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ORIGINAL RESEARCH

The Combined Effect Between Sleep Disorders and Depression Symptoms on Chronic Low Back Pain: A Cross-Sectional Study of NHANES

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Purpose: To explore the combined effects of sleep disorders and depression on chronic low back pain (CLBP) in American adults.

Material and methods: In this cross-sectional study, the data of all participants were obtained from the National Health and Nutrition Examination Survey (NAHNES) between 2009 and 2010. CLBP was defined as persistent LBP for a consecutive three-month period. Sleep disorders were self-reported and were diagnosed by a doctor before. The Patient Health Questionnaire-9 (PHQ-9) was used to assess depressive symptoms by trained personnel. Potential covariates were selected using weighted univariate logistic regression models. Weighted univariate and multivariate logistic regression models were used to evaluate the separate and combined effects of sleep disorders and depression on CLBP, respectively. Results were presented as odds ratios (ORs) and 95% confidence intervals (CIs). Associations were further explored in the subgroups of age, chronic kidney disease (CKD), diabetes, and having pain outside the low back.

Results: A total of 5275 participants were included. Among them, 542 (10.28%) had CLBP. The mean age of all participants was 47.19 (0.53), and 50.65% (n=2668) were female. Sleep disorder (OR=1.52, 95% CI: 1.17–1.98) or depressive symptoms (OR=3.06, 95% CI: 2.41–3.88) were associated with higher odds of CLBP. Compared to participants without sleep disorders and depression symptoms, participants in both conditions had an increased risk of CLBP (OR=3.95, 95% CI: 2.58–6.05, P for trend <0.001). The combined effects of sleep disorders and depressive symptoms were also found in the population aged <45 years, ≥45 years, with and without CKD, with and without diabetes, and no pain outside the low back.

Conclusion: Sleep disorders and depressive symptoms may increase the odds of reporting CLBP. Further research is necessary to explore the effectiveness of multidisciplinary interventions targeting sleep disorders, depressive symptoms, and CLBP.

Keywords: chronic low back pain, sleep disorders, depression, combined effect, the national health and nutrition examination survey

Introduction

Chronic low back pain (CLBP), defined as back pain lasting for at least three months or longer, is a public health burden.[1] Almost 10–30% of people will develop CLBP annually in the US, and the lifetime prevalence is as high as 65–80% in the US.[1] CLBP affects millions of individuals worldwide and prevalence doubles over time.[2] CLBP not only leads to physical discomfort but also has significant psychological and socioeconomic implications, including reduced quality of life, increased healthcare utilization, and work incapacity.[3] CLBP was a dynamic interaction between social, psychological, and biological factors.[4]

Women with mental disorders and poor sleep quality are more vulnerable to CLBP.[5] Sleep is essential to maintain normal emotional, psychological, and physical health. Sleep disorders mainly include insomnia, circadian rhythm disorders, sleep-disordered breathing, hypersomnia/narcolepsy, parasomnias, and restless legs syndrome/periodic limb movement disorders.[6] Meanwhile, individuals with insomnia have twice the odds of reporting CLBP.[7]

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Insomnia can predict outcomes of CLBP, this association may be explained by the pace of biological aging.[8] Worse sleep quality was associated with a higher likelihood of reporting CLBP.[9] Depression was a risk factor for CLBP.[4,10] Depression is associated with CLBP, especially in severely depressed individuals.[11] A bidirectional Mendelian randomization study reported a causal association between major depressive disorder and the risk of chronic back pain.[12] Depression not only predisposes individuals to sleep disorders but also amplifies pain perception and disability in CLBP patients.[13] It has been estimated that 90% of patients with depression complain of sleep disturbance, and people with insomnia are ten times more likely to suffer from clinical depression.[14] Sleep disorders, depression, and CLBP involve similar alterations in structural and functional neurobiology and share common pathophysiological mechanisms.[15] A combined effect between sleep disorders and depression on the risk of cardiovascular disease has been found, the relationship may be associated with their combined effects on autonomic nervous function and inflammatory state,[16,17] while it's also an important pathological mechanism of chronic pain.[18,19] However, the combined effects of sleep disorders and depression on the CLBP risk remains unclear.

Therefore, this study aimed to explore the combined effect between sleep disorders and depression on CLBP. We hypothesized that sleep disorder and depression are both associated with CLBP, and the presence of both conditions may increase the odds of CLBP.

