

**Title: Subjective sleep, depression and anxiety: inter-relationships in a non-clinical sample**

Short running title: Subjective sleep, depression and anxiety

### **Authors**

Andrew G. Mayers<sup>1\*</sup>, Emma A.S. Grabau<sup>2</sup>, Christine Campbell<sup>3</sup>, David S. Baldwin<sup>4</sup>

1: Psychology, School of Design, Engineering & Computing, Bournemouth University; 2: Mid Hants Crisis Resolution and Home Treatment Team, Hampshire Partnership NHS Trust, Winchester 3: School of Management and Social Sciences, St Mary's University College, Twickenham; 4: Clinical Neuroscience Division, University of Southampton

### **Correspondence**

Dr Andrew Mayers

Senior Lecturer in Psychology

School of Design, Engineering & Computing

Bournemouth University

Fern Barrow, Talbot Campus

Poole, BH12 5BB

Tel: To be advised (will amend at typesetting stage)

Fax: To be advised (will amend at typesetting stage)

E-mail: [amayers@bournemouth.ac.uk](mailto:amayers@bournemouth.ac.uk)

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### **CONFLICT OF INTEREST**

We have no conflicts of interest. This distribution of questionnaires study was partly supported by an educational grant from Lichtwer Pharma, UK distributors of St John's wort, made as a donation to Depression Alliance UK, to cover administrative costs.

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## **ABSTRACT**

**Objectives:** Previous research confirms the interdependent relationship between poor sleep and depression, but has often focused on objective measures of sleep and overlooked the importance of subjective factors. Insomnia may be maintained by anxiety and perceptions of poor sleep timing, and depression is associated with poor sleep satisfaction, regardless of perceived sleep timing.

**Methods:** This study explored the contribution of current depression and anxiety to sleep perceptions. Participants (n=98) completed the Hospital Anxiety and Depression scale, and questionnaires were used to evaluate current and previous psychiatric illness, sleep disorders, and prescribed psychotropic medication.

**Results:** A series of ANOVAs and regression analyses indicated that variance in sleep timing perceptions was more likely to be explained by symptoms of anxiety than depression; explained variance (adj.  $R^2$ ) 25%,  $t = 2.361$ ;  $p=.023$ . The analyses also showed that sleep satisfaction perceptions (adj.  $R^2 = 20\%$ ,  $t = 3.085$ ;  $p=.004$ ), and those relating to overall quality of life (adj.  $R^2 = 37\%$ ,  $t = -2.763$ ;  $p=.013$ ), was more likely to be explained by symptoms of depression.

**Conclusions:** These findings support the observation that anxiety appears related to poorer sleep timing perceptions, while depression appears associated with poor sleep satisfaction. Further research is needed to explore the factors that might maintain poor sleep satisfaction in depression.

## INTRODUCTION

The relationship between poor sleep and depression is well established. Typically, depressed individuals describe a range of disruptions to sleep including longer sleep latency, more frequent and longer awakenings, shorter total sleep time, and earlier morning waking, compared to those without depression (Gillin et al. 1979). Depression is also associated with irregular rapid eye movement (REM) sleep, including earlier onset and greater density (Reynolds 1987), and many antidepressants suppress REM sleep (Mayers & Baldwin 2005). While sleep disturbances are found in other mental disorders, their magnitude is greater in depression (Benca et al. 1992). Previous research has been predominated by objective measurement of sleep, particularly with electroencephalography (EEG); very little by comparison has focused on subjective factors. We have argued that subjective perceptions of sleep in depression may significantly contribute to the impact of depression (Mayers, Van Hooff, & Baldwin 2003b; Mayers & Baldwin 2006), and may be as important as objective measurements of sleep disturbance.

One explanation for the relative lack of research into subjective factors in depression may be that perceptions of sleep have been considered inaccurate, when compared to objective measures. Studies in individuals with insomnia suggest an underestimation of sleep timing and an overestimation of disturbance (Edinger & Fins 1995). Studies of the accuracy of subjective perceptions of sleep in depression have produced inconsistent findings (Tsuchiyama et al. 2003; Armitage et al. 1997), and inaccuracy may increase with greater severity of depression (Argyropoulos et al. 2003). An alternative explanation is that these perceptions may be subject to bias that is maintained by depression, or that subjective sleep misperceptions may influence depression.

