSQI should be considered as a single score (14) and single-factor structure obtained acceptable internal consistency in different populations (26).

However, fitting the single-factor model to our data was insufficient; our results are consistent with the results of a number of other studies

(16, 18, 26). According to present results, a single factor or single score of the PSQI did not represent all aspects of sleep among our population. Two-factor and three-factor models have been performed in different populations to assess the structure of the PSQI (18, 24).

The EFA results in current study suggested a two-factor model. This model explains about 56% of the total variance in the structure of PSQI components; "use of sleep medication" component had mild load on both extracted factors of EFA (Table 3).

Generally, in the CFA, our two-factor model suggested by EFA showed better diagnostic measures than other models (Model No. 2 of table 4) except for three-factor structure suggested by Cole et al. (18), which performed slightly better than ours (Model No. 6 of table 5). Our suggested model and the three-factor structure of Cole et al. (18) offer almost the same structure (Models No. 2 and No. 6 of table 5).

**Table 5.** Models evaluated for the Pittsburgh Sleep Quality Index (PSQI) and corresponding fit indices using confirmatory factor analysis (CFA) among women undergoing infertility treatment (n = 157)

Model	$\chi^2$	df	CFI	TLI	SRMR	CD	AIC-BIC	RMSEA
Model 1: Global PSQI score, Buysse et al. (14) (1989)	50.11 P < 0.001	14	0.731	0.597	0.077	0.690	2122-2186	0.128 (0.091-0.167)
Model 2: 2 correlated factors, 7 components (F1: 1, 2, 5, 6, 7; F2: 3, 4, 6) <sup>‡</sup>	19.80 P = 0.071	12	0.942	0.899	0.042	0.873	2096-2166	0.064 (0.000-0.114)
Model 3: 2 correlated factors, 7 components (F1: 1, 2, 5, 6, 7; F2: 3, 4)	23.70 P = 0.034	13	0.920	0.871	0.054	0.871	2098-2165	0.072 (0.020-0.118)
Model 4: 2 correlated factors, 6 components (F1: 1, 2, 5, 7; F2: 3, 4)	18.70 P = 0.017	8	0.921	0.851	0.047	0.870	2044-2102	0.092 (0.037-0.148)
Model 5: Qiu et al. (25) (2016) F1: 1, 2, 3, 4; F2: 5, 7; Cov 13 Cov 23	16.70 P = 0.011	6	0.921	0.802	0.060	1.080	2046-2110	0.106 (0.047-0.169)
Model 6: Cole et al. (18) (2006)	14.60 P = 0.203	11	0.973	0.949	0.042	0.937	2092-2166	0.045 (0.000-0.101)
Model 7: Cole without domain 6, Cole et al. (18) (2006)	10.30 P = 0.112	6	0.968	0.920	0.036	0.937	2040-2104	0.068 (0.000-0.136)

df: Degree of freedom; CFI: Comparative fit index; TLI: Tucker-Lewis index; CD: Coefficient of determination, AIC: Akaike information criterion- BIC Bayesian information criterion; SRMR: Standardized root mean square residual; RMSEA: Root mean square error of approximation  
<sup>‡</sup>1: Subjective sleep quality; 2: Sleep latency; 3: Sleep duration; 4: Habitual sleep efficiency; 5: Sleep disturbances; 6: Use of sleep medication; 7: Daytime disturbances

