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Frequency and Correlates of Sleep Disturbance in Methadone and Buprenorphine-maintained Patients

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Abstract

Background—Opioid use disorder (OUD) is a significant public health problem, and opioid maintenance treatment (OMT) on methadone or buprenorphine is a common approach. This study characterized sleep impairment in patients maintained on methadone or buprenorphine, and evaluated its association with psychiatric and medical comorbidities.

Methods—Participants (N=185) maintained on methadone (N= 125) or buprenorphine (N=60) for OUD completed the Medical Outcomes Study Sleep Scale (MOS) to provide a point-prevalence assessment of sleep impairment. Measures of lifetime problems and current functioning were also examined and compared as both a function of OMT and level of sleep impairment.

Results—Participants reported high levels of sleep impairment on the MOS, including not getting the amount of sleep they needed (42.9%), not sleeping enough to feel rested (39.6%) and trouble falling asleep (23.3%) or falling back asleep after waking (25.8%). Few differences were observed between OMT groups, and psychiatric dysfunction emerged as the most robust predictor of sleep impairment ratings. Patients with sleep impairment, independent of OMT medications, also reported current opioid withdrawal, psychiatric impairment, negative affect, and pain.

Conclusions—Results demonstrate substantial and clinically-significant impairments in sleep that are associated with a variety of current problems that could impact OMT outcomes and decrease quality of life. Outcomes support the development of methods to improve sleep in OMT patients, and to examine the degree to which sleep improvements may be associated with improvements in mood and other health-related measures.

Keywords

opioid use disorder; sleep; methadone; buprenorphine; opioid maintenance treatment

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1. Introduction

Opioid misuse and abuse is a serious public health problem. Maintenance on an opioid agonist like methadone or buprenorphine is endorsed by the World Health Organization as an effective treatment for opioid use disorder (OUD) (World Health Organization, 2007) and is among the most common forms of treatment for this indication. More than 78,000 people in the United States initiated opioid maintenance treatment (OMT) with one of those medications in 2012 (Substance Abuse and Mental Health Services Administration (SAMHSA), Center for Behavioral Health Statistics and Quality, 2014). However, OMT patients continue to experience a host of concurrent psychiatric and medical comorbidities that may interfere with their treatment and/or increase their propensity for relapse, and there is value in understanding the breadth and severity of these issues to help develop supportive resources for this population.

Sleep disturbance is a primary characteristic of multiple substance use disorder syndromes, including OUD (Barth et al., 2013; Caviness, Anderson, de Dios, Kurth, & Stein, 2013; Garcia & Salloum, 2015). Relative to healthy controls (8.8%), significantly more individuals with OUD (80.6%) have ratings ≥5 on the Pittsburgh Sleep Quality Index, indicative of poor sleep quality (Hartwell, Pfeifer, McCauley, Moran-Santa Maria, & Back, 2014), which has also been verified objectively through polysomnography (PSG) testing (Kay, Eisenstein, & Jasinski, 1969; Kay, 1975; Xiao et al., 2010). Sleep disturbance is evident among patients who are newly enrolled into OMT (Burke et al., 2008; Nordmann et al., 2016), as well as long-term OMT patients (Stein et al., 2004). Longitudinal evaluations suggest sleep does not naturally improve over the course of methadone treatment (Nordmann et al., 2016; Peles, Schreiber, Hamburger, & Adelson, 2011) and that sleep may in fact worsen, with the development of central sleep apnea in some patients (Wang et al., 2005).

Previous studies of sleep in OUD patients have also reported associations between sleep impairment and psychiatric comorbidities (Peles, Schreiber, & Adelson, 2006; Stein et al., 2004), however those data were collected in the context of a single clinic and were restricted to methadone-maintained patients. To date, no studies have reported on the sleep characteristics and related comorbidities of buprenorphine-maintained patients. Maintenance medication type is an important distinction for several reasons. First, evidence suggests methadone and buprenorphine treatment modalities may draw different types of patients. Relative to methadone-maintained patients, buprenorphine-maintained patients are more likely to be male, employed, have health insurance, and have milder levels of OUD (e.g., shorter use and treatment histories, less injection drug use, primary prescription opioid users) (Fingerhood, King, Brooner, & Rastegar, 2014; Sullivan, Chawarski, O'Connor, Schottenfeld, & Fiellin, 2005). Second, the fact that buprenorphine is often prescribed from primary care settings suggests those patients may also have greater access to concurrent sleep treatments and pharmacotherapies. Finally, the pharmacological differences between methadone and buprenorphine could impact sleep quality. Specifically, methadone is a full agonist at the mu opioid receptor, whereas buprenorphine is a partial agonist at the mu opioid and ORL-1 receptors and a partial antagonist at the kappa receptor. Preclinical studies report that mu receptor agonists directly inhibit rapid eye movement (REM) (Cronin, Keifer,