Several longitudinal studies confirm that individuals with a history of insomnia are more likely to develop depression than those without such a history (Ford & Kamerow 1989; Breslau et al. 1996), and insomnia may be maintained by anxious perceptions. Harvey (2000; 2002) particularly emphasised 'catastrophising' of the perceived effects of not getting enough sleep (Harvey & Greenhall 2003). Insomnia is associated with poorer perceptions of sleep timing, compared to

healthy controls. A sub-group of insomnia patients described poorer sleep satisfaction than other patients, even though their perceptions of sleep timing did not differ; and this sub-group had greater evidence of depression (Fichten et al. 1995; Alapin et al. 2001). These studies suggest that while there is evidence of a relationship between insomnia and depression, the way that sleep is perceived within each condition may be quite different.

In our previous research (Mayers et al. 2003b) we found that depressed patients were significantly more likely to describe poorer perceptions of sleep satisfaction than did healthy controls, even when perceived sleep timing did not differ. The current study sought to address the relationship with insomnia, and the influence of anxiety. We explored the contributing factors to sleep perceptions in a non-clinical sample, so the findings might be more representative of associations within the general population.

Based on previous findings, it was hypothesised that variance in sleep timing perceptions would more likely be associated with reports of anxiety than depression, while variance in sleep satisfaction and quality of life would more likely be associated with reports of depression.

## **METHODS**

### **Participants**

The depressed sample was mostly drawn from 46 members of Depression Alliance (UK), a depression self-help organisation. These were compared to 52 undergraduate psychology students, who were mostly healthy controls. Participants' history of depression, anxiety and insomnia, and previous use of antidepressants and hypnotic medication, was ascertained from a questionnaire. Current evidence of depression was elicited from responses to questions based on DSM-IV diagnostic criteria for major depressive episode. Ethical approval for the Depression Alliance sample was granted by the (NHS) Southampton and South West Hants Local Research Ethics Committee (LREC Submission No. 234/03/w), and by psychology ethics committee at Southampton Solent University. No participants received financial reward. Table 1 shows the demographic and illness status data for the combined sample. The groups were similar in all

important respects except age, with the Depression Alliance sample significantly older. Because of this, age was accounted for in all analyses.

INSERT TABLE 1 ABOUT HERE

### **Materials**

A sleep diary was used to elicit perceptions of sleep timing: sleep latency (time taken to get to sleep), the number of wakings after sleep onset, the length of those, early morning awakening (time between final waking and getting out of bed), total sleep time, and sleep efficiency (proportion of time in bed spent asleep); and sleep satisfaction: perceived sleep quality, ease of sleep initiation, feeling refreshed on waking, and the extent that the participant felt that they had enough sleep. It was an amended version of the Pittsburgh Sleep Diary (PghSD) which had been developed to measure perceptions of sleep timing and satisfaction (Monk et al. 1994). Since there were several changes from the original PghSD, it was important to demonstrate that its validity had not been compromised. The revised sleep diaries were piloted on a group of 36 women in the postpartum period, and compared to actigraph recordings of sleep. The original PghSD was shown to possess good correlation with actigraphs in respect of sleep timing ( $r=.430$ ,  $p<.001$ ). Data from the pilot postpartum group were examined over 5 nights. Correlation between the revised sleep diary and equivalent actigraph recordings were mostly moderate and significant (sleep latency,  $r = .50$ ; wakings after sleep onset,  $r = .37$ ; length of wakings,  $r = .34$ ; total sleep time,  $r = .59$ ; early morning waking,  $r = .67$ ; all significant to  $p < .05$ ) indicating comparable validity to the original version.

Symptoms of depression and anxiety were assessed using the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith 1983). The HADS has been extensively used in research and comprises two sub-scales whose total scores each range from 0 to 21: scores of 8-10, or 11 and above indicate respectively symptoms of possible or probable clinical significance. These cut-off points have been found to possess good sensitivity and specificity in validation studies (Herrmann 1997).