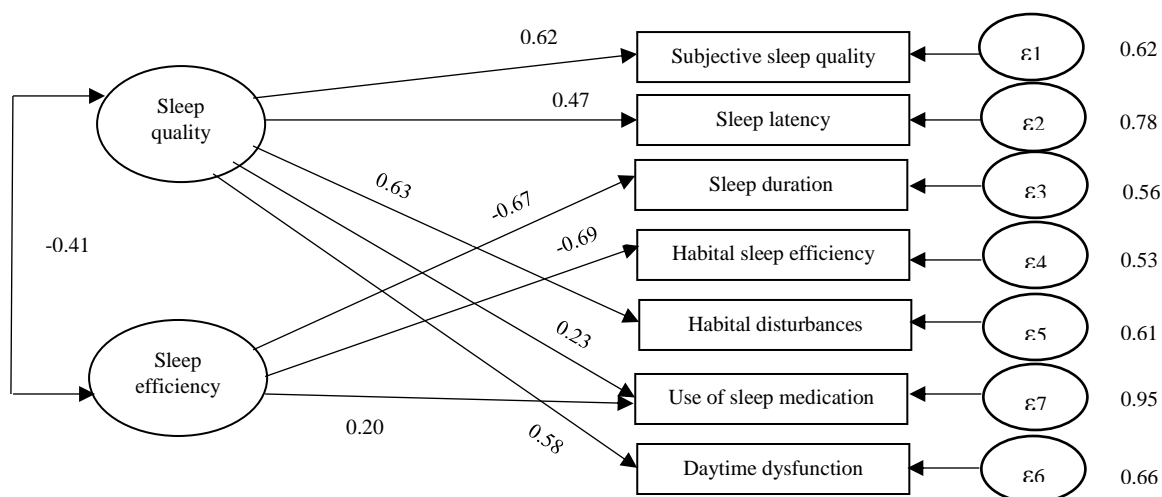


Figure 1. Pittsburgh Sleep Quality Index (PSQI) 2-factor model (Model 2 of table 5)

The “sleep efficiency” factor of the Cole et al.’s three-factor model consisted of the components of “sleep duration” and “habitual sleep efficiency”. Furthermore, these two components were observed in our “sleep efficiency” factor plus component of “use of sleep medication”. The “perceived sleep quality” and the “daily sleep disturbance” factors in Cole et al.’s model are combined and again “use of sleep medication” is added to this combination in order to generate “sleep quality” factor in our two-factor model (Figure 1).

The “use of sleep medication” component was observed in both factors of our model, but in the Cole et al.’s three-factor model (18), this component was seen only in “perceived sleep quality” factor (Figure 2).

As depicted in table 2, the component of “use of sleep medication” had the lowest correlation with other components of the PSQI. Moreover, by removing this component, Cronbach’s alpha of the PSQI slightly increased to 0.65 (Table 2). So, to

some extent, the component of “use of sleeping medication” is separate from the pattern of other components. On the other hand, it showed moderate load on both factors in the suggested two-factor model of EFA (Table 3). In line with these findings of the present study, some studies revealed that the component of “use of sleep medication” had an acceptable correlation in the factor structure of the PSQI with other components (24), and the factor structure of the PSQI without presence of the “use of sleep medication” has also been examined (24-26). Based on the diagnostic measures presented in table 5, excluding “use of sleep medication” component from “sleep efficiency” factor of our suggested model resulted in weaker fit (Model 3 vs. Model 2 in table 5). Also, when “use of sleep medication” was deleted from both factors, this weakness was greater (Model 4 vs. Model 2 in Table 5). Additionally, this phenomenon has been reported by Magee et al. (24).

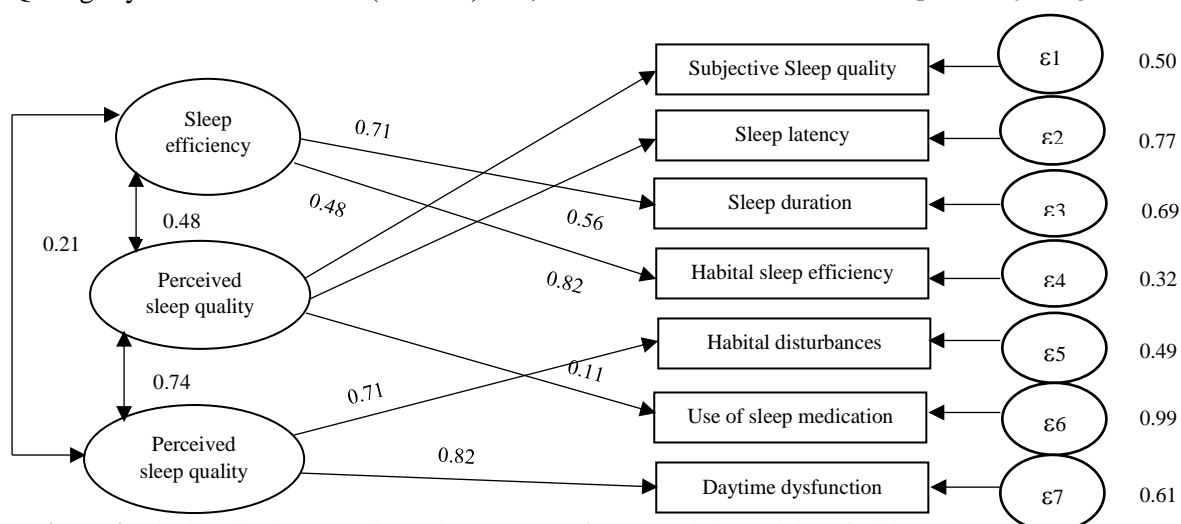


Figure 2. Pittsburgh Sleep Quality Index (PSQI) 3-factor model (Model 6 of table 5)

