The Journal of Arthroplasty 39 (2024) 1474–1479

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Primary Hip and Knee Arthroplasty

# Perioperative Sleep Quality Disturbances in Total Joint Arthroplasty is Multifactorial

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ARTICLE INFO

*Article history:*
Received 17 April 2023
Received in revised form
1 December 2023
Accepted 4 December 2023
Available online 8 December 2023

*Keywords:*
sleep quality
sleep disturbance
opioid use
TKA
THA

ABSTRACT

*Background:* Sleep quality following arthroplasty procedures is important for patient recovery and satisfaction, but remains poorly understood. The purpose of this study was to report risk factors for sleep disturbances in the perioperative period in patients undergoing primary total joint arthroplasty procedures.

*Methods:* Sleep surveys were prospectively collected on 751 consecutive patients undergoing total joint arthroplasty at our institution between June 2019 and February 2021 at their preoperative and postoperative visits (2 and 6 weeks). Data were collected on patient demographics, opioid use (preoperatively and postoperatively) as well as tobacco and alcohol use, and specific medical diagnosis that may influence sleep patterns (ie, depression). Statistical analyses were performed using the Student's *t*-tests and 1-way analysis of variances.

*Results:* For both total hip and total knee patients, worse sleep patterns preoperatively were found in patients who used opioids prior to surgery ($P < .001$), were current smokers ($P < .001$), and were aged less than 65 years ($P < .001$). Postoperative persistent opioid use (more than 3 months) was seen in patients who had worse reported sleep quality preoperatively ($P < .001$). In comparison to total hip arthroplasty, patients who underwent total knee arthroplasty were more likely to report less sleep in the postoperative period. Patients who were current smokers (compared to nonsmokers or previous smokers) ($P = .014$) had worse sleep quality at all time points that persisted at 6 weeks, although these differences were seen more in total hip patients than in total knee patients ($P = .006$ versus $P = .059$).

*Conclusions:* Sleep quality disturbances around the time of surgery appear to be multifactorial.

*Level of Evidence:* Therapeutic Level III.

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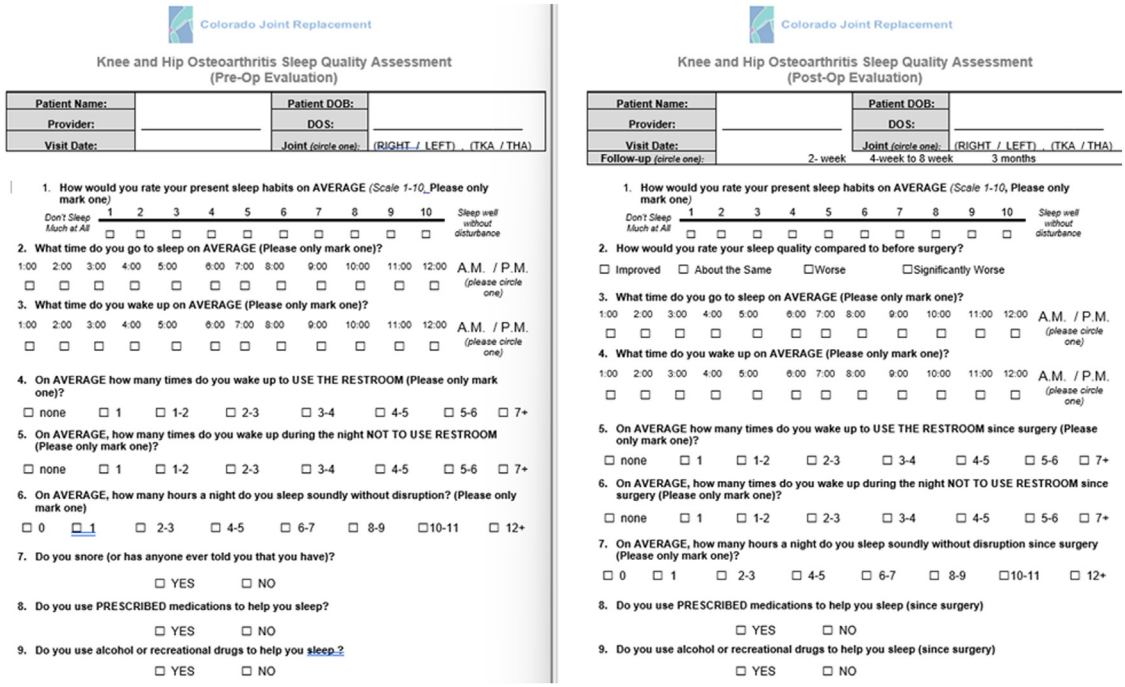
As the incidence of total joint arthroplasty (TJA) continues to grow, there simultaneously has been an international drive to bring down medical costs. It is therefore the duty of all orthopedic surgeons to bring the best value to their patients. To do so, there is a continued push to improve quality metrics and patient-reported outcomes [1]. While pain relief is often a central driver, it is important to look at all aspects of a patient's recovery to improve their final result [2]. This is vitally important as subjective measures of patient well-being have proven to lag objective measures of physical function, such as range of motion and pain levels [3,4].

