

Retrospective Assessment

e What Is the Prevalence of Symptomatic Obstructive Sleep Apnea Syndrome in Chronic Spinal Pain Patients? An Assessment of the Correlation of OSAS with Chronic Opioid Therapy, Obesity, and Smoking

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Background: In modern medicine, obstructive sleep apnea syndrome (OSAS) is a commonly described sleep disorder with airway obstruction, disrupted sleep, and excessive daytime sleepiness. Since its description in 1976 by Guilleminault et al, numerous epidemiologic studies and systematic reviews, with multiple comorbidities related to cardiovascular sequelae, altered cognitive function, and multiple other potential complications have been described. Multiple risk factors have been identified included obesity, smoking, alcohol consumption, and other factors. Chronic pain and chronic opioid therapy also have been described to contribute to a large proportion of patients with OSAS. Chronic pain, obesity, smoking, and chronic opioid therapy are often found together, yet there is a paucity of literature describing OSAS in chronic pain patients.

Objectives: To assess the prevalence of symptomatic OSAS in chronic spinal pain patients receiving chronic opioid therapy and determine the association of OSAS with multiple risk factors and comorbidities.

Study Design: A retrospective assessment of patients who attend a single interventional pain management practice from January 1, 2010 to December 31, 2014.

Setting: A private interventional pain management practice in the United States.

Methods: The data were collected from 4,036 consecutive patients presenting for assessment to a pain management center from January 1, 2010 to December 31, 2014. All assessments were comprehensive and performed by 2 physicians. The comprehensive assessment included a complete history, a physical examination, and a review of records.

Results: The prevalence of OSAS in patients with chronic spinal pain was 13.8%. The results showed a higher prevalence in males compared to females (15.1% versus 12.8%), a higher prevalence in those aged 45 or older compared to those 25-45 years and those 18-25 years (16.3% versus 10.7% or 2.5%), higher prevalence in Hispanics and Asians compared to African Americans and whites (23.7% versus 16.2% versus 13.4%), higher prevalence in patients with combined back and neck pain compared to patients with thoracic pain only or back pain only (16.3% versus 8.2% to 11%). Prevalence also varied by body mass index (BMI): 32.4% in morbidly obese patients, 20.3% in severely obese patients, 15.7% in obese patients, 9.2% in those who were overweight, and only 5.7% in those with normal weight. A significant correlation with OSAS was also observed in patients smoking more than 40 pack years and multiple respiratory symptoms except for chronic bronchitis and multiple cardiovascular ailments.

Limitations: The retrospective nature of the assessment.

Conclusion: This retrospective assessment of over 4,000 patients suffering from chronic pain and receiving chronic opioid therapy indicated a prevalence of sleep apnea syndrome as 13.8%. Multiple risk factors including obesity, chronic obstructive pulmonary disease (COPD), chronic sinus and nasal discharge, and multiple comorbidities including cardiovascular and related ailments have been identified.

Key words: Obstructive sleep apnea syndrome, chronic pain, chronic spinal pain, chronic opioid therapy, obesity, smoking, cardiovascular risk factors, pulmonary risk factors

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Obststructive sleep apnea syndrome (OSAS) is a common sleep disorder with complete or partial airway obstruction, disrupted sleep, and excessive daytime sleepiness (1). Obstructive sleep apnea has been reported to be common and undiagnosed with significant health and health care consequences (2-5). Since its description in 1976 by Guilleminault et al (6), our understanding of sleep apnea syndrome has expanded with the publication of numerous epidemiologic studies and systematic reviews (1,2,7-21). In addition, multiple comorbidities related to cardiovascular sequelae with increase in morbidity and mortality, altered cognitive function with daytime sleepiness leading to motor vehicle crashes and occupational accidents, and description of multiple other potential complications have been established (1,2,7-21). Further, multiple risk factors have been described including obesity, smoking, alcohol consumption, and other factors (7,22-30). However, chronic pain and chronic opioid therapy, which have been characterized to constitute a large proportion of patients with OSAS (31-35), have not been widely discussed as risk factors (1,2,7-21). Chronic pain, obesity, smoking, and chronic opioid therapy are major health care issues and all conditions may present in a single patient in chronic pain management settings (36,37).

