

This manuscript is the final author version of (and should be cited as):

Kamysheva, E., Skouteris, H., Wertheim, E. H., Paxton, S. J., & Milgrom, J. (2010). A prospective investigation of the relationships among sleep quality, physical symptoms, and depressive symptoms during pregnancy. *Journal of Affective Disorders*, 123, 317-320. [doi:10.1016/j.jad.2009.09.015](https://doi.org/10.1016/j.jad.2009.09.015)

A Prospective Investigation of the Relationships Among Sleep Quality, Physical  
Symptoms, and Depressive Symptoms During Pregnancy

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## Abstract

The aim of this study was to examine the prospective relationship between pregnancy physical discomforts experienced during the second trimester and late pregnancy depressive symptoms, as well as the mediating effect of sleep quality on antenatal depressive symptomatology. Healthy pregnant women ( $N=257$ ) completed the Physical Symptoms Questionnaire, the Beck Depression Inventory, and the Pittsburgh Sleep Inventory at early-mid second trimester, and then again at late third trimester. Physical symptoms and sleep quality at the first time point were both correlated moderately with depressive symptoms at late pregnancy. Discomfort associated with physical symptoms was a better predictor of depressive symptoms than Frequency of symptoms, although a score combining Frequency, Discomfort and Effect of symptoms on life was the strongest predictor of depressive symptoms. Results of the hierarchical regression analyses of the mediation model indicated that physical symptoms at early-mid second trimester predicted depressive symptoms in the last trimester both directly, and via poor sleep quality (prospectively), which mediated the relationship. The clinical implications of these findings for antenatal care are discussed.

Key Words: Depressive symptoms; sleep quality; physical symptoms; pregnancy

Two common experiences of pregnancy include sleep problems and pregnancy-related physical symptoms or discomforts (Chou et al., 2003; Dzaja et al., 2005; Lee and Gay, 2004; Wallace et al., 1986), which are both associated with depressive symptoms (Chou et al., 2003; Goya et al., 2007; Kamysheva et al., 2008; Field et al., 2007; Jomeen and Martin, 2007; Skouteris et al., 2008). Given the negative implications of ante-natal depression on health and wellbeing of mother and child (Milgrom et al., 2008), the current study aimed to examine prospectively the relationships among sleep quality, depressive symptomatology, and physical symptoms during pregnancy. Based on substantial literature that links physical symptoms, pain and depression (Trivedi, 2004), it was hypothesized that poorer sleep quality and worse physical symptoms earlier during pregnancy would be related to greater depressive symptoms later in pregnancy. It was also hypothesised that physical symptoms earlier in pregnancy would predict sleep quality in late pregnancy and that sleep quality at this time point would be associated with depressive symptoms in late pregnancy (see Figure 1).

## Method

### *Participants*

Pregnant English speaking Australian women ( $N= 257$ ) self selected for participation in this study (215 of these women were included in a previous cross-sectional study, Kamysheva et al., 2008).

### *Design*

Participants completed measures at two time points: Time 1; T1, mean gestation weeks =18.42 (SD=1.22) and Time 2; T2, mean gestation weeks = 34.71 (SD=1.74).

### *Measures*

*Depressive Symptoms.* Depressive symptoms were assessed using the validated and reliable 13-item short form Beck Depression Inventory (BDI; Beck and Beck, 1972; Beck et al., 1974) that correlates highly with the long form (Beck et al., 1974). The long form BDI has been validated for use with pregnant women (Holcome et al., 1996). The item relating to suicide (due to ethics requirements) and the 'tiredness' item (due to possible confounding effects with physical symptoms items of the Physical Symptoms

Questionnaire described below) were excluded here. Cronbach's alphas were T1  $\alpha=.82$  and T2  $\alpha=.76$ .

*Sleep Quality.* The Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989) assessed sleep quality; the item relating to daytime energy and tiredness was removed, due to possible confounding effects with physical symptoms items of the Physical Symptoms Questionnaire. Total PSQI has demonstrated good psychometric properties in early pregnancy (Jomeen and Martin, 2007). The PSQI Cronbach's alpha was T1= .70 and T2= .76. Removing the sleeping medications component (only 7 women at T1 and 14 at T2 had scores > 0) improved Cronbach's alpha to T1 = .72 and T2= .78 (item-total *rs* from .30 to .72).

*Physical Symptoms Questionnaire.* A questionnaire listing 29 common pregnancy-related physical complaints (Wallace et al., 1986) measured pregnancy-related physical discomfort. 'Other' symptoms could be noted; however, no participant reported any 'other' symptoms. For each symptom, participants rated *frequency* from 0 (*never*) to 3 (*very often*); *discomfort* caused from 0 (*no discomfort*) to 3 (*severe discomfort*); and *effect* on the participant's life from 0 (*no effect*) to 3 (*very strong effect*). Composite scores were calculated for total Number, Frequency, Discomfort, and Effect for each time point. A composite symptom score (SCS) was also calculated for each symptom for each time point by summing the Frequency, Discomfort and Effect totals. Number of symptoms was excluded from the SCS due to very high correlations between Number and Frequency scores (T1:  $r=.71, p<.0005$ ; T2:  $r=.84, p<.0005$ ). The SCSs were used in subsequent regression and path analyses.