Methods

Study Design and Participants

The National Health and Nutrition Examination Survey (NHANES) is a nationally representative cross-sectional survey conducted in the United States, based on a stratified multistage random sampling design. The National Center for Health Statistics Ethics Review Board approved that all participants provided written informed consent. The Harbin Medical University Cancer Hospital did not require ethical approval for this study. Based on the NHANES, previous studies have reported the epidemiology of low-back pain,[20] associations of chronic low back pain with sleep disturbance,[21] depressive symptoms,[22] and health indicators.[23] While the combined effect of sleep disorders and depressive symptoms on CLBP remains unexplored.

In this cross-sectional study, we examined publicly accessible data for participants aged≥ 20 years with complete and reliable information gathered between the 2009 and 2010 waves in the database. Other waves of the NHANES were not used, as chronic low back pain was not measured in these waves. Participants with missing information on sleep disorders, depressive symptoms, or CLBP were excluded.

Chronic Low Back Pain Assessment

CLBP samples were identified from participants who reported current pain in the area between the lower posterior margin of the ribcage and the horizontal gluteal fold at the time of evaluation, with a history of pain lasting almost every day for at least three months. CLBP was measured according to two questions with both answered "yes": "Was there one time when you had pain, aching, or stiffness in your low back on almost every day for 3 or more months in a row" and "Do you still have low back pain, aching or stiffness".

Assessment on Depression Symptoms and Sleep Disorders

The Patient Health Questionnaire-9 (PHQ-9) was used to assess depressive symptoms over the last two weeks.[17] PHQ-9 contains nine items, with each item scored as 0 (not at all), 1 (several days), 2 (more than half the days), and 3 (nearly every day). The total score of the PHQ-9 is 0–27 points, the higher the score, the more severe the depressive symptoms. A total score ≥10 was considered a screening criterion for depression.[24]

Sleep disorders were measured using the question "Have you ever been told by a doctor or other health professional that you have a sleep disorder?". If participants answered "yes", they were considered to have a sleep disorder.[25] Self-reported information was collected through trained interviews, using a computer-assisted personal interview system.

Covariates

Demographic information, including race, education level, smoking status, drinking status, and poverty income ratio (PIR). Race was categorized as Mexican American, non-Hispanic Black, non-Hispanic White, Hispanic, or other. Education levels were categorized into 9–11th grade, college graduate or above, high school grade/General Educational Development (GED) or equivalent, less than 9th grade, and some college or AA degree. PIR represents the ratio of family income to the federal poverty threshold.[26] A PIR of 1 represents the official federal poverty level, while a PIR of 2 is roughly the median of PIR values from the overall population. Smoking status was categorized as no smoking, quitting smoking, or smoking. Drinking status was categorized as no drinking, drinking less than once a week, or drinking at least once a week. The body mass index (BMI) was calculated by dividing the individual's weight by the square of their height (kg/m^2). Drug application information, including antidepressant/other psychotherapeutic drugs, analgesics, anxiolytics, sedatives, and hypnotics, was also recorded. White blood cell (WBC) counts were measured in the laboratory. The doctor diagnosed medical comorbidities including hypertension, malignancy, and cardiovascular disease (CVD). Hypertension was determined based on self-reported diagnosis, use of hypotensive drugs, and systolic blood pressure (SBP) ≥140 mmHg or diastolic blood pressure (DBP) ≥90 mmHg.[27] CVD was defined by self-reported diagnosis and use of cardiovascular agents. Self-reported diagnosis of CVD was determined with a response "yes" to the question "Has a doctor or other health professional ever told you that you had angina or angina pectoris/heart attack/coronary heart disease/stroke/congestive heart failure".[28]

Statistical Analysis

The primary sample unit (sdmvpsu) and stratum (sdmvstra) variables were used to obtain national estimates for household questionnaire variables, and 2-year MEC weights (wtmec2yr) were used for MEC variables. Missing values for the variables are listed in Table S1. Missing variables were manipulated using the random forest chain equation multiple imputation method. There was no significant difference between the data before and after imputation, indicating that the imputation procedure did not alter the distribution of variables. The measurement data were described as mean and standard error (S.E), and weighted t-tests were used for comparisons between groups with and without CLBP. Categorical variables are expressed as numbers and percentages (%), and differences between the two groups were analyzed using chi-square tests. Potential covariates were selected using weighted univariate logistic regression models. Weighted univariate and multivariate logistic regression models were used to evaluate the relationship between CLBP, sleep disorders, and depression. All results are presented as odds ratios (ORs) and 95% confidence intervals (CIs). Associations were further explored in the subgroups of age, chronic kidney disease (CKD), diabetes, and having pain outside the low back. *$P<0.05$ was considered statistical significance*. All statistical analyses were performed using SAS 9.4 (SAS Institute, Inc., Cary, NC, USA).