Obesity, defined as body mass index (BMI) of 30 or higher, has been described in approximately 80 million Americans and is associated with an increased risk of serious medical conditions including heart disease, diabetes, cancer, stroke, hypertension, arthritis, high blood pressure, and more (38). In the United States, more than 30% of adults and 17% of children are considered obese and these rates have been climbing steadily since 1980 (38). Similarly, tobacco abuse remains the single largest preventable cause of death and disease in the United States with almost half a million deaths each year with more than 41,000 of these deaths resulting from exposure to secondhand smoke (39). The costs of obesity and smoking have been skyrocketing, ranging from \$147 billion to nearly \$210 billion per year for obesity: \$14 billion in direct medical costs attributed to 21% of the medical costs to obesity (38). Similarly, smoking related illness in the United States costs more than \$300 billion a year, including nearly \$170 billion in direct medical care for adults and \$160 billion due to a loss in productivity (39,40). The prevalence of chronic pain and its associated disability (41-49) and chronic opioid therapy (50-65) with its adverse consequences continues to escalate in the United States and across

the globe. In addition to the escalating prevalence of chronic pain, the 400% increase in opioid consumption and the associated consequences including opioid-related deaths has been a major focus of policy makers in the United States (66). Chronic pain patients also present with multiple psychological disorders and often undergo drug therapy with multiple psychoactive substances including benzodiazepines, leading to a higher risk of many adverse consequences including OSAS (50,67-75).

The prevalence estimates have been highly variable for OSAS (1,76-89). Early population-based studies suggested the prevalence of OSAS as 4% in men and 2% in women (82) with the rate of prevalence ranging from 0.7% to 3.3% (82-86). However, it has been claimed obstructive sleep apnea is often asymptomatic and the prevalence of patients with OSAS who do not present with clinical syndromes might be as high as 20% to 30% in the middle-aged population (1,88). In fact, a review on the epidemiology of sleep apnea by Franklin and Lindberg (76) indicated daytime sleepiness occurred in 6% (range 3% to 18%) of men and 4% (1% to 17%) of women. They also showed that the prevalence of daytime sleepiness increased with time and OSAS was reported in 37% of men and 50% of women in studies from 2008 and 2013, respectively. In addition, obstructive sleep apnea was diagnosed in 35% to 57% of patients managed in long-term pain clinics (33). Farney et al (89), in a population of young, non-obese, long-term opioid users, found obstructive sleep apnea in 63% of patients on opioids, even though moderate obstructive sleep apnea was seen in 16% and severe sleep apnea was seen in 17% of the patients. Similar to opioid therapy, obesity is believed to predispose patients to obstructive sleep apnea because of mass loading in the upper airway. Sharkey et al (90) showed that OSAS is more common than central sleep apnea in methadone maintenance patients. Young et al (91) estimated that 58% of moderate to severe cases of obstructive sleep apnea are due to a BMI above 25. Smoking and related complications with chronic obstructive pulmonary disorders have been linked to high prevalence of obstructive sleep apnea (76) due to possible airway inflammation and sleep instability from overnight nicotine withdrawal. The prevalence of smoking in patients with obstructive sleep apnea was found to be 35%, whereas it was only 18% in patients without obstructive sleep apnea. Thus, considering that many patients in chronic pain settings are middle aged, take opioids and benzodiazepines, and are obese and

smoke, it is logical that a large proportion of chronic pain patients suffer with OSAS. However, in clinical practice, we have not observed such high occurrence of symptomatic OSAS; consequently, we have undertaken this retrospective assessment to facilitate a prospective evaluation to assess symptomatic OSAS in chronic spinal pain patients.

METHODS

This retrospective assessment, based on the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (92), was conducted in the United States in a private interventional pain management practice, a specialty referral center. Approval from the Institutional Review Board (IRB) was not required since only data collection without identification of patients was involved. The study was conducted with internal resources of the practice without any external funding.

All new patients were given an explanation of the initial evaluation and the information collection process. Informed consent was obtained from all patients prior to assessment. Appropriate precautions were taken to protect the privacy of all patients and full confidentiality was maintained.