Baghdoyan, & Lydic, 1995) and slow wave (Dimsdale, Norman, DeJardin, & Wallace, 2007) sleep, so differences in mu receptor properties between methadone and buprenorphine could theoretically influence sleep quantity and quality.

The present study sought to characterize the self-reported sleep profiles of community-based patients maintained on methadone or buprenorphine for the treatment of OUD and to examine the association between sleep impairment and psychiatric, drug use, and medical comorbidities. The study also examined whether associations varied systematically between methadone and buprenorphine-maintained participants. These data will help to further characterize the breadth and severity of sleep impairment among OMT patients.

2. Methods

2.1 Participants

Participants were recruited between 4/2012 and 2/2014 from eight different methadone and buprenorphine OMT providers in Baltimore, MD. Individuals who were under 18 years of age, not receiving methadone or buprenorphine for the treatment of OUD, or not fluent in English were excluded. A total of 201 individuals completed the survey; of these eight answered “yes” to the quality control question “Have you completed this survey before”, three did not indicate their OMT type, and five did not answer all questions on the MOS (preventing subscale calculations); resulting in a final sample size of 185. This study was approved by the Johns Hopkins IRB and a waiver of written informed consent was obtained.

2.2 Study Procedures

Staff members set up stations within the OMTs that advertised a survey opportunity on health behaviors. Interested patients from within the OMT were provided with self-report surveys to complete, and were compensated up to $10 in cash or giftcards for participation. Study staff were available to help answer questions and read items to participants with low literacy. All surveys were completed in a single session; patients were not allowed to take surveys home for completion. Measures collected information regarding lifetime history (demographics, medical/psychiatric diagnoses) as well as current (ranging from past 30-day to today) experiences.

2.3 Measures

2.3.1 Demographic and Drug Use Questionnaire—Participants completed a brief demographic and drug use questionnaire to help characterize the sample. Past 30-day self-reported illicit drug use and OMT dose were collected but omitted from the analyses due to a large portion of participants not answering those questions.

2.3.2 Medical and Psychiatric Diagnoses—Participants were asked to indicate whether they been diagnosed with one of 61 potential medical or psychiatric problems in their lifetime. The list of psychiatric diagnoses included mood and non-mood disorders that are known to have high prevalence in OMT patients but was not meant to be exhaustive. Diagnoses were categorized into systems and the dichotomous endorsement (yes/no) of any medical condition within each system was included in the analyses.

2.3.3 Medical Outcomes Study (MOS) Sleep Scale—The MOS Sleep Scale is a 12-item self-report measure that assesses sleep retrospectively over the past 30 days. Participants are asked how long it takes them to fall asleep on an ordinal scale and to write in the number of hours they slept each night. Ten additional questions are rated on a 6-point Likert scale ("All of the Time" to "None of the Time"). The MOS Sleep Scale yields a rating of hours slept per night and seven subscales: Sleep Disturbance, Snoring, Sleep Short of Breath or Headache, Sleep Adequacy, Somnolence, Sleep Problems Index I, and Sleep Problems Index II. The MOS Sleep Scale has strong psychometric properties that were derived from a representative sample of men and women in the United States (Allen, Kosinski, Hill-Zabala, & Calloway, 2009; Hays, Martin, Sesti, & Spritzer, 2005) and has been used previously to characterize sleep outcomes within methadone-maintained patients (Burke et al., 2008). Normative values are available and provided for each subscale (see Table 2), and more information regarding the constitution of specific scales are available in the MOS Scoring Manual (Spritzer & Hays, 2003).

2.3.4 Subjective Opiate Withdrawal Scale (SOWS) (Handelsman et al., 1987)—The SOWS is a self-report instrument that rates current opioid withdrawal across 16 potential symptoms using a 5-point Likert scale ("Not At All" to "Extremely"). Values are summed to create a total severity score (range 0-64). The SOWS was used to provide a point-prevalence assessment of acute opioid withdrawal and was evaluated as a potential correlate of sleep impairment.