Results

Characteristics of Participants

A total of 6218 participants were extracted from the database between 2009–2010. Participants were excluded if they had missing information on sleep disorders (n=8), depressive symptoms (n=935), or CLBP (n=3). Ultimately, 5275 participants were included in the final analysis. The screening process is illustrated in Figure 1. The overall prevalence of CLBP was 10.28% (n=542). The mean age of all participants was 47.19 (0.53), and 50.65% (n=2668) were female. Statistical differences were observed between the two groups in terms of race, education level, PIR, antidepressants/other psychotherapeutic drugs, anxiolytics, sedatives and hypnotics, analgesics, WBC, BMI, smoking, drinking, hypertension, malignancy, CVD, sleep disorders, and depression symptoms (all $P<0.05$). The participant characteristics are presented in Table 1.

Associations of Sleep Disorders, Depression Symptoms with CLBP

Table 2 shows the associations between CLBP, sleep disorders, and depression. After adjusting for race, education level, PIR, malignancy, antidepressants/other psychological drugs, analgesics, anxiolytics, sedatives, and hypnotics, WBC count, BMI, smoking status, drinking status, hypertension, cardiovascular disease, sleep disorder (OR=1.52, 95% CI:

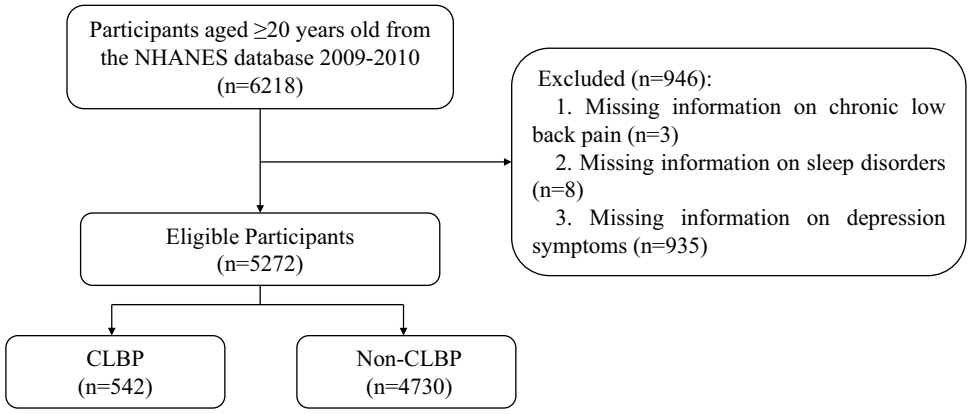

Figure 1 The screen process of included participants.

1.17–1.98) or depression symptoms (OR=3.06, 95% CI: 2.41–3.88) were associated with higher odds of CLBP. Compared to participants without sleep disorders and depression symptoms, participants in both conditions had a higher incidence of CLBP (OR=3.95, 95% CI: 2.58–6.05, *P* for trend <0.001). This combined effect has never been reported before.