The inclusion criteria were that patients be over 18 years of age and had been referred to a pain management center with spinal pain that lasted for at least one year. In addition, patients must be willing to undergo the appropriate assessment and must be able to provide voluntary written informed consent for the evaluation. Exclusion criteria included an inability to understand the process, pain of less than a one-year duration, non-spinal pain, and patients unwilling to participate in the evaluation process.

As standard protocol dictates, a complete medical history was obtained from patients, which included 15 systems: skin, hematologic/lymphatic, head/face, eyes, ear/nose/mouth, chest/breast, respiratory, cardiac/peripheral vascular, hepatic – biliary/gastrointestinal/abdominal, urinary, genital/reproductive, endocrine, musculoskeletal, neurological/psychiatric. As part of the review of the respiratory system, all patients were asked if they suffered from multiple pulmonary ailments including OSAS or symptoms related to OSAS. Diagnosis of OSAS was confirmed by an accredited sleep lab.

Demographics of Sample

The sample in this study included 4,036 patients who were referred to a single private interventional

pain management center. All patients underwent evaluation by one of 2 physicians from January 2010 to December 2014. All patients aged 18 years and older were evaluated with a history, review of medical history, physical examination, psychological evaluation, review of records, urine drug testing, and collected demographics, weight, and height. These evaluations are a normal component of the comprehensive evaluation provided to patients at this clinic. No incentive, financial or otherwise, was provided to patients who were included in this study.

Statistical Methods

Statistical analysis was performed with IBM SPSS 22.0 for Windows packaged software. Univariate analysis and multivariate binary logistic regression analysis were performed to calculate the odds ratio and 95% confidence intervals for OSAS. Results were considered statistically significant if the P value was less than 0.05. Pack years is calculated by number of packs of cigarettes smoked per day multiplied by years of smoking.

RESULTS

Patient Demographics and Association of Obstructive Sleep Apnea Syndrome

The mean age was 48.8 + 13.6 years; mean weight was 195.5 + 54.5 lbs.; mean height was 66.9 + 4.1 inches; the mean BMI was 30.5 + 7.9 (Table 1). Of all the patients included in this study, approximately 57% (n = 2,314) were females and approximately 43% (n = 1,722) were male.

The prevalence of symptomatic and OSAS was 13.8% with no significant difference between the 2 physicians (14.7% vs 12.9%). As shown in Table 1, the prevalence of OSAS was significantly higher in males (15.1%) compared to females (12.8%). The prevalence of OSAS was higher in patients over 45 years of age (16.3%) and the prevalence of OSAS was lower in patients aged 18 - 24.9 years (2.5%). The prevalence of OSAS was greater in African American patients (16.2%) compared to white patients (13.4%).

OSAS is positively associated with number of pain problems (back or neck only or combined back and neck pain) and BMI. The prevalence of OSAS was higher in patients with combined back and neck symptoms (16.3%) rather than patients presenting with either thoracic pain only, neck pain only, or back pain only with a prevalence of 8.2% to 11.0%.

There was significant association between prevalence of OSAS and BMI. While the prevalence was shown

Table 1. Association between demographic characteristics and obstructive sleep apnea syndrome.

	Number	Obstructive sleep apnea syndrome (OSAS) absent	Obstructive sleep apnea syndrome (OSAS) present	Prevalence of obstructive sleep apnea syndrome (OSAS)	Odds of obstructive sleep apnea syndrome (OSAS)	Odds ratio compare to baseline (0)	P value
Gender							
Female	2,314	2,018	296	12.8%	0.147	1.000	0.038
Male	1,722	1,462	260	15.1%	0.178	1.212	
Age (years)							
18 – 24.9	120	117	3	2.5%	0.026	1.000	0.000
25 – 44.9	1,517	1,354	163	10.7%	0.120	4.709	
≥ 45	2,399	2,009	390	16.3%	0.194	7.594	
Race							
White	3,652	3,161	491	13.4%	0.155	1.000	0.075
African American	246	190	56	16.2%	0.295	2.168	
Hispanic and Asian	38	29	9	23.7%	0.310	2.282	
Chronic Pain							
Thoracic pain only	184	169	15	8.2%	0.089	1.000	0.000
Neck pain only	169	153	16	9.5%	0.105	1.178	
Back pain only	1,452	1,295	157	11.0%	0.121	1.366	
Back & neck	2,258	1,890	368	16.3%	0.195	2.194	
BMI							
Normal (< 25)	1,042	983	59	5.7%	0.060	1.00	0.00
Overweight (25 – 30)	1,180	1,072	108	9.2%	0.101	1.678	
Obese (> 30 – 35)	839	707	132	15.7%	0.187	3.111	
Severely obese (> 35 – 40)	477	380	97	20.3%	0.255	4.253	
Morbid obese (≥ 40)	487	329	158	32.4%	0.480	8.001	