2.3.5 Symptom-Checklist 10R (SCL-10R) (Rosen et al., 2000)—The SCL-10R is a brief self-report instrument derived from the SCL-90, and provides an assessment of past 30-day psychiatric functioning on a 5-point Likert scale ("Not At All" to "Extremely"). Values are summed to create a total severity score (range 0-40). The SCL-10R was used to provide a point-prevalence assessment of current psychiatric impairment, and was evaluated as a potential correlate with sleep impairment.

2.3.6 Brief Pain Inventory (BPI) (Cleeland & Ryan, 1994)—The BPI is a 9-item, widely-used, standardized self-report measure of chronic pain (defined as pain over the past 3 months) as well as current pain and pain-related interference. Values are averaged into severity (range 0-10) and interference (range 0-10) subscales.

2.3.7. Positive and Negative Affective Scale (PANAS) (D. Watson, Clark, & Tellegen, 1988)—The PANAS is a 20-item self-report measure that yields ratings of past week positive and negative affective symptoms. Items are rated on a 5-point Likert scale ("Very slightly or not at all" to "Extremely"). Values are summed into positive (range 0-50) and negative (0-50) affective subscales.

2.4 Data Analysis

Data are presented descriptively to characterize sleep impairment in this OMT sample. MOS items were summed into subscale scores, and individual items were then recoded as a dichotomous variable to evaluate the percent of participants who endorsed a maximum level of severity rating for each item. Maximum severity was derived for the ten Likert rated items

and defined as endorsing “all of the time” or “most of the time” for eight of the ten items, and “a little of the time” or “none of the time” for the other two items (Table 2).

Summary scale values were derived for each participant for each of the remaining scales administered. Summary values are presented as a function of the total group and then as a function of methadone and buprenorphine participants. Between-group comparisons were conducted using independent groups t-tests for continuous variables and Chi-squares for categorical variables. Due to the lack of significant differences between the methadone and buprenorphine-maintained patients, the participant samples were collapsed together and Pearson Product correlations were used to evaluate associations between demographic, drug use, and self-report scale ratings with MOS sleep subscale outcomes. Linear regressions for each MOS subscale score were then conducted to evaluate the relative contribution that each correlated variable may have those ratings. Only items that were significantly correlated with each scale were included in the regression models.

In addition, to further explore the association between sleep impairment and collateral medical and psychiatric problems, participants were collapsed across OMT type and dichotomized based upon their Sleep Problem Index II results into those with (≥40) and without (<40) sleep impairment. This threshold was determined based upon a median split of the data, which Receiver Operating Curve analyses of normative data from the Sleep Problem Index II scale indicates has 88.6% specificity and 61% sensitivity for detecting sleep impairment. Between-group comparisons were conducted using independent groups t-tests for continuous and chi-squares for categorical measures. Finally, since the presence of psychiatric disorders was observed to vary significantly between the sleep groups on several measures (as reported below), the specific nature of the psychiatric illness was compared between sleep subgroups using chi-square analyses.

All analyses were conducted with SPSS v. 21, alpha was set at 0.05, and no corrections for missing data were made due to a low percentage of missing data.

3. Results

3.1 Overall Sample

Participants were 47.8% male, had a mean (SD) age of 46.1 (10.1) years, and were 41.6% Caucasian (Table 1). A total of 67.6% (N=125) patients were receiving methadone and 32.4% (N=60) participants were receiving buprenorphine. Participants reported being enrolled in OMT for a mean (SD) of 4.8 (5.3) years, and their mean SOWS rating was 13.9 (13.8) at the time of survey completion (representing mild -moderate opioid withdrawal). Methadone participants were significantly more likely to be injection drug users, had been in treatment for longer durations of time, and had lower ratings on the PANAS Positive Affect scale compared to buprenorphine participants (Table 1).

Overall, participants endorsed high levels of past 30-day sleep impairment on the MOS. Evaluation of time to fall asleep showed participants needed 0-30 minutes (46.5% of participants), 31-60 minutes (30.1%), or more than 60 minutes (23.3%) to fall asleep, and participants reported sleeping a mean (SD) of 5.6 (2.2) hours per night. As shown in Table 2,

9.8% – 42.1% of participants endorsed the highest level of impairment on the individual MOS items. The items endorsed by the largest number of participants included not getting the amount of sleep they needed (42.9%), not getting enough sleep to feel rested (39.6%), and problems with falling asleep (23.3%) or falling back asleep after waking up (25.8%).