Table 1 Characteristics of Patients with and without CLBP

Variables		Chronic low back pain		Statistics	*P*
	Total (n=5272)	No (n=4730)	Yes (n=542)		
Age, year, Mean (S.E)	47.19 (0.53)	47.22 (0.58)	46.90 (0.66)	t=0.38	0.707
Gender, n (%)				χ^2=0.386	0.535
Female	2668 (50.65)	2373 (50.45)	295 (52.36)		
Male	2604 (49.35)	2357 (49.55)	247 (47.64)		
Race, n (%)				χ^2=14.154	0.007
Mexican American	959 (8.53)	866 (8.62)	93 (7.72)		
Non-Hispanic Black	924 (10.92)	836 (11.02)	88 (10.05)		
Non-Hispanic White	2592 (69.30)	2300 (68.69)	292 (74.59)		
Other Hispanic	543 (5.05)	489 (5.09)	54 (4.72)		
Other Race - Including Multi-Racial	254 (6.20)	239 (6.58)	15 (2.93)		
Education level, n (%)				χ^2=31.654	<0.001
9–11th Grade (Includes 12th grade with no diploma)	841 (12.39)	742 (12.07)	99 (15.16)		
College Graduate or above	1089 (27.97)	1025 (29.30)	64 (16.34)		
High School Grad/GED or Equivalent	1227 (23.06)	1082 (22.29)	145 (29.86)		
Less Than 9th Grade	613 (5.93)	548 (5.84)	65 (6.69)		
Some college or AA degree	1502 (30.65)	1333 (30.50)	169 (31.93)		
Marital status, n (%)				χ^2=3.092	0.079
Married	2745 (56.53)	2489 (56.94)	256 (52.93)		
Not married	2527 (43.47)	2241 (43.06)	286 (47.07)		
PIR, Mean (S.E)	2.99 (0.04)	3.03 (0.04)	2.64 (0.11)	t=3.76	0.002
Antidepressants/other psychotherapeutic drugs, n (%)				χ^2=30.237	<0.001
No	4728 (88.52)	4297 (89.62)	431 (78.88)		
Yes	544 (11.48)	433 (10.38)	111 (21.12)		
Anxiolytics, sedative and hypnotics, n (%)				χ^2=48.950	<0.001
No	4947 (93.64)	4488 (94.54)	459 (85.76)		
Yes	325 (6.36)	242 (5.46)	83 (14.24)		

(*Continued*)

Table 1 (Continued).

Variables		Chronic low back pain		Statistics	*P*
	Total (n=5272)	No (n=4730)	Yes (n=542)		
Analgesics, n (%)				χ^2=423.946	<0.001
No	4505 (87.38)	4146 (89.29)	359 (70.75)		
Yes	767 (12.62)	584 (10.71)	183 (29.25)		
Cardiovascular drugs, n (%)				χ^2=0.634	0.426
No	4841 (93.76)	4346 (93.89)	495 (92.65)		
Yes	431 (6.24)	384 (6.11)	47 (7.35)		
White blood cell count (1000 cells/uL), Mean (S.E)	7.11 (0.03)	7.08 (0.03)	7.40 (0.12)	t=−2.70	0.016
Hemoglobin (g/dL), Mean (S.E)	14.24 (0.03)	14.23 (0.04)	14.33 (0.08)	t=−1.23	0.236
BMI, n (%)				χ^2=19.544	<0.001
Normal	1784 (33.58)	1617 (33.72)	167 (32.35)		
Overweight/Obesity	2033 (36.31)	1769 (35.21)	264 (46.01)		
Underweight	1455 (30.11)	1344 (31.07)	111 (21.64)		
Physical activity, n (%)				χ^2=3.178	0.204
≤450MET*min/week	518 (9.29)	458 (9.17)	60 (10.29)		
>450MET*min/week	3296 (67.97)	2981 (68.42)	315 (64.04)		
Unknown	1458 (22.75)	1291 (22.41)	167 (25.67)		
Sedentary activity (hours), Mean (S.E)	5.77 (0.08)	5.77 (0.09)	5.79 (0.20)	t=−0.12	0.904
Smoking status, n (%)				χ^2=30.989	<0.001
No	2824 (55.20)	2617 (56.81)	207 (41.08)		
Quit smoke	1306 (24.80)	1164 (24.45)	142 (27.89)		
Yes	1142 (20.00)	949 (18.74)	193 (31.03)		
Drinking status, n (%)				χ^2=19.748	<0.001
No	1387 (21.98)	1268 (22.38)	119 (18.41)		
<1 time per week	1488 (29.22)	1308 (28.73)	180 (33.48)		
≥ time per week	1770 (38.95)	1612 (39.49)	158 (34.17)		
Unknown	627 (9.86)	542 (9.40)	85 (13.94)		
CKD, n (%)				χ^2=2.037	0.153
No	4431 (87.84)	3958 (87.62)	473 (89.71)		
Yes	841 (12.16)	772 (12.38)	69 (10.29)		
Hypertension, n (%)				χ^2=17.075	<0.001
No	2176 (45.18)	1998 (46.62)	178 (32.57)		
Yes	3096 (54.82)	2732 (53.38)	364 (67.43)		
Diabetes, n (%)				χ^2=3.837	0.050
No	4311 (86.29)	3887 (86.68)	424 (82.89)		
Yes	961 (13.71)	843 (13.32)	118 (17.11)		
Dyslipidemia, n (%)				χ^2=1.767	0.184
No	1599 (31.87)	1455 (32.35)	144 (27.65)		
Yes	3673 (68.13)	3275 (67.65)	398 (72.35)		
Osteoporosis, n (%)				χ^2=2.741	0.254
No	4484 (86.72)	4021 (86.65)	463 (87.39)		
Yes	198 (3.15)	191 (3.35)	7 (1.44)		
Unknown	590 (10.12)	518 (10.00)	72 (11.17)		
Malignancy, n (%)				χ^2=4.600	0.032
No	4733 (89.67)	4247 (89.93)	486 (87.37)		
Yes	539 (10.33)	483 (10.07)	56 (12.63)		
Cardiovascular disease, n (%)				χ^2=9.080	0.003
No	4717 (92.00)	4253 (92.57)	464 (86.95)		
Yes	555 (8.00)	477 (7.43)	78 (13.05)		

