

# Association of depression with sleep quality might be greater than that of pain intensity among outpatients with chronic low back pain

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**Purpose:** No study to date has compared the associations of pain intensity, depression, and anxiety with insomnia among outpatients with chronic low back pain (CLBP). This study aimed to investigate this issue.

**Patients and methods:** A total of 225 outpatients with CLBP were enrolled from a general orthopedics clinic. The Insomnia Severity Index was used to evaluate sleep quality. Major depressive disorder (MDD) and anxiety disorders were diagnosed using the Structured Clinical Interview for *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition, text revision, Axis I Disorders. Two psychometric scales were used to evaluate depression and anxiety. The Visual Analog Scale was employed to assess pain intensity. Multiple linear regressions were performed to determine the association of insomnia with pain intensity, depression, and anxiety.

**Results:** Among the 225 subjects, 58 (25.8%) had clinical insomnia; 83 (36.9%) had severe low back pain; 49 (21.8%) had MDD, including 21 (9.3%) with a current major depressive episode (MDE); and 52 (23.1%) had anxiety disorders. More than half (56.9%) of the subjects with CLBP and clinical insomnia had MDD and/or anxiety disorders. Subjects with a current MDE or anxiety disorders had greater severities of pain and insomnia as compared with subjects without these conditions. After controlling for demographic variables, MDE was more strongly associated with insomnia than severe low back pain; moreover, the severity of depression had a greater association with insomnia than pain intensity.

**Conclusion:** The association of depression with insomnia was not inferior to that of pain intensity with insomnia. Among patients with CLBP and insomnia, integration of depression and anxiety treatment into treatment of pain might help to improve sleep quality.

**Keywords:** depressive disorder, anxiety, sleep quality, backache, insomnia

## Introduction

Insomnia that causes stress or functional impairment may be considered as a primary disorder or associated with other medical or psychiatric disorders. Among patients with chronic low back pain (CLBP), the prevalence of insomnia ranges from 50% to 90%.<sup>1,2</sup> Insomnia affects quality of life, daily functioning, and recovery from pain in these patients.<sup>3-5</sup> In fact, physical and mental discomfort as well as social and occupational disruption due to CLBP are aggravated by a poor sleep quality.<sup>6,7</sup>

Depression and/or anxiety are associated with sleep quality. It has been estimated that 90% of patients with depression complain of sleep disturbance.<sup>8,9</sup> People with insomnia are ten times more likely to suffer from clinical depression.<sup>10</sup> In fact, sleep disturbance is one of the diagnostic criteria for major depressive disorder (MDD).<sup>11</sup>

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Sleep disturbance is also common in patients with anxiety disorders.<sup>12</sup> Approximately 80% of patients with anxiety disorders have comorbid sleep disturbance at the same time, or the insomnia appears after the anxiety disorder had developed.<sup>13</sup> In addition, the diagnostic criteria for generalized anxiety disorder include difficulty in sleeping.<sup>11</sup>

Previous studies have investigated the prevalence and severity of insomnia in patients with CLBP.<sup>2,14–17</sup> Pain intensity was found to be one of the most important factors related to insomnia among patients with chronic musculoskeletal pain.<sup>2,18</sup> One study found that pain intensity and fatigue level were strongly associated with insomnia among patients with CLBP.<sup>2</sup> However, another study reported a weak association between pain intensity and insomnia.<sup>14</sup> An earlier study indicated that pain intensity, anxiety, and depression were significantly correlated with insomnia among patients with CLBP.<sup>15</sup> To the best of our knowledge, no study has compared the associations of pain intensity, depression, and anxiety with insomnia among patients with CLBP. This issue is important because gaining an understanding of the ranking of these factors might allow physicians to formulate more effective treatment plans and educate patients.

Therefore, the purpose of this study was to compare the associations of pain intensity, depression, and anxiety with insomnia among patients with CLBP. We hypothesized that the association of psychological factors with insomnia might be as strong as that of pain intensity with insomnia among patients with CLBP.

## Patients and methods

### Patients

This study was conducted in the general orthopedics clinic of the Chang Gung Memorial Hospital at Linkou, a medical center in Taiwan, Republic of China, from August 2008 to November 2010, and was approved by the institutional review board of the same hospital. Patients were eligible for the study if they 1) had made a first visit to our orthopedics clinic; 2) were 20–65 years of age; and 3) had complained of low back pain (LBP) for at least 3 months. Patients were excluded from the study if they had 1) taken antidepressants or antipsychotics within the past 4 weeks and had 2) mental retardation, psychotic symptoms, or severe cognitive impairment with obvious difficulty in being interviewed. Based on the guidelines regulated in the Declaration of Helsinki, all subjects gave written informed consent prior to study enrollment.