3.2 Comparison of Sleep in Methadone and Buprenorphine OMT patients

No significant differences in the percent of methadone and buprenorphine participants who reported needing 0-30 minutes (47.8% vs. 45.9%); 31-60 minutes (28.9% vs. 30.6%) and more than 60 minutes (23.3% vs. 23.5%) of time to fall asleep, were observed, respectively (Table 2). Further, no significant differences were evident regarding the percent of participants who reported severe impairment on the individual MOS items, with the exception that more methadone participants reported feeling drowsy throughout the day relative to buprenorphine participants (25.5% vs. 12.2%, p=0.02). However, several variables trended closely towards significance, including not getting enough sleep to feel rested (p=0.06), awakening short of breath or with a headache (p=0.06), snoring during sleep (p=0.08), and not getting the amount of sleep they feel they need (p=0.08). Analyses of the MOS subscales revealed no significant between-group effects.

3.3 Correlates of Sleep Impairment

Table 3 reports correlates with MOS subscale scores, collapsed across methadone and buprenorphine participants. MOS subscale scores were not generally correlated with demographic and drug use variables, however were highly correlated with the SOWS total score, the SCL-10R, and the PANAS Negative Affect Scale. Of the correlated the items, regressions revealed the single most robust contributor to the MOS outcomes were ratings on the SCL-10R. For instance, the Sleep Disturbance regression was significant (R^2=0.30, F(4,173)=18.86, p<.01) and indicated that SCL-10R (b=0.50, t(173)=4.44, p<.001) and having pain (b=0.16, t(173)=2.52, p=.01) were significantly associated with the outcomes. The SCL-10R was the only significant contributor to the Sleep Short of Breath or Headache (R^2=0.23, F(5,165)=10.02, p<.01; b=0.26, t(165)=2.19, p=0.03), Somnolence (R^2=0.26, F(3,177)=21.13 p<.001; b=0.43, t(177)=3.75, p<.01), Sleep Problems I (R^2=0.31, F(4,171)=20.44, p<.01; b=0.51, t(171)=4.59, p<.001), and Sleep Problems II (R^2=0.35, F(4,171)=23.33, p<.01; b=0.56, t(171)=5.11, p<.01) scales. Only two scales deviated away from SCL-10R. The first was the Sleep Adequacy (R^2=0.11, F(2,177)=11.35, p<.01) scale that was driven by duration in treatment (b=-0.16, t(177)=-2.29, p=0.02) and ratings on the PANAS positive subscale (b=-0.30, t(177)=-4.23, p<.01). The second was the number of hours slept per night (R^2=0.09, F(4,158)=.06, p<.01) which was driven by the PANAS positive subscale (b=0.2, t(158)=3.14, p<.01). While the regressions for the Snoring scale was significant, none of the correlated variables were significantly associated with outcomes.

3.4 Comparison of Participants With and Without Impaired Sleep

Collapsed across OMT type, a total of 51.3% (N=95) patients were categorized as having sleep problems based upon their responses to the Sleep Problem Index II. Significantly more participants with sleep impairment reported a history of medical and psychiatric problems, including history of cancer, endocrine disorder, hepatitis, injury, psychiatric disorder,

reproductive disorder, and respiratory disorders (Table 1). Further exploration of psychiatric illness revealed that participants with sleep impairment were more likely to report having been previously diagnosed with depression (67.4 vs. 41.1; χ^2=11.4, p=0.001), obsessive compulsive disorder (21.1 vs. 5.5; χ^2=9.7, p<.01), panic disorder (34.7 vs. 21.1; $\chi^{24.1}$, p=0.03), and post-traumatic stress disorder (23.2% vs. 5.6%; χ^2=11.5, p=0.001), relative to participants without sleep impairment, respectively. No between-group differences were observed in non-mood or anxiety disorder psychiatric diagnoses (e.g., ADHD, antisocial personality disorder, schizophrenia). Finally, participants with sleep impairment also endorsed experiencing several more current problems, including significantly higher opioid withdrawal ratings on the SOWS (18.9 vs. 9.6), greater psychiatric impairment based on the SCL-10R (7.0 vs. 5.6), more negative affect on the PANAS (24.3 vs. 16.8), and more severe pain (5.5 vs, 3.7) and pain-related interference (4.9 vs. 2.9) on the BPI, compared to participants without sleep impairment, respectively (Table 1).