(*Continued*)

Table 1 (Continued).

Variables		Chronic low back pain		Statistics	*P*
	Total (n=5272)	No (n=4730)	Yes (n=542)		
Sleep disorder, n (%)				χ^2=89.762	<0.001
No	4869 (92.42)	4409 (93.16)	460 (85.88)		
Yes	403 (7.58)	321 (6.84)	82 (14.12)		
Depression, n (%)				χ^2=249.014	<0.001
No	4770 (92.27)	4367 (93.93)	403 (77.66)		
Yes	502 (7.73)	363 (6.07)	139 (22.34)		
Combined effect, n (%)				χ^2=250.463	<0.001
No sleep disorder and no depression	4468 (86.39)	4109 (88.33)	359 (69.44)		
No sleep disorder and depression	401 (6.02)	300 (4.83)	101 (16.45)		
Sleep disorder and no depression	302 (5.87)	258 (5.60)	44 (8.23)		
Sleep disorder and depression	101 (1.71)	63 (1.23)	38 (5.89)		

Abbreviations: SE, Standard error; CLBP, chronic low back pain; PIR, poverty to income ratio; BMI, body mass index; CKD, chronic kidney disease.

Associations of sleep disorders, depression symptoms with CLBP in subgroups of age, CKD, diabetes, and having pain outside the low back

The associations between sleep disorders, depression, and CLBP in different subgroups are shown in Table 3. Compared to participants without sleep disorders and depression, individuals who had both sleep disorders and depression symptoms were associated with higher odds of CLBP in subgroups of age <45 years (OR=2.87, 95% CI: 1.15–7.17, *P* for trend <0.001), age ≥45 years (OR=4.71, 95% CI: 2.10–10.55, *P* for trend <0.001), with (OR=8.71, 95% CI: 2.13–35.56, *P* for trend =0.005) and without (OR=3.55, 95% CI: 2.10–6.01, *P* for trend <0.001) CKD, with (OR=3.12, 95% CI: 1.81–5.39, *P* for trend <0.001) and without (OR=11.50, 95% CI: 2.91–45.49, *P* for trend <0.001) diabetes, and no pain outside the low back (OR=3.86, 95% CI: 1.80–8.28, *P* for trend <0.001). These results confirm that the combined effects of sleep disorders and depression on CLBP were stable.

Table 2 Associations of Sleep Disorders, Depression Symptoms with CLBP

Variables	Model 1		Model 2	
	OR (95% CI)	*P*	OR (95% CI)	*P*
Sleep disorders				
No	Ref		Ref	
Yes	2.24 (1.85–2.71)	<0.001	1.52 (1.17–1.98)	0.002
Depression				
No	Ref		Ref	
Yes	4.45 (3.63–5.46)	<0.001	3.06 (2.41–3.88)	<0.001
Combined effect			Trend	<0.001
No sleep disorder and no depression	Ref		Ref	
No sleep disorder and depression	4.33 (3.25–5.78)	<0.001	2.99 (2.13–4.21)	<0.001
Sleep disorder and no depression	1.87 (1.40–2.50)	<0.001	1.36 (0.91–2.02)	0.133
Sleep disorder and depression	6.07 (4.33–8.49)	<0.001	3.95 (2.58–6.05)	<0.001

Notes: Model 1 was crude model. Model 2 adjusting race, education level, PIR, malignancy, antidepressants/other psychological drugs, analgesics, anxiolytics, sedatives, and hypnotics, WBC, BMI, smoking status, drinking status, hypertension, and cardiovascular disease.
Abbreviations: Ref, reference; OR, odds ratio; CI, confidence interval; CLBP, chronic low back pain.