One area that is frequently overlooked is the patient's ability to restore the normal physiologic process of sleep. Sleep affects both patient's physical and mental health [5]. When there are disturbances, including difficulties with timing, duration, and quality, poor sleep can affect many aspects of the patient's recovery, including but not limited to anxiety, depression, and pain sensitization [6,7]. Sleep quality, however, around the time of arthroplasty procedures is poorly understood [8–10].

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to https://doi.org/10.1016/j.arth.2023.12.009.

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https://doi.org/10.1016/j.arth.2023.12.009
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Colorado Joint Replacement

Knee and Hip Osteoarthritis Sleep Quality Assessment
(Pre-Op Evaluation)

| Patient Name: | | Patient DOB: | |
|---|---|---|---|
| Provider: | | DOS: | |
| Visit Date: | | Joint (circle one): | (RIGHT / LEFT) , (TKA / THA) |

1. How would you rate your present sleep habits on AVERAGE (Scale 1-10, Please only mark one)
Don't Sleep Much at All 1 2 3 4 5 6 7 8 9 10 Sleep well without disturbance
2. What time do you go to sleep on AVERAGE (Please only mark one)?
1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 A.M. / P.M. (please circle one)
3. What time do you wake up on AVERAGE (Please only mark one)?
1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 A.M. / P.M. (please circle one)
4. On AVERAGE how many times do you wake up to USE THE RESTROOM (Please only mark one)?
☐ none ☐ 1 ☐ 1-2 ☐ 2-3 ☐ 3-4 ☐ 4-5 ☐ 5-6 ☐ 7+
5. On AVERAGE, how many times do you wake up during the night NOT TO USE RESTROOM (Please only mark one)?
☐ none ☐ 1 ☐ 1-2 ☐ 2-3 ☐ 3-4 ☐ 4-5 ☐ 5-6 ☐ 7+
6. On AVERAGE, how many hours a night do you sleep soundly without disruption? (Please only mark one)
☐ 0 ☐ 1 ☐ 2-3 ☐ 4-5 ☐ 6-7 ☐ 8-9 ☐10-11 ☐ 12+
7. Do you snore (or has anyone ever told you that you have)?
☐ YES ☐ NO
8. Do you use PRESCRIBED medications to help you sleep?
☐ YES ☐ NO
9. Do you use alcohol or recreational drugs to help you sleep ?
☐ YES ☐ NO

Colorado Joint Replacement

Knee and Hip Osteoarthritis Sleep Quality Assessment
(Post-Op Evaluation)

| Patient Name: | | Patient DOB: | |
|---|---|---|---|
| Provider: | | DOS: | |
| Visit Date: | | Joint (circle one): | (RIGHT / LEFT) (TKA / THA) |
| Follow-up (circle one): | 2- week | 4-week to 8 week | 3 months |