4. Discussion

This study characterized self-reported sleep impairment in a large sample of participants maintained on either methadone or buprenorphine for the treatment of OUD. Results demonstrated that a substantial subpopulation of these participants endorsed significant problems with self-reported sleep, though level of sleep impairment did not vary significantly between the OMT groups. In contrast, between-group comparisons of sleep subgroups collapsed across OMT type indicated that participants with sleep impairment had been diagnosed with significantly more medical and psychiatric illnesses in their lifetime and also had more severe levels of current opioid withdrawal, psychiatric impairment, negative affect, and pain, compared to those who did not meet criteria for sleep impairment. Regression analyses revealed the most frequent correlate of poor sleep ratings were scores on the SCL-10R measure of psychiatric disturbance, and sleep subgroup analyses suggested this may have been driven by a greater prevalence of mood or anxiety disorders among participants with sleep impairment. Overall, these data suggest that a sizable portion of OMT patients are experiencing problems with sleep, that this is true for both methadone and buprenorphine-maintained patients, and that sleep problems are associated with both a history of medical/psychiatric problems as well as a variety of current problems that could negatively impact OMT treatment outcomes and overall quality of life. Results indicate that OMT patients with sleep impairment may be under significant distress, and provide support for identifying methods to address sleep problems in this population.

The finding that self-reported sleep is impaired among OUD patients adds to existing reports of poor sleep in this population (Burke et al., 2008; Nordmann et al., 2016; Peles et al., 2011). MOS subscale results from this study are highly consistent with previous characterizations of sleep impairment in methadone patients. The exception to this is the Sleep Adequacy subscale, which was substantially higher among participants in this study relative to a previous characterization of sleep in OUD patients with the MOS survey (Burke et al., 2008). That study compared methadone patient ratings on the MOS Sleep Scale to a normative sample and reported significantly higher impairment among methadone patients on the Sleep Problems Index, Sleep Disturbance, Somnolence, Sleep Short of Breath or Headache, Sleep Adequacy, and hours slept per night subscales relative to the normative

values; the Snoring subscale ratings in that study were consistent with normative values (Burke et al., 2008). Comparison of the current study to the normative ratings presented in Table 2 revealed higher ratings on all subscales except the Snoring and Sleep Adequacy subscales, suggesting this OMT sample has higher overall levels of sleep-related impairment relative to the general population.

Numerous variables, including the SCL-10R, SOWS ratings, BPI subscale scores, and PANAS subscale scores, were correlated with ratings on the MOS sleep scales in this study. These same variables were also rated as more severe among participants categorized as having sleep impairment relative to those without sleep impairment. Regression analyses revealed that psychiatric functioning, as measured by the SCL-10R, was the variable most frequently associated with MOS subscale scores when all correlated factors were considered. Psychiatric dysfunction is also highly associated with sleep impairment in the general population (Kallestad et al., 2012). Sleep subgroup comparisons suggest this effect may be driven by a greater prevalence of mood or anxiety disorders in patients with sleep impairment, however these results should be considered preliminary since this study did not use validated instruments to confirm self-reported mental disorders. Overall, these outcomes support additional research regarding the causal relationship that may exist between sleep impairment and psychiatric functioning in OMT patients. Evaluations of the degree to which interventions that reduce either psychiatric dysfunction or sleep impairment may also alleviate impairment in the corresponding domain would be of particular clinical value.

This is the first study, to our knowledge, to directly compare sleep impairment between methadone and buprenorphine-maintained patients. OMT groups did not differ significantly on most subscales of the MOS, though there was a trend towards differences for several items that suggested more sleep impairment in the methadone versus buprenorphine participants (including awakening short of breath or with a headache, snoring, and not feeling they had adequate sleep), in a manner consistent with sleep apnea. Although there were no significant differences in the percent of methadone and buprenorphine participants who reported a previous diagnosis of sleep apnea, a previous study found an association between weight gain in methadone patients and onset of sleep-disordered breathing (Peles et al., 2011). Future studies should aim to more thoroughly evaluate sleep-disordered breathing and its contribution to impaired sleep continuity among methadone and buprenorphine-maintained patients, using objective measures.