Table 3 Associations of Sleep Disorders, Depression Symptoms with CLBP in Subgroups of Age, CKD, Diabetes, and Having Pain Outside the Low Back

Group	Variables	OR (95% CI)	*P*
Age <45 years (n=2214)	Combined effect	Trend	<0.001
	No sleep disorder and no depression	Ref	
	No sleep disorder and depression	2.27 (1.49–3.46)	<0.001
	Sleep disorder and no depression	0.82 (0.41–1.62)	0.560
	Sleep disorder and depression	2.87 (1.15–7.17)	0.024
Age ≥45 years (n=3058)	Combined effect	Trend	<0.001
	No sleep disorder and no depression	Ref	
	No sleep disorder and depression	3.73 (2.19–6.34)	<0.001
	Sleep disorder and no depression	1.60 (0.93–2.74)	0.091
	Sleep disorder and depression	4.71 (2.10–10.55)	<0.001
Non-CKD (n=4431)	Combined effect	Trend	<0.001
	No sleep disorder and no depression	Ref	
	No sleep disorder and depression	3.21 (2.22–4.66)	<0.001
	Sleep disorder and no depression	1.14 (0.69–1.89)	0.596
	Sleep disorder and depression	3.55 (2.10–6.01)	<0.001
CKD (n=841)	Combined effect	Trend	0.005
	No sleep disorder and no depression	Ref	
	No sleep disorder and depression	1.88 (0.46–7.63)	0.377
	Sleep disorder and no depression	3.89 (1.90–7.97)	<0.001
	Sleep disorder and depression	8.71 (2.13–35.56)	0.003
Non-diabetes (n=4311)	Combined effect	Trend	<0.001
	No sleep disorder and no depression	Ref	
	No sleep disorder and depression	2.97 (2.03–4.33)	<0.001
	Sleep disorder and no depression	1.21 (0.83–1.78)	0.320
	Sleep disorder and depression	3.12 (1.81–5.39)	<0.001
Diabetes (n=961)	Combined effect	Trend	<0.001
	No sleep disorder and no depression	Ref	
	No sleep disorder and depression	3.35 (1.64–6.82)	<0.001
	Sleep disorder and no depression	1.97 (0.74–5.25)	0.175
	Sleep disorder and depression	11.50 (2.91–45.49)	<0.001
No pain outside the low back (n=4683)	Combined effect	Trend	<0.001
	No sleep disorder and no depression	Ref	
	No sleep disorder and depression	2.38 (1.42–4.00)	0.001
	Sleep disorder and no depression	1.58 (0.85–2.96)	0.151
	Sleep disorder and depression	3.86 (1.80–8.28)	<0.001
Have pain outside the low back (n=589)	Combined effect	Trend	0.129
	No sleep disorder and no depression	Ref	
	No sleep disorder and depression	1.77 (0.90–3.47)	0.095
	Sleep disorder and no depression	1.06 (0.43–2.65)	0.897
	Sleep disorder and depression	1.32 (0.57–3.08)	0.521

Note: Ref: Reference, OR: Odds Ratio, CI: Confidence Interval. Adjusting race, education level, PIR, malignancy, antidepressants/other psychological drugs, analgesics, anxiolytics, sedative and hypnotics, WBC, BMI, type of work done last week, smoking status, drinking status, hypertension, cardiovascular disease.

Abbreviations: CLBP, chronic low back pain; CKD, chronic kidney disease.

Discussion

To our knowledge, this is the first study to explore the combined effect of sleep disorders and depressive symptoms on CLBP using the NHANES 2009–2010 dataset. Our findings showed that individuals with depressive symptoms or sleep disorders were related to a higher incidence of CLBP. Depression and sleep disorders have synergistic effects on CLBP occurrence. Our findings are consistent with previous studies that separately explored the effects of sleep disorders or

depression symptoms on CLBP.[29,30] However, our study uniquely contributes by elucidating the combined effects of these two conditions on the risk of CLBP.

