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# Assessing Sleep During Pregnancy: A Study Across Two Time Points Examining the Pittsburgh Sleep Quality Index and Associations with Depressive Symptoms

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## Abstract

*Background and Purpose.* Sleep quality appears to be an antecedent to depressive symptoms during pregnancy. We sought to: (1) examine the psychometrics of the Pittsburgh Sleep Quality Index (PSQI) in pregnancy; (2) examine whether sleep quality predicted increases in depressive symptoms, and (3) compare PSQI scores across three or two levels of depressive symptoms.

*Methods.* Each of the 252 participants completed the Beck Depression Inventory (short form) and a sleep quality measure at mid and late pregnancy.

*Results.* PSQI total scores showed good internal consistency and construct validity. An improved model of the internal structure of the PSQI in pregnancy was found with one factor labelled Sleep Efficiency, a second labelled Night and Daytime Disturbances, and an Overall Sleep Quality component associated with, but separate from, both of these two factors. While PSQI scores showed moderate stability over time, sleep disturbance scores increased in late pregnancy. Importantly, PSQI prospectively predicted increases in depressive symptoms.

*Conclusions.* Findings suggest that the PSQI is useful in pregnancy research. Findings also support the idea that sleep problems are *prospective* risk factors for increases in depressive symptoms during pregnancy. Practitioners are advised to screen for sleep quality during early pregnancy.


Key words: PSQI, pregnancy, construct validity, depressive symptoms, sleep disturbances, sleep quality

# Assessing Sleep During Pregnancy: A Study Across Two Time Points Examining the Pittsburgh Sleep Quality Index and Associations with Depressive Symptoms

Sleep problems are frequently reported by pregnant women (Dzaja et al., 2005; Lee & Gay, 2004; Schweiger, 1972), possibly due to the occurrence of pregnancy-related physical symptoms or discomforts (nausea, back pain, increased urinary frequency), hormonal changes, enlargement of the fetus and/or shortness of breath (see Lee, 1998). There is now evidence that sleep quality earlier in pregnancy may contribute to the development of higher levels of depressive symptoms later in pregnancy (Skouteris, Germano, Wertheim, Paxton, & Milgrom, 2008). Similarly sleep patterns in late pregnancy are associated with elevated symptoms of depression in the first few weeks post birth (Wilkie & Shapiro, 1992; Wolfson, Crowley, Anwer, & Bassett, 2003). If indeed sleep quality is an antecedent to depressive symptoms, as these studies suggest, it may be important to screen for and address sleep difficulties during pregnancy to prevent increases in depressive symptomatology at a life stage when women's well being is particularly important (Skouteris et al., 2008).

One measure of sleep quality that has established test-retest reliability and validity in non pregnant samples is the Pittsburgh Sleep Quality Index (PSQI: Backhaus, Junghanns, Broocks, Riemann, & Hohagen, 2002; Byusse, Reynolds, Monk, Berman, & Kupfer, 1989; Carpenter & Andrykowski, 1998). The PSQI measures quality and patterns of sleep, including difficulties related to subjective overall sleep quality, latency, duration, and disturbance; habitual sleep efficiency; use of sleep medication; and daytime sleep dysfunction over the past month. To our knowledge, only two recent studies have used the PSQI to assess subjective sleep quality in pregnant women. With a small sample of pregnant women ($n$ = 19), Okun, Hall, and Cussons-Read (2007) administered the PSQI at approximately 12, 24 and 36 weeks gestation and found that PSQI scores did not differ significantly across pregnancy. Whilst the psychometric properties of the PSQI were not evaluated in that research, they were in a study by Jomeen and Martin (2007) who administered the PSQI to a group of 148 women at a mean

gestation of 14 weeks. Women classified as having minor/major depressive symptoms at this early pregnancy time point, based on concurrent Edinburgh Postnatal Depression Scale (EPDS) scores, had significantly poorer sleep quality, than women with no depressive symptoms, in all PSQI scales with the exception of sleep disturbances (sleep medication data were not analysed due to zero means). Moreover, as expected, the PSQI sub-scales and global sleep quality component scores were associated with higher scores on the EPDS but were not correlated with age (except for a positive correlation with the sleep duration sub-scale) revealing convergent and divergent validity, respectively. Internal consistency was acceptable using the seven component subscales scores but improved slightly from 0.73 to 0.76 after excluding the sleep medication subscale which few women endorsed.