Methadone and buprenorphine treatments differ in many important ways that could impact their associations with sleep, including that each draws slightly different patient populations, provides differential access to concurrent treatments, and have pharmacological differences in their mechanisms of action. The degree to which sleep problems may have preceded or been caused by chronic opioid use and/or OMT is not known. However, preclinical and clinical data clearly demonstrates that provision of opioid agonists, including methadone and buprenorphine, directly interferes with sleep patterns (Cronin et al., 1995; Gauthier, Guzick, Brummett, Baghdoyan, & Lydic, 2011; Staedt et al., 1996; C. J. Watson, Lydic, & Baghdoyan, 2007), and that sleep quality is associated with differences in human endogenous opioid receptor binding potential (Campbell et al., 2013). These studies suggest that continued maintenance on an opioid agonist is likely to interfere with sleep, and the data

from this survey suggest that a relatively large percentage of OMT patients endorse sleep problems. Importantly, between-group comparisons of patients with and without sleep impairment revealed that patients with sleep impairment had significantly higher levels of current opioid withdrawal, psychiatric impairment, negative affect, and pain, suggesting this subgroup of OMT patients may be highly impaired. Though it is not possible from this study to determine the causal pathway of these associations, these results suggest that ratings of sleep impairment may be an important clinical tool for identifying patients who may be in vital need of further evaluation, support, and resources. Additional research regarding methods to reduce sleep impairment in OMT patients as well as the degree to which sleep improvements correlate with other positive treatment outcomes and quality of life improvements is warranted.

The strengths of this study include the characterization of sleep impairment in buprenorphine vs. methadone-maintained patients, and the comparison of outcomes across a wide-range of potential domains that may be associated with sleep impairment. This study is limited by the use of self-report measures, which prevent objective verification of variables, including specific OMT variables such as status in treatment, results of urinalysis testing, and OMT dose. Data were also a point-prevalence assessment so they are unable to inform changes in sleep over the course of treatment. Further, though psychiatric problems emerged as an important correlate to sleep impairment, this study did not fully explore all possible psychiatric disorders, so it cannot conduct a thorough characterization of this association. Finally, due to differences in sample sizes, this study may have been underpowered to detect strong between-group differences in sleep outcomes among methadone and buprenorphine-maintained patients.

5. Conclusion

Overall, these results provide additional evidence of sleep impairment among OMT patients and extend these impairments to buprenorphine-maintained patients. Results suggest that sleep impairment did not vary meaningfully between methadone and buprenorphine-maintained patients, but did indicate that OMT patients who have sleep impairment may be experiencing numerous additional problems that have the potential to negatively impact their OMT outcomes and reduce their overall quality of life. Sleep impairment was most highly associated with psychiatric dysfunction, though the direction of this effect is unknown and warrants further exploration. Ultimately, this study supports research into methods to reduce sleep impairment in OMT patients.

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Highlights

- Large numbers of opioid maintenance treatment (OMT) patients suffer from sleep impairment.
- Levels of impairment were similar between methadone and buprenorphine-maintained patients.
- Impairment was associated with several concurrent problems suggestive of substantial distress.
- Research to reduce sleep impairment in OMT patients is warranted.

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Table 1

Participant Characteristics[a]