1. How would you rate your present sleep habits on AVERAGE (Scale 1-10, Please only mark one)
Don't Sleep Much at All 1 2 3 4 5 6 7 8 9 10 Sleep well without disturbance
2. How would you rate your sleep quality compared to before surgery?
☐ Improved ☐ About the Same ☐Worse ☐Significantly Worse
3. What time do you go to sleep on AVERAGE (Please only mark one)?
1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 A.M. / P.M. (please circle one)
4. What time do you wake up on AVERAGE (Please only mark one)?
1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 A.M. / P.M. (please circle one)
5. On AVERAGE how many times do you wake up to USE THE RESTROOM since surgery (Please only mark one)?
☐ none ☐ 1 ☐ 1-2 ☐ 2-3 ☐ 3-4 ☐ 4-5 ☐ 5-6 ☐ 7+
6. On AVERAGE, how many times do you wake up during the night NOT TO USE RESTROOM since surgery (Please only mark one)?
☐ none ☐ 1 ☐ 1-2 ☐ 2-3 ☐ 3-4 ☐ 4-5 ☐ 5-6 ☐ 7+
7. On AVERAGE, how many hours a night do you sleep soundly without disruption since surgery (Please only mark one)?
☐ 0 ☐ 1 ☐ 2-3 ☐ 4-5 ☐ 6-7 ☐ 8-9 ☐10-11 ☐ 12+
8. Do you use PRESCRIBED medications to help you sleep (since surgery)
☐ YES ☐ NO
9. Do you use alcohol or recreational drugs to help you sleep (since surgery)
☐ YES ☐ NO

**Fig. 1.** Surveys distributed.

One of the difficulties with evaluating sleep in TJA patients lies with the variety of assessment tools, limiting one's ability to standardize sleep quality measures. The gold standard for objective measurement is the polysomnography; however, it is challenging to obtain with prolonged time expenditure required [11]. Wearables are much more accessible, however, have less accuracy in detecting wakefulness [12]. Subjective sleep measures are also used, including the Epworth sleepiness scale, insomnia severity index, and Pittsburgh sleep quality index; however, none of these measures are specific to evaluating sleep after TJA [13,14].

Therefore, it was the goal of this study to use a survey designed specifically to evaluating sleep disturbance after joint arthroplasty and use it to identify measures or tools that could improve sleep quality. By evaluating a large patient population and retrospectively reviewing their charts, variables that could affect sleep disturbances were evaluated. The purpose of this study was to report risk factors for sleep disturbances in the perioperative period in patients undergoing primary TJA procedures. Our hypothesis was that patients who have a history of sleep disorders and substance use would report worse sleep in the perioperative period of TJA.

## Methods

Approval by our Institutional Review Board was obtained before the study initiation. There was no source of funding used for this study. The study period was from June 1, 2019 to February 28, 2021. We prospectively collected a questionnaire from patients at their preoperative visit and then at the 2-week and 6-week postoperative visits following TJA. Questionnaires were provided in person at the preoperative and postoperative visits. If patients were unable or did not present for any of the appointments, the questionnaires were sent via e-mail. All patients in our practice were included if they were undergoing a primary TJA (hip or knee). Patients were excluded if they declined the questionnaire.

There were 1,798 patients who were approached with the initial questionnaire, and 272 declined to complete for an 85% response rate. There were 775 excluded as they did not complete their postoperative questionnaires, leaving 751 patients who completed all 3 questionnaires and were included in the analysis.

Primary TJA was performed by 5 fellowship-trained arthroplasty surgeons at our institution. All patients ambulated on the day of surgery with supervised physical therapy. In the postoperative period, no patients were given prescriptions for supplemental sleeping aid. Patients were discharged with Tylenol, Meloxicam (unless contraindicated), and narcotic for breakthrough pain. Narcotic selection was variable and based on discussion with the patient at preoperative evaluation. To assess preoperative sleep quality and presence of sleep disturbance, a custom questionnaire was created to assess sleep in the setting of hip and knee arthritis. The questionnaire consisted of 9 questions preoperatively and postoperatively, with questions surveying self-reported sleep behaviors and if medications or aids are required to assist in sleep habits (Figure 1). Sleep quality and habits were measured using a

**Table 1**
Patient Demographics.

| Patient Demographics | Mean ± STDEV (Min-Max) |
|---|---|
| Age (range) | 65 (19 to 89)<br>TKA: 66 (27 to 88)<br>THA: 64 (19 to 89) |
| BMI (range) | 29.1 (16.6 to 50.4)<br>TKA: 29 (18 to 50)<br>THA: 28 (17 to 50) |
| | N = 751 |
| Sex | |
| | Women: (443) 59%<br>Men: (308) 41%<br>TKA: 60% Female<br>THA: 57% Female |
| Case Type | |
| | Total Knee (446) 59.4%<br>Total Hip (305) 40.6% |

BMI, body mass index; STDEV, standard deviation; min, minimum; Max, maximum; TKA, total knee arthroplasty; THA, total hip arthroplasty.