Baseline is where coded value is 0.

to be 5.7% in patients with normal weight and BMI, it gradually increased to 9.2% in those who were overweight, 15.7% in those who were obese with a BMI of 30 to 35, 20.3% in those who were severely obese with a BMI of 35 to 40, and 32.4% in morbidly obese patients.

Correlation with Chronic Opioid and Benzodiazepine Treatment

Table 2 shows the correlation of prevalence of OSAS with chronic opioid therapy alone or a combination of opioid therapy and benzodiazepine therapy. The prevalence of OSAS was 10.5% in patients with chronic pain with no opioid or benzodiazepine therapy compared to 13.9% in patients receiving long-term opioids. In contrast, the prevalence of OSAS was 13.8% in patients receiving a combination of opioids and benzodiazepines, which is similar the prevalence in patients

receiving opioids alone.

Correlation with Smoking and Respiratory Disorders

As shown in Table 3, the prevalence of OSAS was 15.7% in nonsmokers and 13.3% in smokers. However, the mean age was 51.6 ± 15.7 in nonsmokers compared to the mean age of smokers of $48.1 + 12.92$, which may partly explain the higher prevalence in nonsmokers. Further, the ratio of male and female was also significantly different with a higher proportion of males. However, the frequency and level of smoking showed significant correlation with those smoking greater than 40 pack years with a significantly higher prevalence of OSAS at 16.3% compared to those smoking less than 40 pack years, where pack years is calculated by multiplying the number of packs of cigarettes smoked per day

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Table 2. Correlation of prevalence of obstructive sleep apnea syndrome with chronic opioid and/or benzodiazepine therapy.

	Obstructive sleep apnea syndrome (OSAS) absent	Obstructive sleep apnea syndrome (OSAS) present	Total
No opioid or benzodiazepine therapy	154	18 (10.5%)	172
Chronic opioid therapy	2,308	374 (13.9%)	2682
Chronic benzodiazepine therapy	15	4 (21.1%)	19
Combined opioid and benzodiazepine	1,003	160 (13.8%)	1163
Total	3,480	556 (13.8%)	4,036

$P < 0.475$

Table 3. Correlation of smoking and Obstructive sleep apnea syndrome.

	Number	Mean Age	Prevalence of obstructive sleep apnea syndrome (OSAS)	Odds of obstructive sleep apnea syndrome (OSAS)	Odds ratio compared to baseline (0)	P value
Smoking						
No	840	51.6 ± 15.7	15.7% (132)	0.1864	1.0000	0.072
Yes	3,196	48.1* ± 12.92	13.3% (424)	0.1530	0.8204	
Pack Years #						
< 20 pack years	1,060	40.6 ± 11.5	10.4% (110)	0.115789	1.0000	0.001
20 - 40 pack years	696	47.8 ± 9.9	10.2% (71)	0.1136	0.9811	
> 40 pack years	607	54.5* ± 9.5	16.3% (99)	0.194882	1.6831	

For 825 patients, pack years information was not available.

Pack years = packs of cigarettes smoked per day x years of smoking

by the number of years the person has smoked.

OSAS is positively associated with several respiratory problems, including nasal discharge, chronic sinus infections and allergies, bronchial asthma, emphysema, and chronic obstructive pulmonary disease (COPD) (Table 4). The prevalence of OSAS was higher in patients with sinus discharge, chronic sinus problems, bronchial asthma, emphysema, and finally, COPD. However, there was no significant difference in prevalence of OSAS between patients with or without chronic bronchitis as shown in Table 4.

As shown in Table 5, the prevalence of OSAS was significantly higher in patients with hypertension, hyperlipidemia, coronary artery disease (CAD), congestive heart failure or stroke, and those receiving antiplatelet therapy.