#### *Procedure*

Following University ethics approval, women currently 12 to 17 weeks pregnant were invited to participate in a study, "Your Experiences during Pregnancy", exploring health and well being during pregnancy (Skouteris et al., 2005). At T1 women completed the questionnaire package, reporting on the previous 4-week period for sleep quality and the previous 8-week period for physical symptoms. For depressive symptoms, women reported how they were feeling "today, that is right now". Questionnaire packages were number coded and returned in reply-paid envelopes. Participants were mailed the T2

questionnaire package (same as T1 measures) and reply paid envelopes 16 weeks after first contact.

### *Data Analysis*

All assumptions of parametric tests were met except BDI-T1 and BDI-T2 were not normally distributed. A square root transformation was therefore applied to BDI for correlations.

Pearson's correlations explored relationships between all variables. A stepwise hierarchical regression of factors predicting BDI-T2 was performed (see Figure 1). At Step 1, BDI-T1 was controlled for. In Step 2, PSQI-T1 and SCS-T1 were entered, and in Step 3 PSQI-T2 was entered. Then a final regression predicting PSQI-T2 was performed, where BDI-T1 was controlled in Step 1, and SCS-T1 and PSQI-T1 were entered in Step 2.

## Results

Participants' age ranged from 18 to 42 years ( $M=31.64$  years,  $SD=4.56$ ). Forty-seven percent ( $n = 120$ ) of women were primiparous. Most were married (76.7%;  $n=197$ ) or living with a de facto partner (17.9%;  $n=46$ ); 72.8% ( $n=187$ ) were university educated. Thirty percent of women ( $n=76$ ) reported a family annual income of over A\$105,000 (approximately US\$64,722), 27.5% ( $n=71$ ) between A\$75-104,000, 24.2% ( $n=62$ ) between A\$45-74,000, and 12.8% ( $n=43$ ) below A\$44,000 (approximately US\$27,121). Participants were mostly Australian-born (81.7%;  $n=210$ ) and of Australian (63.4% maternal,  $n= 163$ ; 56.8% paternal,  $n=146$ ) or European (16.3% maternal,  $n=42$ ; 20.2% paternal,  $n=52$ ) heritage. Regarding attrition, 303 women completed T1 questionnaires, of whom 46 (15.2%) did not return their T2 questionnaires and hence were excluded from final analyses. These 46 women did not differ in scores on any measures from women who completed and returned both time points ( $p > .05$ ).

### *Concurrent and Prospective Relationships Between Depression, Sleep Quality and Physical Symptoms*

Given Fatigue was the most commonly reported physical symptom (93.8% at T1 and 92.2% at T2) and may have a relationship to depressive symptoms, it was removed from the SCS calculation here. Table 1 shows intercorrelations between SCSs, PSQI and BDI at T1 and T2; no multicollinearity was observed ( $r > .70$ ; Tabachnik and Fidell, 1996).

In the first regression predicting BDI-2, BDI-T1 in Step 1 accounted for 42.6% of the variance,  $F(1, 255) = 189.93, p < .0005$ . In Step 2, when both PSQI-T1 and SCS-T1 were entered, only SCS-T1 was a significant predictor of BDI-T2, accounting for another 3.6% of the variance,  $F\Delta(2, 253) = 8.39, p = .0005$ . In Step 3, PSQI-T2 was a significant predictor of BDI-T2, accounting for 3.0% of variance,  $F\Delta(1, 248) = 8.38, p = .004$ .

In the second regression, predicting PSQI-T2, in Step 1 BDI-T1 accounted for 10.5% of the variance,  $F(1, 255) = 29.81, p < .0005$ . In Step 2, both SCS-T1 and PSQI-T1 were significant predictors of PSQI-T2, accounting for 28% unique variance,  $F\Delta(2, 253) = 57.57, p < .0005$ . The results of both these regressions are summarized in the path model in Figure 2 (with individual beta weights listed).

## Discussion

The results indicated that pregnancy-related physical symptoms at 15-23 weeks gestation predicted, prospectively, increased depressive symptoms at 26-39 weeks. This supported the proposed hypotheses and extended findings of our previous research (Kamysheva et al., 2008), suggesting that women's experiences of physical symptoms may have clinical implications for the development of antenatal depression. Given symptoms of antenatal and postnatal depression are highly correlated, further research should evaluate the impact of antenatal experiences of physical symptoms and postpartum depressive symptoms, both directly and indirectly via antenatal depressive symptoms and sleep quality.

When earlier pregnancy physical symptoms and later pregnancy sleep quality were entered in the regression analyses at the same time, earlier pregnancy sleep quality was not a significant predictor of later pregnancy depressive symptomatology as was shown by Skouteris et al. (2008). Whilst previous research has shown that sleep quality is an antecedent to depressive symptoms (Ford and Kamerow, 1989; Reid et al., 2006;

Wilkie and Shapiro, 1992; Wolfson et al., 2003), our findings accord with Jomeen and Martin's (2007) conclusion that the relationship between sleep quality and depression may be more complex. Women who experience greater frequency, severity and effect of symptoms on life during earlier stages of pregnancy are also likely to suffer from poorer sleep quality at later pregnancy, and this poor sleep quality is associated with depressive symptoms.