Jomeem and Martin (2007) further examined the internal structure of the PSQI. Confirmatory factor analyses of several competing models suggested the best fitting model comprised two correlated factors. Factor 1 included overall sleep quality, sleep latency, sleep duration and sleep efficiency subscales and Factor 2 included sleep disturbance and daytime dysfunction subscales which reflected having problems sleeping for reasons such as feeling hot or cold, snoring, coughing, pain, and night-time or early morning waking, and having difficulty staying awake and functioning properly during the day.

Changes over time in PSQI scores were not assessed by Jomeem and Martin (2007). Given prior reports that sleep becomes more disturbed in later pregnancy (Dzaja et al., 2005; Pien & Schwab, 2004), one would expect the PSQI to reflect this poorer sleep quality in late pregnancy. Whilst Okun et al. (2007) found that PSQI scores did not differ significantly across time points during pregnancy, the mean PSQI total score was noticeably higher in the third trimester compared to the first and second. Hence, it is possible that their small sample size ($n$ = 19) precluded meaningful differences reaching significance statistically.

The aim of the current study was to extend upon Jomeen and Martin's (2007) study with a larger sample size examining *two* time points during pregnancy (mean of 18 weeks gestation

and 33 weeks gestation) instead of just one; to examine Jomeen and Martin's two-factor model at two time points; to assess construct and predictive validity of the PSQI; and to examine 15-week stability in PSQI scores. In relation to internal structure of the PSQI, we examined internal consistency and factor structure at two antenatal time points to confirm the component structure of the PSQI across this life stage. Construct validity was expected to be supported by moderate correlations between PSQI and depression scores. Validity of PSQI scores was also assessed by examining whether scores increased over the course of the pregnancy, as would be expected across extended time points (for a review of the literature see Dzaja et al., 2005; Pien & Schwab, 2004). Data collection at two time points also allowed stability of sleep problems to be examined over time, which has implications for test-retest reliability of PSQI scores. Given laboratory (Lee, 1998; Lee, Zaffke, McEnany, 2000) and questionnaire (Field et al., 2007) findings of moderate stability in sleep profiles for women across pregnancy, we predicted significant moderate, but not high, correlations over an average 15-week period between second trimester and third trimester. At the first time point, PSQI scores were also compared across three degrees of depressive symptoms (none, mild, moderate/severe) instead of only two (none versus mild to severe as in Jomeen and Martin's study) enabling comparison of sleep difficulties across more varied degrees of severity in depressive symptomatology.

Finally, we also assessed whether sleep quality predicted increases in levels of depressive symptoms over and above baseline levels of depressive symptoms. There were two purposes of examining prediction of changes in depression scores, the first being to examine the predictive validity of PSQI scores in pregnancy, as noted above. The second purpose was to confirm data suggesting that poor sleep quality is a risk factor for increases in depressive symptoms during pregnancy (Wilkie & Shapiro, 1992; Wolfson et al., 2003), which would have clinical implications. If the PSQI effectively predicts worsening of depressive symptoms, it could form part of a screening package for predicting antenatal depressive syndromes.

## Method

### *Participants*

The sample consisted of 252 pregnant women ranging in age from 18 to 42 years with a mean age of 31.67 (*SD* = 4.55) years. The majority of women (83.7%) reported that their pregnancy was planned and 47.2% were primiparous. Most women were born in Australia (81.3%) and the majority (73.8%) had a tertiary degree; 40.1% reported an annual family income of more than AUD$95,000 (approximately USD$85,500) and 16.7% reported earning a family income of less than AUD$45,000 (approximately USD$38,100). Almost all women were partnered (94.8%).