Assessment of Significant Correlates

Significant correlation of multiple factors with risk and comorbidity are illustrated in Table 6.

Based on the binary logistic regression analysis, the factors with a significant level of association with OSAS were age (Exp [B]: 1.009), BMI (Exp [B]: 1.088), gender (Exp [B]: 0.626), sinus or nasal discharge (Exp [B]: 1.571),

chronic sinus infections and allergies (Exp [B]: 1.832), COPD (Exp [B]: 1.441), hyperlipidemia (Exp [B]: 1.617), ASCVD/CAD (Exp [B]: 1.811), and history of congestive heart failure or stroke (Exp [B]: 1.988). However there was not a significant association with OSAS and smoking and chronic bronchitis.

DISCUSSION

The results of this assessment of over 4,000 patients in a chronic pain management center with spinal pain of longer than one year with the majority of them on chronic opioid therapy have shown the prevalence of symptomatic OSAS as 13.8%. The results also showed a higher prevalence in males compared to females (15.1% versus 12.8%), higher prevalence in those aged 45 or over compared to those younger than 45 (16.3% versus 10.7% or 2.5%), higher prevalence in Hispanics and Asians compared to African-Americans and whites (23.7% versus 16.2% versus 13.4%), higher prevalence in patients with combined back and neck pain than involvement of a single region (16.3% versus 8.2% - 11%), and 32.4% in morbidly obese patients, 20.3% in severely obese patients, 15.7% in obese patients, 9.2% in those who were overweight, and 5.7% in those who

Table 4. Correlation of respiratory disorders and obstructive sleep apnea syndrome.

	Number		Prevalence of obstructive sleep apnea syndrome (OSAS)	Odds of obstructive sleep apnea syndrome (OSAS)	Odds ratio compared to baseline (0)	P value
	No (0)	Yes (1)				
Sinus and nasal discharge	No (0)	2,748	11.3% (311)	0.127616	1.0000	0.000
	Yes (1)	1,288	19.0% (245)	0.234899	1.8407	
Chronic sinus infections/allergies	No (0)	3,252	11.8% (385)	0.134287	1.0000	0.000
	Yes (1)	784	21.8% (171)	0.278956	2.0773	
Bronchial asthma	No (0)	3,734	13.1% (491)	0.151403	1.0000	0.000
	Yes (1)	302	21.5% (65)	0.274262	1.8115	
Chronic bronchitis	No (0)	2,774	13.4% (371)	0.15439	1.0000	0.147
	Yes (1)	1,262	14.7% (185)	0.171773	1.1126	
Emphysema	No (0)	3,052	13.3% (405)	0.153003	1.0000	0.057
	Yes (1)	984	15.3% (151)	0.181273	1.1848	
Chronic obstructive pulmonary disease (COPD)	No (0)	3,234	11.9% (385)	0.135135	1.0000	0.000
	Yes (1)	802	21.3% (171)	0.270998	2.0054	

Table 5. Correlation of cardiac related disorders and obstructive sleep apnea syndrome.

	Number		Prevalence of obstructive sleep apnea syndrome (OSAS)	Odds of obstructive sleep apnea syndrome (OSAS)	Odds ratio compare to baseline (0)	P value
	No (0)	Yes (1)				
Hypertension	No (0)	2,475	10.1% (249)	0.11186	1.0000	0.000
	Yes (1)	1,561	19.7% (307)	0.244817	2.1886	
Hyperlipidemia	No (0)	3,131	10.5% (328)	1.0000	10.5%	0.000
	Yes (1)	905	25.2% (228)	2.8780	25.2%	
Atherosclerotic cardiovascular disease /CAD	No (0)	3,524	11.5% (405)	0.129849	1.0000	0.000
	Yes (1)	512	29.5% (151)	0.418283	3.2213	
H/o congestive heart failure/stroke	No (0)	3,855	12.8% (492)	0.146298	1.0000	0.000
	Yes (1)	181	35.4% (64)	0.547009	3.7390	
Anti-platelet therapy	No (0)	3,438	11.5% (396)	0.1302	1.0000	0.000
	Yes (1)	598	26.8% (160)	0.3653	2.8061	

were normal weight. In addition, there was a significant correlation between pack-years and OSAS, even though the prevalence of OSAS was not higher in smokers compared to nonsmokers. There was a correlation between OSAS and patients with multiple respiratory problems including sinus and nasal discharge, chronic sinus infections or allergies, bronchial asthma, emphysema, and COPD. However, there were no significant differences noted in patients with chronic bronchitis. The results also showed a significant positive correlation with hypertension, hyperlipidemia, CAD, history of congestive failure or stroke, and antiplatelet therapy with a higher prevalence of OSAS. These findings are consistent with previous reports (1,76-89,93-95) with in-

creasing age, male gender, obesity, COPD, and chronic pain, as well as opioid therapy alone, or opioid therapy with benzodiazepines.