After enrollment, subjects underwent physical examinations, which were performed by a board-certified orthopedist. They were then interviewed by a board-certified psychiatrist

who was blind to the data related to CLBP. The Structured Clinical Interview for *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition, text revision, Axis I Disorders was used to diagnose MDD and anxiety disorders.<sup>19</sup>

### Assessment of insomnia related to CLBP

The Insomnia Severity Index (ISI) is a seven-item scale with good reliability and validity to evaluate insomnia severity in the past 2 weeks.<sup>20–22</sup> Each item is rated on a 5-point scale (0 = not at all; 4 = extremely) and summed to generate a total score that ranges from 0 to 28. A total score of 0–7 indicates “no clinically significant insomnia”, 8–14 “subthreshold insomnia”, 15–21 “clinical (moderate) insomnia”, and 22–28 “clinical (severe) insomnia”. A cutoff point of  $\geq 15$  resulted in optimal sensitivity (94%) and specificity (95%). In this study, clinical insomnia was defined as ISI  $\geq 15$ .

### Assessment of the severities of pain, depression, and anxiety

The Visual Analog Scale (VAS), with 0 representing “no pain” and 10 representing “pain as severe as I can imagine”, was used to evaluate the average pain intensity of LBP in the past week. In this study, VAS  $\geq 7$  was considered to indicate severe pain.

Two scales – the Hospital Anxiety and Depression Scale (HADS) and the Depression and Somatic Symptoms Scale (DSSS) – were used to evaluate the severities of depression, anxiety, and somatic symptoms (SS).<sup>23,24</sup> The DSSS included 12 items for the depression subscale (DS) and ten items to evaluate SS, which were composed of five pain and five non-pain SS. The DS, the design of which is based on the criteria for a major depressive episode (MDE) and common depressive scales, included four items related to physical symptoms (insomnia, fatigue, decreased sexual desire, and decreased appetite).<sup>23,24</sup> The total scores ranged from 0 to 36 for the DS and 0 to 30 for the SS. The reliability and validity of the DSSS have been proved.<sup>25,26</sup> The HADS, which assesses depression and anxiety severity simultaneously and does not include any SS, is composed of seven items for the depression (HADS-D) and anxiety (HADS-A) subscales.<sup>27</sup> The total scores of the HADS range from 0 to 21 for the HADS-D and HADS-A. A higher score indicates a greater severity of symptoms.

### Statistical methods

All statistical analyses were performed using SPSS for Windows 15.0 (SPSS Inc., Chicago, IL, USA). The independent *t*-test, chi-square test, and Pearson’s correlation were used appropriately. To determine the ranking of the

associations of these factors with insomnia, two models of multiple linear regression using the forward method were employed. The first regression model compared the associations of three categorical variables (presence of MDE or not, presence of anxiety comorbidities or not, and presence of severe LBP or not) with insomnia. The dependent variable was the score of the ISI. The independent variables included five demographic variables (age, sex, educational years, marital status, and employment status) and the abovementioned three categorical variables. The second regression model compared the associations of five continuous variables (DS, SS, HADS-D, HADS-A, and pain intensity of LBP) with insomnia (ISI score) after controlling for demographic variables. The dependent variable was the score of the ISI. The independent variables included the five demographic variables and the five continuous variables. A two-tailed test with a  $P$ -value  $<0.05$  was considered to indicate statistical significance in all statistical analyses.

## Results

### Subjects

In this study, 243 patients were recruited in line with the inclusion and exclusion criteria. Two-hundred and twenty-five patients agreed to participate, and 18 (7.4%) declined to participate. Among the remaining 225 subjects, 49 (21.8%) had MDD, with 21 (9.3%) experiencing a current MDE. Fifty-two (23.1%) subjects had at least one anxiety disorder, including one (0.4%) with panic disorder, one with agoraphobia, 16 (7.1%) with social phobia, 28 (12.4%) with specific phobia, four (1.8%) with posttraumatic stress disorder, one with obsessive-compulsive disorder, and 19 (8.4%) with generalized anxiety disorder. Eighty-three (36.9%) subjects had severe LBP. Table 1 shows the demographic variables for the full sample and the groups. There were no significant differences in these demographic variables between groups, with the exception that the group of subjects with anxiety comorbidities consisted of a higher percentage of women.