Quality of life perception was explored using the Quality of Life of Insomniacs Questionnaire (QOLI; Rombaut et al. 1990). The QOLI has been validated in several studies to examine sleep-related quality of life (e.g. Pires de Souza 1996) and has been used in previous studies that have examined sleep perceptions in depression (Mayers, Van Hooff, & Baldwin 2003a; Mayers, Van Hooff, & Baldwin 2003b). The QOLI measures perceptions of insomnia (extent of sleep disturbance) and daytime fatigue (extent of disruption of tiredness on daily routine), the extent of physical complaints, perceptions of mood and anxiety, and the quality of personal relationships.

### **Procedure**

Questionnaire packs were sent to Depression Alliance (DA) members selected at random by DA office staff; 56 completed packs were returned but 10 of these could not be used due to significant omissions and errors in completion. Further questionnaire packs were sent by the psychology student to fellow students and staff members at that student's university; 60 of these were returned, but 5 could not be analysed due to errors and omissions. Participants completed the questionnaires relating to any history of mental health problems, treatments, and current illness rating, followed by the HADS scale. Over the course of seven days they completed the sleep diaries, one each morning, indicating perceptions about sleep during the previous night. At the end of that week they completed the QOLI.

### **Statistical analyses**

An independent one-way ANOVA was used to investigate between-group differences in current subjective depression, in respect of sleep timing perception and sleep satisfaction perception. An analysis of covariance (ANCOVA) was employed to factor out the possible interference of age. Multiple regression analyses were used to examine the variance in perceptions of sleep timing, sleep satisfaction and quality of life, with respect to variations in current anxiety and depression symptoms, insomnia, psychosis, and psychotropic medication. Logistic regression was used to explore the likelihood of sleep timing perception group status and sleep satisfaction group status, with respect to anxiety and depression ratings.

## RESULTS

All data were checked for normal distribution; skewness and kurtosis were within normal parameters, using Kolmogorov-Smirnov tests. Potentially, there were five variables from the questionnaires that could determine a categorisation for depression status: history of depression, current treatment from a GP, current subjective self-assessment of depression (DSM-IV questions), the HADS depression sub-scale score, and current antidepressant treatment. Each has its merits, but it makes more sense to use a current measure, rather than a historical one. Antidepressants are often prescribed for conditions other than depression, and a person can be depressed without a diagnosis or current treatment, so these may not be the best indicators. This leaves the two current subjective measures: self-assessed symptoms based on DSM-IV criteria and HADS depression sub-scale score. The latter of these was selected as it represents self-reported current symptoms, and can be used alongside commensurate HADS Anxiety scores. It was an important aim of this study to measure reports of depression and anxiety against perceptions of sleep.

### **The nature of sleep perceptions in perceived depression**

Current perceptions of depression were examined in respect of sleep timing perception score and sleep satisfaction score, to establish whether depression influenced these sleep perceptions differently. Table 2 shows the main scores for sleep timing and sleep satisfaction, in respect of current depression status.

INSERT TABLE 2 ABOUT HERE

Initial analyses indicated that sleep timing perceptions were significantly poorer when the participant met a current diagnosis for depression than when they did not ( $F_{1,96} = 13.034$ ,  $p < .001$ ); this represented a fairly large effect size ( $d = .37$ ). However, it was noted earlier that the samples in this study differed significantly for age. Therefore, ANCOVA was used to account for the possibility that age might have influenced this observed outcome. The difference was still

significant, but substantially reduced: ( $F_{1,93} = 4.653, p = .034$ ). The effect size was now somewhat lower than medium ( $d = .22$ ).

Sleep satisfaction perceptions were also significantly poorer when the participant met a current diagnosis for depression than when they did not ( $F_{1,96} = 19.083, p < .001$ ); this represented a large effect size ( $d = .45$ ). Age had a much less dramatic effect when ANCOVA was applied than it did for sleep timing perceptions. The difference, whilst reduced, was still highly significant ( $F_{1,93} = 11.537, p < .001$ ). The effect size remained fairly high ( $d = .35$ ).