### *Measures and Procedure*

Following university human ethics approval, pregnant women were recruited from advertisements placed at prenatal exercise class venues and in a university newsletter, from flyers left in obstetricians' waiting rooms, as well as direct recruitment at a relevant Mother, Child, and Baby show to take part in a large prospective study exploring women's health and well-being during pregnancy (Skouteris, Carr, Wertheim, Paxton, & Duncombe, 2005). Each participant completed a depression inventory and a sleep quality measure two times, first when women were between 15-23 weeks gestation (*M* = 18.32; *SD* = 1.61; Time 1: T1), then approximately 16 weeks after first contact when women were between 29-39 weeks gestation (*M* = 34.63; *SD* = 1.71; Time 2: T2). The average return time (between participants receiving and returning questionnaires) for T1 questionnaires was 2.54 weeks (*SD* = 1.60) and for T2 it was 2.11 weeks (*SD* = 1.69).

At T1 participants reported their demographic information and parity status. At T1 and T2 women completed the Pittsburgh Sleep Quality Index (PSQI: Buysse et al., 1989), which, as noted in the Introduction, is a highly used sleep quality measure that has been validated in non-pregnant samples (Backhaus et al., 2002; Carpenter et al., 1998). In addition, total PSQI has demonstrated good internal consistency as well as some convergent and discriminant validity in early pregnancy (Jomeen & Martin, 2007). The 19 items assess quality and patterns of sleep, including difficulties

latency, duration, and disturbance; habitual sleep efficiency; use of sleep medication; daytime sleep dysfunction over the past month and an estimate of subjective 'overall' sleep quality.

The short version of the Beck Depression Inventory (BDI: Beck & Beck, 1972; Beck, Rial, & Rickels, 1974) was also completed at T1 and T2. The long BDI form has been validated for use with pregnant women as long as cut-off scores for depression are increased (Hocombe, Stone, Lustman, Gavard, & Mostello, 1996). The short form of the BDI correlates .89 to .97 with the long form (Beck et al., 1974) and has advantages over the long form as it omits all but one item (tiredness) from the full BDI that could be influenced by pregnancy hormonal changes (e.g., appetite, fatigue, body image). Twelve of the 13 items of the short BDI were administered, excluding an item relating to suicide. The one question that could reflect sleep disturbances or hormonal changes ("I get too tired to do anything") was dropped for analyses to avoid inflated correlations with PSQI scores. In the current sample Cronbach's $\alpha$ =.81 (T1) and .76 (T2).

*Data Analysis*

To address skewness, square root transformations were applied to BDI scores. Structural Equation Modelling (SEM) was used to test the two factor correlated model supported by Jomeen and Martin's (2007) data. Pearson's product-moment correlations explored relationships between between PSQI and age and education to assess discriminant validity and between PSQI and BDI to assess convergent validity. In analyses in which the PSQI was related to BDI scores, analyses were conducted with the item reflecting *keeping up enthusiasm to get things done* dropped in the relevant component score, in order to avoid inflated correlations with depressive symptoms scores. Repeated measures ANOVAs examined differences in PSQI scores between T1 and T2. At T1, ANOVAs explored the differences in PSQI scores between groups of women categorised into BDI categories of no depressive symptoms, mild depressive symptoms, and moderate to severe depressive symptoms. At T2 *t*-tests between the first two groups were conducted (non- to mild

versus moderate or more severe). Multiple regressions were conducted to examine whether sleep factors (again without the enthusiasm item) predicted depression concurrently at T1 and T2 and prospectively across these two time points.