Among the 225 subjects, 137 (60.9%) had insomnia, including 79 (35.1%) with subthreshold insomnia and 58 (25.8%) with clinical insomnia ( $ISI \geq 15$ ). Among the 58 subjects with clinical insomnia, 32 (55.2%) had severe LBP and 33 (56.9%) had MDD and/or anxiety comorbidities, including 23 (39.7%) with MDD, 13 (22.4%) experiencing a current MDE, and 22 (37.9%) with anxiety comorbidities.

### Differences in the severity of insomnia and psychometric scores between groups

Table 2 shows the severity of insomnia, pain intensity of LBP, and the severities of depression, anxiety, and SS for the full sample and for the groups. Subjects experiencing a current MDE, those with anxiety comorbidities, and those with severe LBP had significantly higher scores on the ISI, pain intensity (VAS), depression (DS and HADS-D), anxiety (HADS-A), and SS scales as compared with subjects without these conditions.

### Correlations of ISI score, depression, anxiety, and SS

The ISI score was significantly (all  $P < 0.01$ ) correlated with the VAS score of LBP (correlation coefficient:  $r=0.33$ ), DS ( $r=0.57$ ), SS ( $r=0.54$ ), HADS-D ( $r=0.38$ ), and HADS-A ( $r=0.42$ ). The DS had the highest correlation coefficient, followed by the SS, HADS-A, HADS-D, and pain intensity. The correlations of ISI score with age ( $r=-0.12$ ,  $P=0.08$ ) and educational years ( $r=0.13$ ,  $P=0.06$ ) were of borderline significance.

Pain intensity of LBP was significantly (all  $P < 0.01$ ) correlated with the DS ( $r=0.37$ ), SS ( $r=0.42$ ), HADS-D ( $r=0.29$ ), and HADS-A ( $r=0.33$ ).

### Differences in insomnia severity between groups

Table 3 shows the differences in the percentages of patients with clinical insomnia ( $ISI \geq 15$ ) between groups. Patients

**Table 1** Demographic variables of the groups

	Total	MDE		Anxiety comorbidities		Severe LBP <sup>a</sup>	
		Yes (n=21)	No (n=204)	Yes (n=52)	No (n=173)	Yes (n=83)	No (n=142)
Age (years) <sup>c</sup>	40.7±11.4	40.1±10.6	40.7±11.5	39.3±12.3	41.1±11.2	40.8±10.9	40.6±11.7
Female (%)	45.8	66.7 <sup>b</sup>	43.6	59.6 <sup>*</sup>	41.6	45.8	45.8
Educational years <sup>c</sup>	11.4±3.4	11.5±3.1	11.3±3.4	11.1±3.13	11.4±3.44	11.3±3.2	11.4±3.5
Married (%)	69.3	57.1	70.6	61.5	71.7	74.7	66.2
Employment (%)	67.6	57.1	68.6	57.7	70.5	69.9	66.2

**Notes:** <sup>a</sup>Severe LBP was defined as a score on the VAS  $\geq 7$ . <sup>b</sup>Borderline significance with  $P=0.06$ . <sup>\*</sup> $P < 0.05$ . <sup>c</sup>Data in age and educational years presented as mean  $\pm$  standard deviation.

**Abbreviations:** MDE, major depressive episode; LBP, low back pain; VAS, Visual Analog Scale.

**Table 2** The scores of insomnia and psychometric scales of the groups<sup>a,b</sup>

	Total	MDE		Anxiety comorbidities		Severe LBP	
		Yes (n=21)	No (n=204)	Yes (n=52)	No (n=173)	Yes (n=83)	No (n=142)
ISI	9.7±6.7	16.0±8.4*	9.0±6.2	12.0±6.6*	9.0±6.7	11.9±6.7*	8.4±6.4
VAS	5.7±2.7	7.2±1.9*	5.6±2.7	7.0±2.5*	5.4±2.6	8.5±1.1*	4.1±1.8
DS	8.9±7.1	21.7±5.3*	7.6±5.8	13.3±7.1*	7.6±6.5	11.6±7.2*	7.4±6.6
SS	8.7±5.0	16.1±4.7*	7.9±4.4	11.7±4.9*	7.8±4.7	10.8±4.6*	7.5±4.8
HADS-D	5.8±4.1	11.2±4.1*	5.3±3.7	6.9±4.0**	5.5±4.2	6.9±4.2*	5.2±4.0
HADS-A	7.3±4.4	13.0±3.1*	6.7±4.1	9.0±4.6*	6.8±4.3	8.7±4.2*	6.4±4.3