### **Sleep timing perceptions**

Multiple linear regression analyses for sleep timing perceptions were examined for sleep timing perceptions, using the Enter method. The analyses for all of regression analyses in this study met accepted levels of multicollinearity, independence of residuals, and normality of distribution. The number of predictors used was appropriate for the sample size.

INSERT TABLE 3 ABOUT HERE

In all cases relationships in the following analyses are reported in respect of worsening sleep timing perceptions on the continuum of scores. Table 3 shows that the regression analysis did not present a significant model, nor did any predictors significantly contribute to the variance in sleep timing perceptions when the participant indicated signs of depression (via HADS depression scores), or comorbid depression and anxiety (via HADS depression and anxiety scores). However, the regression model was significant for anxious participants ( $F = 3.468, p = .005$ ), which explained 25% of overall variance in sleep timing perceptions (adjusted  $R^2$ ). Poorer perceptions of anxiety and a history of psychosis significantly contributed to worsening perceptions. When the participant showed no signs of anxiety or depression, the regression model was also significant ( $F = 3.687, p = .009$ ), which represented 25% of variance in sleep timing perceptions. Taking antidepressants significantly contributed to worsening perceptions.



## **Sleep satisfaction perceptions**

INSERT TABLE 4 ABOUT HERE

Table 4 shows that the regression model was significant when the participant indicated signs of depression ( $F = 2.282, p = .047$ ), which explained 20% of overall variance in sleep timing perceptions. Poorer perceptions of depression significantly contributed to worsening perceptions. The regression model was also significant for anxious participants ( $F = 3.365, p = .012$ ), which explained 25% of overall variance in sleep timing perceptions. Poorer perceptions of anxiety significantly contributed to worsening perceptions. However, the regression model was not significant when the participant showed signs of comorbid anxiety/depression ( $F = 2.026, p = .108$ ), which represented 22% of variance in sleep timing perceptions. Having a history of insomnia significantly contributed to worsening perceptions. When the participant showed no signs of anxiety or depression, the regression model was significant ( $F = 3.429, p = .005$ ), which represented 25% of variance in sleep timing perceptions. Having a history of psychotic disorder significantly contributed to worsening perceptions.

## **Quality of Life perceptions**

INSERT TABLE 5 ABOUT HERE

Table 5 shows that the regression model was significant when the participant indicated signs of depression ( $F = 2.7532, p = .032$ ), which explained 37% of overall variance in quality of life perceptions. A current subjective rating of depression significantly contributed to worsening perceptions. The regression model was also significant for anxious participants ( $F = 5.647, p < .001$ ), which explained 45% of overall variance in quality of life perceptions. Poorer perceptions of anxiety and poorer sleep timing perceptions significantly contributed to worsening perceptions. However, the regression model was not significant when the participant showed signs of comorbid anxiety/depression ( $F = 2.039, p = .102$ ), which represented 28% of variance in quality of life

perceptions. A current subjective rating of depression significantly contributed to worsening perceptions. When the participant showed no signs of anxiety or depression, the regression model was significant ( $F = 8.570$ ,  $p < .001$ ), which represented 59% of variance in quality of life perceptions. A current subjective rating of depression, taking antidepressants, Poorer perceptions of anxiety, and poorer sleep satisfaction significantly contributed to worsening perceptions.

### **Current depression status vs. sleep perceptions**

Logistic regression analyses were employed to examine the likelihood of having a current rating of subjectively rated depression, in respect of sleep timing perceptions and sleep satisfaction perceptions (both accounting for age). For sleep timing perceptions, the logistic regression model significantly predicted sleep timing perception group status (poor vs. good;  $\chi^2 = 38.562$ ,  $df 3$ ,  $p < .001$ ). The model accounted for between 33.4% and 44.5% of variance in those perceptions, with 69.6% of those presenting poor STP, and 79.6% of those presenting good sleep timing perceptions, being corrected predicted (74.7% accuracy rate overall). Increasing age (odds ratio (OR) .948; 95%CI .912 - .985;  $p = .006$ ) and poorer anxiety scores (OR .852; 95%CI .733 - .989;  $p = .035$ ) were significantly associated with poor sleep timing perception group status, but depression scores were not associated with the model.