## Results

### *Internal Consistency*

Cronbach's alpha of the PSQI (items were the seven component sub-scale scores) was .70 and .76 at T1 and T2, respectively, exceeding Kline's (2000) criterion, and sufficient for a 7-item scale. Removing the sleeping medications component (only 7 women at T1 and 14 at T2 had scores > 0) improved Cronbach's alpha to .72 and .78 for T1 and T2, respectively (item-total *r*s from .30 to .72).

### *SEM: Test of a Correlated Two-Factor Model for PSQI*

The best-fitting model from Jomeen and Martin's (2007) study (the two-factor correlated model: Factor 1 included overall sleep quality, sleep latency, sleep duration and sleep efficiency subscales and Factor 2 included sleep disturbance and daytime dysfunction subscales) was tested using Structural Equation Modelling (AMOS); see Model 1 in Table 1 for fit indices. An acceptable fit between a model and the data are reflected by a root mean square error of approximation (RMSEA) below .10 (with a good fit <.05); chi square (minimum discrepancy) divided by degrees of freedom (CMin/DF) in the range of 2 to 3 (lower is better); goodness-of-fit index (GFI) and comparative fit index (CFI) minimally above .90 and preferably above .95 (close to 1.0 is best); and lower expected cross-validation index (EVCI) (Arbuckle, 1999). As shown in Table 1, the resulting fit for Model 1 was poor (although similar to most of Jomeen and Martin's tested models) and modification indices (MI) suggested removing Overall Sleep Quality from Jomeen and Martin's Factor 1 and adding a path between Overall Sleep Quality and the remaining Factor 1 subscales (sleep latency, sleep duration and sleep efficiency) and between Sleep Quality and Factor 2 (sleep disturbance and daytime sleep dysfunction) (MI =

16.406; par change of .521). Indices for the resulting model (Model 2) resulted in a close fit (see Table 1 and Figure 1) with a RMSEA well below .05. When Model 2 was retested with the T2 data, the fit remained adequate, whereas Model 1 was again poor. Factor 1, in Model 2, was labelled *Sleep Efficiency* and Factor 2 was labelled *Night and Daytime Disturbances.* In subsequent analyses below, Sleep Efficiency and Night and Daytime Disturbances subscale scores were calculated by summing the relevant components indicated in this model.

*Test-retest Reliability and Construct Validity*

As expected, test retest-reliability correlations between T1 and T2 were significant and moderate: $r$=.56 for PSQI total scores, with Sleep Efficiency $r$=.45, Night and Daytime Disturbances $r$= .52, and Sleep Quality $r$=.39. Supporting validity, PSQI scores increased significantly from T1 to T2 (see Table 2). PSQI scores did not correlate with gestation at either time point ($p$>.05), although, at Time 1, for nulliparous women only, higher weeks gestation was associated with worse Sleep Efficiency, $r$=-.27, $p$<.0005, and poorer Sleep Quality, $r$= -.22 , $p$ =.02, with a similar non-significant tendency for Night and Daytime Disturbances, $r$= -.18 , $p$ =.05 To address skewness, square root transformations were applied to BDI scores for subsequent analyses. Moderate positive correlations were found between PSQI (total score, Sleep Efficiency, Night and Daytime Disturbances and Sleep Quality) and BDI at T1 and T2 (see Table 2) supporting construct validity. Regarding discriminant validity, PSQI scores did not correlate significantly with either age (all $r$s < -.05) or education (all $r$s < -.11).