**Notes:** <sup>a</sup>Severe LBP was defined as a score on the VAS  $\geq 7$ . <sup>b</sup>Eight (3.6%) subjects had both a current MDE and anxiety comorbidities. The scores of the ISI, VAS, DS, SS, HADS-D, and HADS-A were 16.8±6.9, 7.0±2.0, 23.3±6.7, 16.8±6.3, 11.5±3.3, and 13.4±2.7, respectively. \* $P < 0.01$  and \*\* $P < 0.05$ . Data presented as mean  $\pm$  standard deviation.

**Abbreviations:** MDE, major depressive episode; LBP, low back pain; ISI, Insomnia Severity Index; VAS, Visual Analog Scale; DS, depression subscale of the DSSS; SS, somatic subscale of the DSSS; HADS-D, depression subscale of the HADS; HADS-A, anxiety subscale of the HADS; DSSS, Depression and Somatic Symptoms Scale; HADS, Hospital Anxiety and Depression Scale.

with a current MDE, anxiety comorbidities, or severe LBP (VAS  $\geq 7$ ) had a higher risk of clinical insomnia than subjects without these conditions. There was no significant difference in the percentage of patients with clinical insomnia between the male and female subjects, between subjects with and without employment, and between married or single subjects.

## Independent factors associated with insomnia

Table 4 identifies the factors independently related to the ISI score. In the first model, a current MDE had the highest  $R^2$  change, followed by severe LBP. In the second model, the DS had the highest  $R^2$  change, followed by the SS. Pain intensity of LBP and the HADS-A did not appear in the second regression model.

## Discussion

In the first regression model, a current MDE was the factor most strongly associated with insomnia, followed by severe LBP. In the second regression model, the DS was the factor most strongly associated with insomnia, followed by the SS;

however, the pain intensity of LBP did not appear in the model. All correlation efficiencies (0.57–0.38) of the four psychometric subscales with the ISI score were higher than the correlation efficiency (0.33) of the VAS score with the ISI score. This demonstrated that the association of depression with insomnia might be greater than that of pain intensity with insomnia. This might partially result from the following reasons: 1) Sleep disturbance is one of the most important criteria of MDD,<sup>11</sup> and moreover, decreased physical activity due to depression, for reasons such as lack of motivation, fatigue, and psychomotor retardation, might lead to insomnia; 2) Some items of the ISI that rated dissatisfaction with sleep and worry about insomnia might be correlated with negative thoughts or the emotional status of patients with depression, and moreover, the last item of the ISI rated impairment in daily functioning (eg, daytime fatigue, mood, concentration, and memory) due to insomnia. Patients with CLBP might not attribute functional impairment due to depression to insomnia; 3) Patients with chronic pain and MDD might have a greater presleep arousal, poorer sleep hygiene, and more dysfunctional beliefs about sleep.<sup>28</sup> Our results did

**Table 3** The percentages of clinical insomnia in the groups

	Clinical insomnia <sup>a</sup> (%)	Odds ratio (95% CI)	P-value <sup>c</sup>
MDE			
Yes	61.9	5.74 (2.24–14.71)	<0.001
No	22.1		
Anxiety comorbidities			
Yes	42.3	2.79 (1.44–5.41)	0.003
No	20.8		
Severe LBP <sup>b</sup>			
Yes	38.6	2.80 (1.52–5.17)	0.001
No	18.3		

**Notes:** <sup>a</sup>Clinical insomnia was defined as a score on the ISI  $\geq 15$ . <sup>b</sup>Severe LBP was defined as a score on the VAS  $\geq 7$ . <sup>c</sup>Chi-square test was used in these tests.

**Abbreviations:** MDE, major depressive episode; LBP, low back pain; ISI, Insomnia Severity Index; VAS, Visual Analog Scale; CI, confidence interval.