For sleep satisfaction perceptions, the logistic regression model significantly predicted sleep satisfaction perception group status (poor vs. good;  $\chi^2 = 22.006$ ,  $df 3$ ,  $p < .001$ ). The model accounted for between 20.7% and 27.6% of variance in those perceptions, with 60.0% of those presenting poor sleep satisfaction perceptions, and 78.0% of those presenting good satisfaction, being corrected predicted (69.5% accuracy rate overall). Only poor depression scores (OR .863; 95%CI .745 - .999;  $p = .049$ ) were significantly associated with poor sleep satisfaction perception group status; neither age nor anxiety scores were associated with the model.

## **DISCUSSION**

As hypothesised, variance in sleep timing perceptions was more likely to be explained by the presence of anxiety than depression, regardless of whether a categorical or continuous measure of

perceived sleep timing was used. Poorer sleep timing perceptions and sleep satisfaction perception were initially associated with current depression status, using an independent one-way ANOVA. However, when age was removed from the analysis, using ANCOVA, only sleep satisfaction perceptions remained strongly related to depression status. Multiple regression analyses consistently confirmed that variance in sleep timing perception scores were more likely to be explained by anxiety than depression. Logistic regression showed that poor sleep timing group status was associated with higher anxiety and older age, but not depression.

This supports previous findings that sleep timing perceptions and insomnia are associated with anxiety (Harvey 2000; Harvey 2002; Harvey & Greenhall 2003). The results also supported our previous findings about sleep satisfaction in depression (Mayers et al. 2003a, 2003b). In participants without current symptoms of either anxiety or depression, poorer sleep timing perception variance was more likely to be explained if the participant was currently taking an antidepressant (presumably as continuation treatment of depressive illness and/or anxiety disorders) supporting the observation that perceptions of poorer sleep is associated with antidepressant treatment (Mayers & Baldwin 2005). However, it was not possible to verify whether those participants were actually taking antidepressants.

As predicted sleep satisfaction perceptions were more associated with depression than anxiety, supporting previous findings (Mayers, Van Hooff, & Baldwin 2003b). Multiple regression analyses indicated that variance in sleep satisfaction scores was more likely to be explained by depression than anxiety. Logistic regression revealed that poor sleep satisfaction group status was only associated with increasing depression scores, and not age or anxiety. The presence of depression appears more likely to influence sleep satisfaction in participants with anxiety, even when depressive symptoms are sub-threshold. Variations in quality of life perceptions were more likely to be explained by the presence of depression and by sleep satisfaction. When anxiety symptoms were present, variations in perceived sleep timing were more likely to contribute to perceptions of poorer sleep quality. These findings help inform understanding of what influences quality of life in depressed individuals and in those presenting symptoms of insomnia. Overall, the results provide

support for the theory that depression is associated with poorer sleep satisfaction, whereas anxiety is associated with poorer sleep timing perceptions.

This study has a number of limitations that might be addressed in future investigations. Insomnia may be maintained by cognitive biases relating to anxiety, particularly to ‘catastrophising’ of outcome (Harvey & Greenhall 2003) but the effect of the typical cognitive biases that are seen in depression is uncertain. Further studies could address the accuracy of sleep perceptions in depression, with comparison to the more objective measures of sleep EEG, and further explore the relationship between sleep dissatisfaction, depression and other factors. A further limitation was the lack of evidence regarding the relationship between sleep perceptions and current antidepressant treatment. Many studies have explored the effects of antidepressant treatment on sleep (Mayers & Baldwin 2005), though usually as a secondary consideration to overall efficacy: few studies have focused on perceived sleep, and none differentiate between perceptions of sleep timing and satisfaction.

In summary, these findings provide further evidence that depression is associated with poorer sleep satisfaction, regardless of perceived sleep timing; this contrasts with the situation in insomnia, which appears more related to perceptions of poor sleep timing. More information is needed about the role of maladaptive cognitions in maintaining these perceptions,. This could be addressed by applying the techniques used in insomnia research (Harvey 2000, 2002; Harvey & Greenhall 2003) to depressed populations. Particular attention could be paid to how antidepressant treatment may affect these perceptions.

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