Even though a prospective design was used in the current study, the findings are limited as the postpartum period was not examined to explore the longer-term implications and relationships of earlier pregnancy physical symptoms and sleep quality with postpartum depressive symptomatology. Further limitations include the higher education and socio-economic status of the participants, which could have been due to the self-selection bias of women who volunteered for, and continued with, the prospective study. Nonetheless the current findings have implications for clinical practice in antenatal care, suggesting that women, who experience greater levels of physical symptoms earlier on in pregnancy, are at more risk of developing both sleeping difficulties and depressive symptoms during later pregnancy. Our findings indicate the importance of screening for the possible impact of physical symptoms in earlier stages, as well as for poor sleep quality at later stages of pregnancy to enable early treatment and even prevention of the development of antenatal and postpartum depression.

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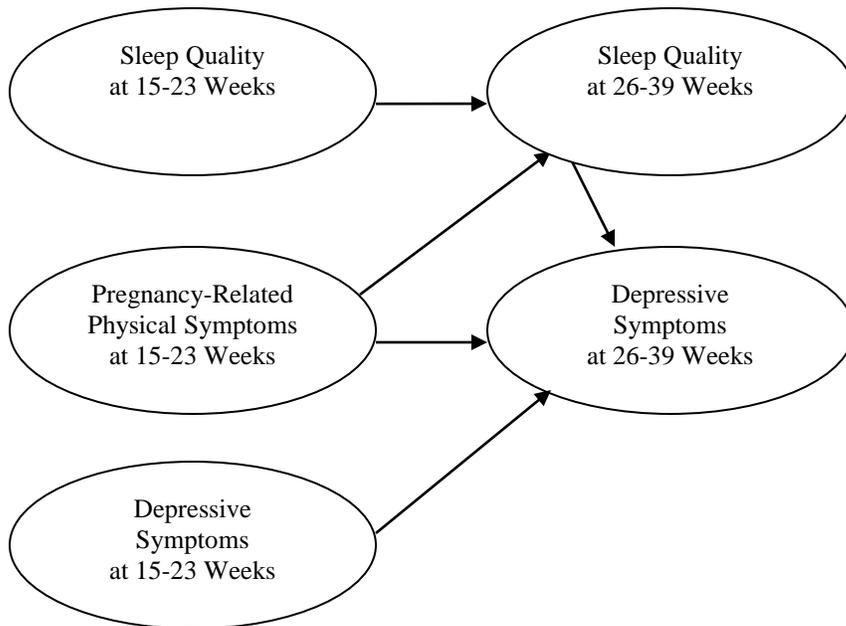
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Table 1

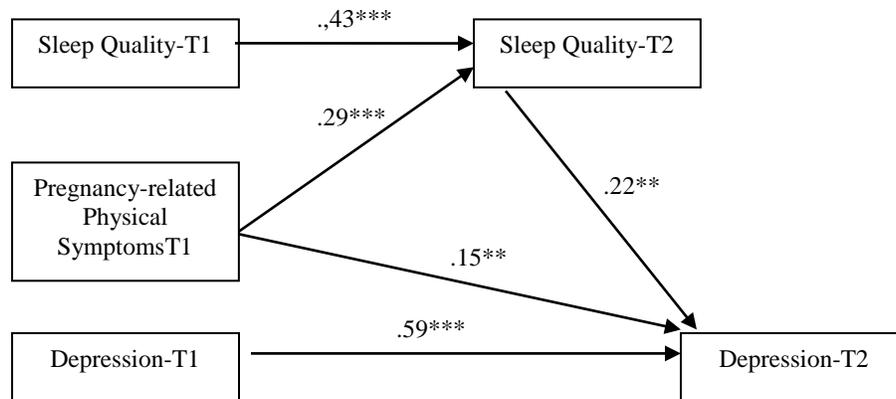
*Intercorrelations, Means and Standard Deviations for Physical Symptoms, Sleep Quality and Depression scores at T1 and T2.*

	1	2	3	4	5	6
1SCS-T1	-	.72**	.50**	.50**	.42**	.43**
2 SCS-T2		-	.40**	.53**	.33**	.45**
3 PSQI-T1			-	.57**	.52**	.46**
4 PSQI-T2				-	.32**	.44**
5 BDI-T1					-	.65**
6 BDI-T2						-
<i>M</i>	56.86	62.48	6.29	7.42	3.66	3.79
<i>SD</i>	20.11	25.95	3.09	3.21	3.44	2.80

Note: \*\* Correlation is significant at  $p = .01$  level. Square root transformed BDI data were used in Pearson's correlations. Means and Standard Deviations are reported for the non-transformed data.



*Figure 1.* Proposed Model of Factors Predicting Depressive Symptoms at 26-39 weeks Gestation.



Note: \*\*  $p < .01$ ; \*\*\*  $p < .0005$

*Figure 2.* Path model depicting significant predictors of sleep quality and depression at Time 2.