*Differences Between Groups*

At T1, women were classified as having no depressive symptoms (0-3), mild depressive symptoms (4-8) or moderate to severe depressive symtpoms (9+) on our BDI scores, based on Furlanetto, Mendlowicz, and Romildo's (2005) screening cut-off of 9 to 10 for moderate depression on the 13-item BDI and Beck and Beck's (1972) original criteria for mild

depression. These cut-offs were conservative since two items had been deleted. ANOVAs followed by Scheffe post-hoc tests revealed that the non-depressed women reported significantly less sleep difficulties on all four PSQI measures (total score, Sleep Efficiency, Night and Daytime Disturbances and Sleep Quality) compared to both the mild and the moderate-severe groups who did not differ from each other (see Table 3). When the Disturbances component was examined without the enthusiasm item the difference between non-depressed and moderated depressed women *p* level dropped to .08. Insufficient women with moderate-severe depressive symptoms (*n*=8) precluded replication at T2, however, *t*-tests indicated the women with no symptoms differed significantly from the combined mild and moderate to severe groups on all PSQI measures (all $t > -2.70$, $p < .01$) and also from the mild group of women only (Night and Day Disturbances without enthusiasm $t=-2.08$, $p = .04$; all other *t*s >3.80, $p<.0005$).

*Concurrent Prediction of Degree of Depressive Symptomatology*

As noted above, the PSQI full score was also found to correlate moderately ($p<.001$) with BDI scores at T1 as did Sleep Efficiency, Night and Daytime Disturbances, and Sleep Quality; this was also the case for T2 (see Table 2). A hierarchical multiple regression conducted at T1 entered PSQI variables in two steps. In Step 1 Sleep Efficiency ($p<.0005$), and Night and Daytime Disturbances without enthusiasm item ($p=.001$) were significant predictors, overall $F(2, 249)=17.88$, $R=.354$, $R^2=.126$, $p<.0005$. In Step 2, Sleep Quality contributed a further 5.8% variance, in T1 BDI scores, *F change* (1, 248) =17.62, $R = .429$, $p<.0005$ and Sleep Quality was the only significant predictor, $t=4.20$, $p<.0005$, with Night and Daytime Disturbances approaching significance, $t = 1.96$, $p = .05$, and Sleep Efficiency $t = 1.33$, $p = .18$. A parallel regression at T2 was also significant at both steps. At Step 1, $F(2, 249) = 13.55$, $R=.313$. $R^2 = 098$, $p<.0005$, both Sleep Efficiency ($p<.001$) and Night and Daytime Dysfunction ($p = .008$) explained significant variance. Step 2 added 2.6% further variance, *F change* (1, 248) =7.39, $R = .353$. $R^2 = 124$, $p<.0005$; the primary cross-sectional predictor was T2 Sleep Quality *t*

= 2.72, $p$ =.007, with T2 Night and Daytime Disturbances, $t$ = 115, $p$ =.08, and Sleep Efficiency $t$ =1.47, $p$ =.14.

*Prospective Prediction of Depressive Symptomatology*

A final regression prospectively predicted T2 BDI from Time 1 variables. At Step 1 T1 BDI was controlled for, predicting 42.1% of the variance of T2 BDI, $F(1, 250) = 181.96$, $p$ <.0005. At Step 2 T1 Sleep Efficiency ($p$ =.002) and Night and Daytime Disturbances (without enthusiasm item) ($p$=.04) explained a significant 3.6% further variance of T2 BDI, $F\Delta$ (2, 248) = 8.21, $R$=.676, $p$<.0005. Step 3 did not add significant further variance, $F\Delta$ (1, 247) = 3.09, $R^2\Delta$ =.007, $p$ =.08; although the full equation was significant, $F$ (4, 247) = 53.43, $R$ =.681, $p$<.0005, Sleep Quality $t$=1.76, $p$=.08, Sleep Efficiency $t$ =1.90, $p$ =.06, and Night and Daytime Disturbances $t$ =1.47, $p$ =.14.