A previous study reported that common mental disorders were associated with an increased prevalence of CLBP, which is consistent with our finding of a relationship between depression symptoms and CLBP.[5] We also reported that sleep disorders are associated with higher odds of CLBP. In a study of schoolteachers, a prospective and bidirectional association was found between poor sleep quality and CLBP.[9] Individuals with sleep disorders may have an increased prevalence of depression and anxiety and increased intensity and maintenance of chronic pain.[21] Depression and sleep disorders were considered significant risk factors for CLBP in adults according to the Swedish Longitudinal Occupational Survey of Health.[31] However, the combined effects of sleep disorders and depressive symptoms on CLBP occurrence of CLBP were rarely been studied. In the current study, we found a combined effect of sleep disorders and depressive symptoms on CLBP development. In addition, we found that the combined effects of sleep disorders and depressive symptoms on CLBP risk were consistent among subgroups.

Several potential mechanisms may explain the higher odds of CLBP in individuals with sleep disorders or depression. First, both sleep disorders and depression are known to be associated with alterations in pain processing and perception.[9,32] Sleep disturbances can disrupt the normal regulation of pain signals, leading to increased pain sensitivity.[33] Similarly, depression has been shown to enhance pain perception through various physiological and psychological mechanisms such as altered norepinephrine and serotonin levels and increased attention to painful stimuli.[34] Therefore, a combination of these two conditions may amplify pain perception and exacerbate CLBP. Second, sleep disorders and depression share common neurobiological pathways.[35] Both conditions have been linked to dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis and abnormalities in the stress response system.[36,37] Chronic activation of the HPA axis can lead to increased inflammation and oxidative stress, which are known contributors to CLBP.[38] Consequently, the co-occurrence of sleep disorders and depression may intensify the dysregulation of the HPA axis, resulting in a higher risk of CLBP. Third, lifestyle factors associated with both sleep disorders and depression may contribute to the increased risk of CLBP. Individuals with sleep disorders often experience disrupted sleep patterns leading to fatigue and decreased physical activity.[39] Similarly, depression is frequently associated with reduced motivation and engagement in regular exercise.[40] Sedentary behavior and physical inactivity have been identified as risk factors for CLBP.[41] Therefore, the combination of sleep disorders and depression may compound these detrimental lifestyle factors, further increasing the susceptibility to CLBP.

Clinicians should be aware that patients with both sleep disorders and depression have a heightened risk of developing CLBP. A comprehensive assessment of both conditions should be conducted to evaluate the individuals. Early identification and appropriate management of sleep disorders and depressive symptoms could potentially prevent or mitigate CLBP onset. Furthermore, clinicians should consider implementing multidisciplinary approaches to the treatment of patients with concurrent sleep disorders, depressive symptoms, and CLBP. Integrating interventions targeting all three conditions, such as cognitive-behavioral therapy, exercise therapy, and pharmacotherapy, may yield more favorable outcomes than treating each condition in isolation.

Despite the strengths of our study including its large sample size and sampling weight, several limitations should be acknowledged. First, the cross-sectional study design limits causal inferences. Prospective studies are required to confirm the temporal relationship between the combined effects of sleep disorders and depression on CLBP development. Second, the sleep disorder was self-reported and may not reflect the true picture of sleep status. Future studies should employ objective measures such as polysomnography and diagnostic interviews to accurately assess these conditions. Finally, the type of sleep disorders in the NHANES dataset is unknown. Further research exploring the association between the categories of sleep disorders, depressive symptoms, and CLBP is warranted.

Conclusion

This cross-sectional study found a combined effect of sleep disorder and depression on CLBP. These findings support the need for comprehensive evaluation and management of sleep disorders and depressive symptoms in individuals. Further research is necessary to elucidate the underlying mechanisms driving this relationship and explore the effectiveness of multidisciplinary interventions targeting sleep disorders, depression, and CLBP.

Ethics Approval and Informed Consent

The requirement for ethical approval for this study was waived by the Institutional Review Board of Harbin Medical University Cancer Hospital because the data were obtained from the NHANES (and Nutrition available database). The need for written informed consent was waived by the Institutional Review Board of Harbin Medical University Cancer Hospital owing to the retrospective nature of the study. The data accessed complied with Federal confidentiality laws including Section 308(d) Public Health Service Act [42 U.S.C. 242m(d)] and the Confidential Information Protection and Statistical Efficiency Act or CIPSEA [Pub. L. No. 115-435, 132 Stat. 5529 § 302].

Consent for Publication

Not applicable.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

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