	Total Sample	Methad one	Buprenorp hine		Sleep Proble ms	No Sleep Proble ms	
	(N=18)	(N=12)	(N=60)	p-value[b]	(N=9)	(N=9)	p-value[b]
Demographics							
Male (%)	47.8	47.2	48.3	0.56	42.1	53.3	0.08
Age (yrs)	46.1 (10.1)	46.1 (10.8)	46.1 (9.4)	0.98	46.3 (10.1)	45.9 (10.6)	0.76
Caucasian (%)	41.6	44.8	38.3	0.18	45.3	40.0	0.26
Married (%)	2.3	19.2	23.3	0.33	20	21.1	0.51
Employed (%)	22.5	20.0	25.0	0.30	16.8	26.7	0.07
Medical Conditions (%)							
Sleep Apnea	12.7	12.0	13.3	0.48	12.6	12.2	0.56
Cancer	4.5	7.2	1.7	0.11	10.5	0	**0.001**
Cardiovascular	41.5	36.0	46.7	0.11	42.1	36.7	0.27
Chronic Pain	50.7	48.0	53.3	0.30	55.8	43.3	0.06
Chronic Disease	31.1	27.2	35.0	0.18	33.7	25.6	0.15
Endocrine Disorder	16.7	18.4	15	0.36	23.2	11.1	**0.02**
Gastrointestinal Disorder	33.4	38.4	28.3	0.12	37.9	32.2	0.26
Hepatitis (A, B, C)	47.4	48.0	46.7	0.50	55.8	38.9	**0.02**
HIV/AIDS	16.9	10.4	23.3	0.02	17.9	11.1	0.14
Injury	80.9	80.0	81.7	0.48	86.3	74.4	**0.03**
Neurological	17.1	19.2	15	0.32	22.1	13.3	0.09
Obesity	10.6	12.8	8.3	0.26	12.6	10.0	0.37
Psychiatric Disorder	64.9	66.4	63.3	0.40	76.8	53.3	**0.001**
Renal Disorder	10.2	12.0	8.3	0.32	13.7	7.8	0.15
Reproductive Disorder	23.8	20.8	26.7	0.24	28.4	16.7	**0.04**
Respiratory Disorder	23.7	22.4	25	0.41	31.6	14.4	**0.01**
Drug Use Characteristics							
Injection Drug Use (%)	61.5	69.6	53.3	**0.02**	68.4	60.0	0.13

	Total Sample	Methad one	Buprenorp hine		Sleep Proble ms	No Sleep Proble ms	
	(N=18)	(N=12)	(N=60)	p-value[b]	(N=9)	(N=9)	p-value[b]
Duration in Treatment (yrs)	4.8 (5.3)	5.7 (5.9)	3.8 (4.6)	**0.03**	5.1 (6.1)	5.0 (4.9)	0.94
SOWS (range 0-64)	13.9 (13.8)	15.3 (13.7)	12.4 (13.9)	0.18	18.9 (13.8)	9.6 (12.1)	**<.001**
SCL-10R (range 0-40)	9.9 (10.0)	10.3 (9.9)	9.5 (10.1)	0.61	7.0 (10.5)	5.6 (14.3)	**<.001**
PANAS Positive Affect	27.8 (9.0)	25.2 (8.6)	30.4 (9.3)	**<.001**	26.4 (7.9)	27.4 (10.3)	0.44
PANAS Negative Affect	20.5 (9.3)	21.0 (8.6)	19.9 (9.9)	0.42	24.3 (9.5)	16.8 (6.7)	**<.001**
BPI Severity Score (range 0-10)	4.5 (2.8)	4.9 (2.5)	4.1 (3.1)	0.054	5.5 (2.5)	3.7 (2.7)	**<.001**
BPI Interference Score (range 0-10)	4.0 (2.8)	4.0 (2.6)	3.9 (3.0)	0.08	4.9 (2.5)	2.9 (2.6)	**<.001**

[a]Sleep problems defined as ≥40 rating on the Sleep Problem Index II. Values represent mean (SD) unless otherwise indicated. All values based upon self-report. SOWS=Subjective Opiate Withdrawal Scale; SCL-10R= Symptom Checklist 10 Revised; PANAS=Positive and Negative Affect Scale; BPI= Brief Pain Inventory

[b]p-values based upon independent groups t-tests for continuous and Chi-squares for dichotomous variables