## Conclusion

The current study supported good psychometrics of the Pittsburgh Sleep Quality Index (PSQI) in a sample of middle and late-pregnancy women and provided a series of advances over the only prior study to evaluate the psychometric properties of the PSQI in pregnancy (Jomeen & Martin, 2007). While the full PSQI showed good overall internal consistency, our study suggested that the PSQI is best viewed as comprising three main correlated factors. Our results produced an improved model of the PSQI internal structure compared to Jomeen and Martin's (2007) best fitting model. Consistent with Jomeen and Martin's model, one factor, labelled *Sleep Efficiency*, was related to Sleep Latency, Duration and Efficiency and a second factor was labelled *Night and Daytime Disturbances* which included night-time and daytime sleep-related dysfunction components. However, our improved model (which had not been examined by Jomeen and Martin) indicated that while the *Overall Sleep Quality* component correlated with the Sleep Efficiency factor as Jomeen and Martin found, it was best conceptualised as a separate overall quality factor correlated with, but separate from, both sleep efficiency and sleep disturbances (at night and

associated ones in the day). Use of the three components enabled efficient analyses of which factors were contributing to predictions.

Findings further suggested good discriminant validity related to demographic variables (age, education) and good convergent validity; the PSQI (total score, Sleep Efficiency, Night and Daytime Disturbances and Overall Sleep Quality) was found to be associated with depressive symptoms in women scoring in both the mild and moderate to severe symptom ranges. Similarly, the PSQI total score, and the primary three factors that emerged from this study, were all associated with depressive symptoms. In regressions, it was further indicated that unique variance in depression was explained by both sleep efficiency and night and day disturbances in a first regression step and that overall sleep quality added additional unique variance. Together these sleep variables reflect a self-perception of low quality sleep, difficulty falling sleep, fewer hours slept, and experiencing multiple problems staying asleep uninterrupted during the night as well as staying awake and functioning properly during the day.

The PSQI scores were found to be moderately stable over a several-month period, which was considered supportive of test-retest reliability given that some fluctuations in sleep patterns are expected across pregnancy (Dzaja et al., 2005); future research should consider reliability of the PSQI during pregnancy between two closer time points to determine the robust nature of this argument. Expected increases in PSQI scores at late pregnancy were also observed (although gestation was only associated with PSQI scores *within* time points for nulliparous women at the first gestation time point). In addition, the PSQI predicted increases in depression several months later, after controlling for baseline depression levels. These findings support the idea of sleep problems being a *prospective* risk factor for increases in depressive symptoms during pregnancy and the utility of the PSQI for assessing these disturbances.

Several study limitations should be noted. Our findings were based on self-report and most, but not all, participants were tertiary educated with relatively high family incomes. Replication with a larger percentage of women from low socioeconomic groups and other methods that do not rely

solely on self-reports (such as direct observation and partner/ obstetrician reports) is needed. Furthermore, the method of recruitment did not permit calculation of a response rate and the possibility of selection and volunteer biases exists (Skouteris et al., 2005). It is possible that women who self-selected to participate in the study were different from the general population. Finally, whilst PSQI scores did not correlate with age or education, we did not examine hours of work, which is likely to change more between time points than other factors; future research should assess employment and other general demographic information.

Despite these limitations, this study supports the usefulness of the PSQI in pregnant samples; the sample was larger than in similar studies examining the PSQI in pregnancy and participants represented a range of levels of sleep difficulties and depressive symptoms. Specifically the findings suggested that total score and two major factors, plus an overall sleep quality component, best represent the PSQI for use in future pregnancy research. The study also potentially informs research on sleep assessment in non-pregnant populations given that, to our knowledge, the seven components of the PSQI have previously only been used separately or have been summed to produce a total score.

In relation to the clinical implications of this study, the PSQI appears to be a reliable and valid tool that can be used by health practitioners to assess sleep efficiency, night and daytime disturbances and overall sleep quality during pregnancy. The results also supported findings in non-pregnant (Ford & Kamerow, 1989; Reid et al., 2006) and perinatal (Skouteris et al., 2008; Wilkie & Shapiro, 1992; Wolfson et al., 2003) samples, suggesting that sleep quality is not only associated with depression, but is also an antecedent to increases in depressive symptoms. In this context, the current study suggested that the PSQI is a potentially useful as part of a screening package of risk factors for later development of increased depressive symptomatology.