As discussed earlier, the prevalence of OSAS is highly variable (1,76-89). Despite early studies suggesting the prevalence of OSAS ranges from 0.7% to 3.3% (82-86), the prevalence of asymptomatic OSAS might be as high as 20% to 30% (1,88). Franklin and Lindberg (76) showed that the prevalence increased with time, with prevalence reaching 37% in men and 50% in women, and the prevalence of obstructive sleep apnea defined at an apnea-hypopnea index of greater than 5 was a mean of 22% (range 9% to 37%) in men and 17% (4% to 50%) in women in 11 published epidemiologi-

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Table 6. Assessment of significant correlation among multiple risk factors and comorbidities with obstructive sleep apnea syndrome.

	B	SE	Wald	df	Sig.	Exp (B)	95% CI for Exp (B)	
							Lower	Upper
Age (Years)	.009	.004	3.882	1	0.049	1.009	1.000	1.017
BMI	.085	.006	190.184	1	0.000	1.088	1.075	1.101
Gender	-.469	.104	20.385	1	0.000	0.626	0.510	0.767
Smoking	.096	.125	.590	1	0.442	1.101	0.861	1.408
Sinus or nasal discharge	.452	.103	19.133	1	0.000	1.571	1.283	1.924
Infections or allergies	.606	.115	27.747	1	0.000	1.832	1.463	2.295
Bronchial asthma	.115	.172	.446	1	0.504	1.122	0.801	1.572
Chronic bronchitis	-.047	.119	.158	1	0.691	0.954	0.755	1.205
Emphysema								
COPD	.366	.127	8.282	1	0.004	1.441	1.124	1.849
Hypertension	.060	.109	.303	1	0.582	1.062	0.858	1.315
Hyperlipidemia	.481	.115	17.536	1	0.000	1.617	1.291	2.026
CAD	.594	.145	16.781	1	0.000	1.811	1.363	2.406
H/o congestive heart failure or stroke	.687	.188	13.349	1	0.000	1.988	1.375	2.875
Anti-platelet therapy	.237	.143	2.775	1	0.096	1.268	0.959	1.677
Constant	-5.534	.323	292.845	1	0.000	0.004		

B - the coefficient for the constant (also called the "intercept"), SE - Standard error around the coefficient for the constant, Wald - Wald chi-square test, Exp (B) - Exponentiation of the B coefficient, which is an odds ratio.

cal studies between 1993 and 2013. However, none of these studies have shown chronic pain or chronic opioid therapy as risk factors. Guillemineault et al (33) showed that the majority of patients were found to have sleep-disorder breathing, whereas, Farney et al (89) found obstructive sleep apnea in 63% of patients on opioids, with severe sleep apnea in 17% of the patients and moderate sleep apnea in 16% of the patients. In methadone users, obstructive sleep apnea was diagnosed in 35% of the patients (90), with another study contradicting these results without any significant increase in sleep apnea in another group of patients (96). Further, in fibromyalgia patients (97), obstructive sleep apnea was shown to have an incidence of 10-fold higher than in the normal population. In another study of patients with chronic neck or low back pain (81), high sleep deprivation was seen in 42% of the patients even though obstructive sleep apnea was not assessed. Further, studies in patients with headaches showed no significant differences with occurrence of sleep apnea syndrome (55). Our study shows a modest prevalence of sleep apnea in patients with chronic low back and neck pain with a higher prevalence in patients with pain in multiple regions, and a prevalence of 16.3% in patients with back and neck pain compared to 8.2% with tho-

racic pain only, 9.5% with neck pain only, and 11% in those with back pain only.