Table 2
MOS Sleep Scale Impairment Ratings

	Total Sample (N=185)	Methadone (N=125)	Buprenorph ine (N=60)	p-value
Individual Items				
How long did it take to fall asleep (%)				
0-30 minutes	46.5	47.8	45.9	0.96
31-60 minutes	30.1	28.9	30.6	
More than 60 minutes	23.3	23.3	23.5	
Hours slept per night (mean, SD)	5.6 (2.2)	5.3 (2.1)	5.8 (2.3)	0.15
Maximum Impairment (% participants endorsing)				
Feel sleep was NOT quiet[a]	16.8	20.2	18.9	0.48
Get enough sleep to feel rested[b]	39.6	49.9	35.6	0.06
Awaken short of breath or with a headache[a]	9.8	19.1	10.0	0.06
Feel drowsy or sleeping during the day[a]	14.8	25.5	12.2	**0.02**
Have trouble falling asleep[a]	23.3	29.8	22.2	0.16
Awaken during sleep and have trouble falling back asleep[a]	25.8	29.8	23.6	0.22
Have trouble staying awake during the day[a]	16.9	26.9	17.8	0.10
Snore during sleep[a]	18.1	28.0	18.0	0.08
Take naps (>5 mins) during the day[a]	12.2	17.4	13.5	0.30
Get the amount of sleep you need[b]	42.1	50.5	38.9	0.08
MOS Subscales (mean, SD)[c]				
Sleep Disturbance (normative ratings: 29.2 (23.4))	37.9 (26.7)	37.6 (26.9)	38.2 (26.7)	0.88
Snoring (normative ratings: 30.9 (30.1))	32.9 (33.7)	34.9 (33.3)	30.8 (34.1)	0.42
Sleep Short of Breath or Headache (normative ratings: 13.3 (21.8))	23.2 (29.3)	26.6 (30.3)	19.6 (28.0)	0.10
Sleep Adequacy (normative ratings: 60.7 (25.4))	60.1 (26.5)	61.8 (27.0)	58.4 (26.0)	0.38
Somnolence (normative ratings: 26.4 (19.8))	34.0 (24.8)	33.6 (25.6)	34.5 (24.1)	0.81
Sleep Problems Index I (normative ratings: 28.3 (18.1))	44.1 (19.0)	45.6 (19.1)	42.5 (18.8)	0.27
Sleep Problems Index II (normative ratings: 29.2 (18.0))	40.7 (18.9)	41.2 (19.2)	40.0 (18.7)	0.67

p-values based upon independent groups t-tests for continuous and Chi-squares for dichotomous variables

[a]Percent of participants answering “All of the time” or “Most of the time”

[b]Percent of participants answering “A little of the time” or “None of the time”

[c]Normative means taken from MOS Sleep Scale Manual and represent Medical Outcomes Study Results (N=3445)

Table 3

MOS Sleep Scale Correlations

	MOS Sleep Subscales							
	Sleep Disturbance	**Snoring**	**Sleep Short of Breath or Headache**	**Sleep Adequacy**	**Somnolence**	**Sleep Problems Index I**	**Sleep Problems Index II**	**Hours Slept Per Night**
Male	-0.18 *	0.02	-0.13	-0.03	-0.07	-0.16 *	-0.17 *	0.02
Age in Years	-0.03	0.11	0.03	-0.07	0.03	-0.04	-0.02	-0.01
Caucasian	0.13	0.09	0.01	0.07	-0.08	0.04	0.08	0.08
History of IV Drug Use	0.07	0.05	0.03	0.15 *	0.15	0.14	0.13	-0.02
OMT Type	0.01	0.00	-0.02	-0.08	-0.02	-0.08	-0.04	0.19 *
Duration in Treatment	-0.09	-0.03	0.09	-0.15 *	0.03	-0.09	-0.08	0.09
SOWS Score	0.36 **	0.19 *	0.43 **	-0.01	0.38 **	0.40 **	0.40 **	-0.21 **
SCL-10R Total Score	0.54 **	0.25 **	0.46 **	0.08	0.52 **	0.57 **	0.60 **	-0.18 *
Number of Medical Conditions	0.37 **	0.23 **	0.31 **	0.04	0.31 **	0.33 **	0.39 **	-0.06
Presence of Chronic Pain	0.18 *	0.07	0.11	0.04	0.05	0.10	0.17 *	-0.05
BPI Severity	0.36 **	0.20 **	0.30 **	0.02	0.37 **	0.37 **	0.39 **	-0.25 **
BPI Interference	0.46 **	0.17 *	0.33 **	0.00	0.30 **	0.40 **	0.45 **	-0.20 *
PANAS Positive Scale	0.01	-0.04	-0.01	-0.33 **	0.09	-0.10	-0.07	0.25 **
PANAS Negative Scale	0.49 **	0.23 **	0.40 **	0.03	0.47 **	0.49 **	0.52 **	-0.12

Significant correlations (2-tailed) designated as

* (0.05) and

** (0.01) level.

MOS=Medical Outcomes Survey Sleep Scale; IV=Intravenous; OMT= opioid maintenance treatment, SOWS=Subjective Opiate Withdrawal Scale; SCL-10R= Symptom Checklist 10 Revised; BPI= Brief Pain Inventory; PANAS=Positive and Negative Affect Scale