In relation to both clinical practice and policy, findings suggest there may be a need to educate, mothers, maternal health nurses and other relevant groups so that they can be alert to the relationship between depressive symptoms and sleep problems and for health practitioners to

encourage new mothers to prioritise positive sleep patterns where possible, rather than assume poor sleep patterns will have no consequences. Policy implications include ensuring appropriate sleep assessment and support are put into place in health systems, and prioritising research and data collection on women's mental health during pregnancy to better understand what social, physical, and environmental factors affect women's psychopathology at this very important life stage. Finally and more specifically, further research exploring whether improving sleep quality early on in pregnancy contributes to lower levels of depressive symptoms latter in pregnancy is needed to ensure an evidence base for these clinical and policy suggestions. Indeed, given that depressive symptoms can lead to clinical depression (Milgrom et al., 1999), the implications of our findings for the development of antenatal and potentially postnatal depression are serious (see also Skouteris et al., 2008).

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Table 1

*Model Fit of the Components of the PSQI at Times 1 and 2 for Models 1 and 2*

| | $X^2$ *(df)* | CFI | RMSEA | GFI | CMIN/DF | ECVI |
|---|---|---|---|---|---|---|
| Time 1 | | | | | | |
| Model 1 | 41.3 (8) | .91 | .13 | .95 | 5.16 | .27 |
| Model 2 | 6.5 (7) | 1.00 | .00 | .99 | .93 | .14 |
| Time 2 | | | | | | |
| Model 1 | 53.4 (8) | .91 | .15 | .94 | 6.67 | .32 |
| Model 2 | 18.2 (7) | .98 | .08 | .98 | 2.60 | .18 |

*Note*. Model 1 = replication of Jomeen & Martin's (2007) two-factor correlated model (Factor 1 included overall sleep quality, sleep latency, sleep duration and sleep efficiency subscales and Factor 2 included sleep disturbance and daytime dysfunction subscales); Model 2 is the revised model with a path from overall sleep quality to both of the factors identified in Jomeen and Martine's two-factor correlated model (their best fit model). Abbreviations: Comparative Fit Index (CFI); Root Mean Squared Error of Approximation (RMSEA); Goodness of Fit Index (GFI); Chi square (minimum discrepancy) divided by degrees of freedom (CMIN/DF); Expected cross-validation index (ECVI)

Table 2.

*PSQI Means (SDs), Cross Sectional Correlations with BDI at Time 1 and at Time 2, and Repeated Measures ANOVA Examining Difference in Means from Time 1 to Time 2*

| | Time 1 | | Time 2 | | Comparison of means | |
|---|---|---|---|---|---|---|
| | Mean *(SD)* | *r* with BDI | Mean *(SD)* | *r* with BDI | *F* | $\eta^2$ |
| PSQI total score | 6.09 (*3.01*) | .47*** | 7.85 (*3.77*) | .36*** | 73.09*** | .23 |
| Factor 1- Sleep Efficiency | 1.98 (*1.89*) | .29*** | 3.28 (*2.51*) | .26*** | 76.16*** | .23 |
| Factor 2- Night and Daytime Disturbances | 2.83 (*1.13*) | .45*** | 2.98 (*1.13*) | .38*** | 4.87* | .03 |
| Night and Daytime Disturbances Composite Without Enthusiasm Item | 1.77 *(0.59)* | .29*** | 1.89 *(0.58)* | .23*** | 8.84** | .03 |
| Overall Sleep Quality | 2.24 *(0.71)* | .47*** | 2.50 *(0.77)* | .46*** | 24.32*** | .09 |

*Note.* *$p$<.05, $p$<.01, **$p$<.001, $N$=252,

Table 3.