It is worth mentioning that modification index after CFA suggested that adding the path between the error term of "daytime dysfunction" with the components of "subjective sleep quality", "habitual sleep efficiency", and "sleep disturbances", and/or adding the path between the error component of "subjective sleep quality" and "habitual sleep efficiency" could reduce the amount of chi-square of the model by 25% to 40%, and improve other diagnostic measures of our two-factor model.

Only adding two numbers of the above-mentioned pathways results in the model with better fit than the three-factor model of Cole et al. (18). For example, adding the pathways between "daily dysfunction" component with "habitual sleep efficiency" and "sleep disturbances" components had the greatest effect on improving the fitness of the model. It seems that part of correlation between "daily dysfunction" component and other components was not extracted by our two-factor model and remained as residual. Also, three-factor model, proposed by Cole et al. (18) and Magee et al. (24), developed from two-factor model based on pathways suggested by modification index.

On the other hand, in the study by Cole et al., correlation coefficient of the path between the factors of "perceived sleep quality" and "daily disturbances" was reported as 0.75 (18). In Becker and de Neves Jesus' study (26), the correlation between these two factors was 0.62. Also, in our 3-factor model, this correlation was 0.74 (Figure 2) which is in line with the study by Magee et al. (24), where the largest coefficient of the three-factor pathway was associated with factors similar to those of Cole et al. (18). Given the high correlation between these two factors and by considering that in our suggested model, these two factors are aggregated into one factor, similarity of the diagnostic measure of our two-factor model and the three-factor model of Cole et al. is justifiable. Also Magee et al. concluded that there was an overlap between "perceived sleep quality" factor and "daily dysfunction", and argued that use of a two-factor model was more appropriate and it could be omitted from the three-factor model, which is in contradiction of pathway suggested by modification index.

This contradiction could be interpreted through adding one or two paths between error terms based on suggestion of modification index to improve the fitting of the two-factor model. It can indicate a need to rescale some of the seven components of PSQI instead of splitting one factor to

multiple factors.

There are other studies suggesting different two or three factors instead of one-factor model and also, there are studies which agree with one-factor structure originally proposed by Buysse et al. (14). Differences in the method of factors extraction and variations among methods of factors rotation can explain part of the differences in the results of the structural analysis of PSQI (24). Different studies are available on the clinical and non-clinical communities in various cultural conditions and diseases with different risks of sleep disorders. These differences in various studies can explain another part of the differences in the proposed factor structure of PSQI in various studies (24).

Finally, despite the slightly better fit of three-factor model, given the complexity of the interpretation and big correlation of "perceived sleep quality" factor and "daily dysfunction" factor, it is not suggested as the final model in our study. As presented in results, almost the distribution of the global PSQI score and other characteristics are the same for the categories of infertility causes. So, it can be concluded that all women may suffer from the same psychological and sleep quality level. Certain past interventions were not associated with scores on the PSQI. Although the sample size of the study was enough for EFA and CFA, we should be cautious to generalize results of this study. Our study is the first application of this type of analysis in a population of Iranian couples assessing assisted reproductive technology.

The current study at least revealed that use of the two-factor model in comparison with the single-factor model could lead to a more accurate assessment of sleep quality in specific populations of women with infertility problems and improve the sensitivity of the PSQI in screening of sleep disorders.

## Conclusion

The original single-factor model of PSQI did not fit well with the data of the current study. The proposed two-factor model of this study and the suggested three-factor model (18) showed acceptable goodness of fit measures on the sample of women with infertility problems. In summary, despite the slightly better fit of three-factor model, given the complexity of the interpretation and big correlation of "perceived sleep quality" factor and "daily dysfunction" factor, it is not suggested as the final model in our study and two-factor model



can be considered as the final model for married women with infertility problems in the present study. Also, based on pathways suggestion of modification index, future studies could investigate new scoring systems and/or rescale the components of PSQI in two- or three-factor structure in order to improve PSQI.

### Conflict of Interests

Authors have no conflict of interests.

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