**Table 4** Independent factors related to the ISI among 225 outpatients with CLBP

Independent variables	$\beta$	t	$R^2$ change	P-value <sup>b</sup>
Model 1				
MDE	0.27	4.41	0.09	<0.001
Severe LBP <sup>a</sup>	0.23	3.69	0.05	<0.001
Educational years	0.13	2.08	0.02	0.04
Model 2				
DS	0.38	4.72	0.32	<0.001
SS	0.25	3.11	0.03	0.002

**Notes:** <sup>a</sup>Severe LBP was defined as a score on the VAS  $\geq 7$ . <sup>b</sup>Multiple linear regression with the Forward selection method were employed.

**Abbreviations:** ISI, Insomnia Severity Index; CLBP, chronic low back pain; MDE, major depressive episode; LBP, low back pain; DS, depression subscale of the DSSS; SS, somatic subscale of the DSSS; VAS, Visual Analog Scale; DSSS, Depression and Somatic Symptoms Scale.

not indicate that the pain intensity of LBP is unimportant in relation to insomnia among patients with CLBP. In fact, insomnia, depression, anxiety, and pain intensity were correlated and interacted with each other. For example, insomnia might exacerbate pain symptoms; conversely, pain symptoms might induce insomnia.<sup>4,5,15,29</sup> Similarly, pain symptoms are common among patients with MDD, and patients with chronic pain have a higher risk of depression.<sup>16,17,30</sup> Moreover, insomnia is also a common symptom of anxiety.<sup>10,12,13,31</sup>

Our results had clinical implications. First, for most patients with CLBP, pain is the main reason for seeking help and is thought to be the most likely factor associated with sleep disturbance.<sup>5</sup> Conversely, depression might be easily neglected for two reasons: 1) negative stigma surrounding depression and other mental disorders<sup>32,33</sup> might cause patients with CLBP to conceal their mood problem and, 2) patients with CLBP do not have enough knowledge about depression. Some symptoms of depression, such as lack of motivation, fatigue, poor concentration, and a leaden feeling of the extremities, might be misattributed to insomnia or pain. If depression is not treated, improvement of pain and insomnia might be limited, because depression, insomnia, and pain might exacerbate each other.<sup>7,17,29</sup> Second, pain intensity, insomnia, depression, and anxiety interact with each other. The relationships of the four dimensions might not be of the simple causal type. Treating pain symptoms might require simultaneous management of the other three dimensions. Third, among patients with CLBP and clinical insomnia, 56.9% have MDD or anxiety comorbidities. Insomnia might be an important symptom that physicians should note, as patients with CLBP and clinical insomnia may suffer from mood and/or anxiety disorders. Fourth, insomnia is common among patients with CLBP, with 60.9% of subjects having subthreshold or clinical insomnia. Decreased exercise or physical activity due to pain and/or depression might exacerbate insomnia.<sup>34</sup> Therefore, education in sleep hygiene that is specific to patients with CLBP is indicated.

There were limitations in our study: 1) The subjects were enrolled from a medical center. Expansion of the results to the general population should be performed cautiously; 2) Pain, insomnia, depression, and anxiety were found to be correlated. However, the cause-and-effect relationships of the four dimensions could not be identified in this study. In the future, longitudinal follow-up studies to investigate the long-term impacts of depression, anxiety, and pain intensity on insomnia might increase our understanding of the interactions and cause-and-effect relationships of the four dimensions; 3) The different psychometric scales for depression and/or anxiety

had different components. The DS had a higher correlation with insomnia than the HADS-D, which may be a result of the fact that the DS included insomnia and other physical items. Anxiety-related symptoms, such as fear, avoidance, or a catastrophizing reaction, were not included in this study. Therefore, our results need to be confirmed using other different psychometric scales.

## Conclusion

Insomnia was common among the patients with CLBP. More than half (56.9%) of the patients with CLBP and clinical insomnia had MDD and/or anxiety disorders. Patients with CLBP comorbid with MDE or anxiety disorders had greater severities of insomnia, pain intensity of LBP, depression, and anxiety. The severity of insomnia was significantly correlated with depression, anxiety, and pain intensity. After controlling for demographic variables, the association of depression with insomnia was greater than that of pain intensity with insomnia. In clinical practice, physicians should simultaneously consider and manage depression, anxiety, and pain intensity of LBP among patients with CLBP and insomnia.

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## Disclosure

The authors report no conflicts of interest in this work.

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