*Means and Standard Deviations and ANOVA Findings for Depressed Groups Across PSQI Factors, PSQI Total Score and Overall Sleep Quality*

| Dependent variable | F | BDI Means (*SD*) | | | $\eta^2$ |
|---|---|---|---|---|---|
| | | No-depressive symptoms (*n* = 185) | Mild depressive symptoms (*n* = 51) | Moderate/Severe depressive symptoms (*n* = 16) | |
| PSQI total score | 25.25** | 5.37 (*2.67*)[a] | 7.75 (*3.05*)[b] | 9.13 (*2.73*)[b] | .17 |
| Sleep Efficiency | 7.81** | 1.72 (*1.71*)[a] | 2.47 (*2.09*)[b] | 3.31 (*2.39*)[b] | .06 |
| Night and Daytime Disturbances | 23.31** | 2.56 (*1.04*)[a] | 3.53 (*1.03*)[b] | 3.69 (*1.08*)[b] | .16 |
| Night and Daytime Disturbances Without Enthusiasm Item | 9.17*** | 1.68 *(0.55)* [a] | 2.04 *(0.60)* [b] | 1.77 *(0.70)* | .07 |
| Overall Sleep Quality | 19.84** | 2.09 (0.05)[a] | 2.57 (0.09)[b] | 2.94 (0.16)[b] | .14 |

*Note.* **$p$<.001; $N$=252; Post-hoc tests (Scheffe) revealed significant differences between variables labeled [a] compared to [b]

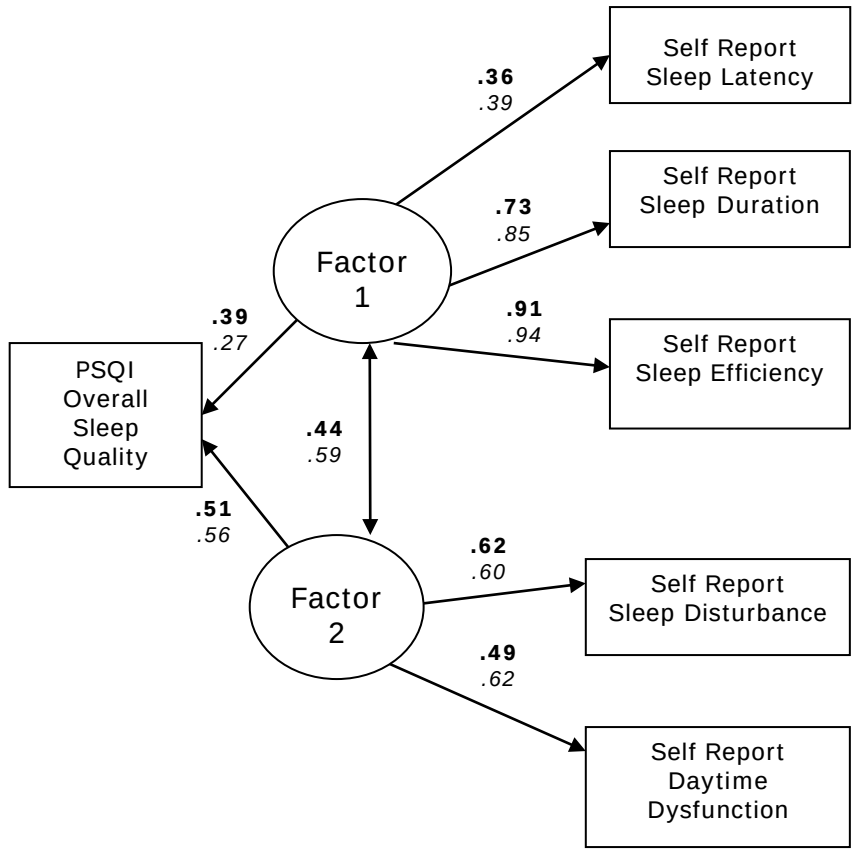


*Figure 1.* Standardised regression weights for paths associated with Model 2 at Time 1 (in bold) and Time 2 (in italics). Factor 1 = Sleep Efficiency and Factor 2 = Night and Daytime Disturbances.