In this study, we are unable to determine the differences between chronic pain patients with or without opioid therapy since an overwhelming majority of the patients were on chronic opioid therapy and a significant proportion were on chronic benzodiazepines and opioid combination therapy. In a small number of patients without opioid or benzodiazepine therapy (154 of 4,032 patients), the prevalence was shown to be 10.5% compared to those with chronic opioid therapy or combined opioid and benzodiazepine therapy at almost 14%. Overall this study may not resolve the issue in relation to the association of chronic pain or chronic pain with chronic opioid therapy.

Epidemiologic studies report the prevalence of OSAS as almost 8 times greater in patients over 45 years compared to patients 18 - 24.9 years (1,76-89, 93-95). Age was a marginally significant predictor in the binary logistic regression analysis. The effect of age is of particular interest as some research suggests that the nature of sleep disorders is distinct depending on the age group, with middle and older age groups exhibiting a higher prevalence of central events and more severe cases of sleep apnea occurring in the young

(95). Furthermore, sleep-related problems in older populations may be a natural part of the aging process without a serious increased risk of mortality or morbidity (98). Gender is also a risk factor for OSAS, with a higher prevalence in male patients compared to female patients. In addition, gender was a significant predictor in the regression model.

Higher levels of BMI were associated with a higher prevalence of OSAS and BMI was also a significant predictor in the regression model, in accordance with previous studies (91,99). These findings are important in chronic pain management settings. A large proportion (74%) of patients are either overweight or obese and the data from this study shows approximately a quarter of patients were either severely obese or morbidly obese. Further, prevalence of OSAS was 20.3% in severely obese patients and 32.4% in morbidly obese patients. Considering the significant impact of obesity and related medical costs, identification of sleep apnea syndrome and avoidance are crucial (38).

There is not a clear consensus on the effects of smoking on OSAS. Our results indicated that the prevalence of OSAS was greater in nonsmokers compared to smokers. In addition, smoking was not a significant predictor in the regression analysis (21,40). Previous studies have reported an increased prevalence of OSAS in smokers (16,89). However, patients who smoked greater than 40 pack years had a higher prevalence of OSAS compared to those who smoked less. It has been previously hypothesized that smoking increases the risk of OSAS through several mechanisms including airway inflammation and the effects of lowered blood nicotine levels on the stability of sleep.

In addition, multiple other factors showing higher prevalence included sinus or nasal discharge, chronic sinus infections or allergies, bronchial asthma, emphysema, COPD, hypertension, hyperlipidemia, CAD, history of congestive heart failure or stroke, and anti-platelet therapy. The literature on multiple factors in chronic pain is scant. These risk factors and subsequent

comorbidities may influence treatment options. There are many advantages to this assessment, along with multiple limitations. The advantages include a large sample size, chronic spinal pain patients with at least one year of duration of pain, chronic opioid therapy, and associated multiple comorbidities. The limitations include the retrospective nature of the analysis with a potentially higher prevalence of symptomatic OSAS, and even significantly higher proportion of asymptomatic obstructive sleep apnea or syndrome and lack of evaluation of patients with potential OSAS.

Overall, our results show a significantly lower prevalence of OSAS in spinal pain patients and also in patients undergoing chronic opioid therapy. This may be due to inclusion of a heterogenous sample with a large number of patients with or without OSAS and with or without chronic opioid therapy. The previous estimations utilized either specific patients selected with suspected OSAS, or smaller sample sizes. Considering a major triad of chronic pain, chronic opioid therapy, and obesity, with numerous adverse consequences and escalating health costs, physicians must be cautious in administering chronic opioid therapy in patients suspected of OSAS. In those who are diagnosed with sleep apnea syndrome, if chronic opioid therapy is administered, the patients must be monitored cautiously for any sleep disturbances including those of OSAS and the nighttime doses of opioids must be avoided. The results of this study are also important in that they are applicable to clinical settings of pain management with chronic opioid therapy.

CONCLUSION

This retrospective assessment of over 4,000 patients showed the prevalence of sleep apnea syndrome in 13.8% of the patients suffering with chronic pain and also receiving chronic opioid therapy. Multiple risk factors and comorbidities including obesity, COPD, chronic sinus and nasal discharge, and multiple comorbidities including cardiovascular and related ailments have been identified.

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