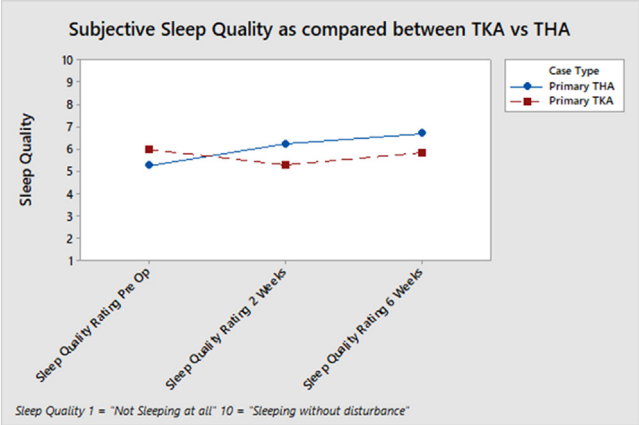



**Fig. 2.** Subjective sleep quality of before and after total hip arthroplasty (THA) and total knee arthroplasty (TKA). Preop, preoperatively; TKA, total knee arthroplasty; THA, total hip arthroplasty.

survey question from 1-10, where 1 was a score consistent with not sleeping at all, in comparison to a score of 10 where one slept well without disturbance. The postoperative survey included questions specifically about disturbances related to pain, mechanical devices (ie, braces, ten hose, and ace wraps), and bathroom use. Postoperative sleep was assessed for improvement or worsening of previous sleep habit.

Data were also collected on patient demographics, including but not limited to self-reported marijuana drug use, opioid use (preoperatively and postoperatively), and tobacco and alcohol use. Specific medical diagnoses were also queried to identify disorders that may influence sleep patterns, including depression, sleep apnea, insomnia, and narcolepsy. To assess the effect of age on sleep habits after TJA, the study population was divided into 3 cohorts: <50 years, 50 to 64 years, and >64 years of age. Smoking status was studied based on never, previous, and current smokers. Alcohol use was evaluated based on current nondrinkers, 1 drink per week, social drinks as 2 to 7 drinks per week, and everyday drinkers who have more than 8 drinks per week. To evaluate the contribution of opioid use in the setting of sleep disturbances, a statewide prescription monitoring program was used to determine morphine milligram equivalents of opioids prescribed to patients. Opioid use

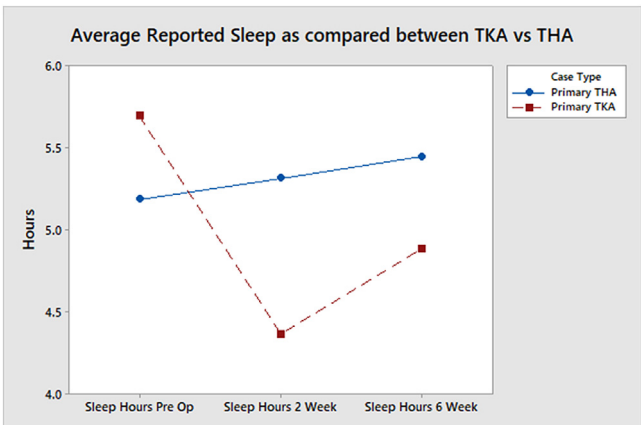



**Fig. 3.** Average reported sleep after total hip arthroplasty (THA) and total knee arthroplasty (TKA). Preop, preoperatively; TKA, total knee arthroplasty; THA, total hip arthroplasty.

**Table 2**
Sleep Quality Between Total Hip and Total Knee Patients.

| Sleep Quality (0 to 10) | THA (305) | TKA (446) | *P* Value |
|---|---|---|---|
| Preop | 5.2 ± 2.2 | 6.0 ± 2.1 | <.000 |
| 2 Week[a] | 6.2 ± 2.1 | 5.3 ± 2.2 | <.000 |
| 6 Week[b] | 6.7 ± 1.9 | 5.8 ± 2.1 | <.000 |

Preop, preoperatively; TKA, total knee arthroplasty; THA, total hip arthroplasty.
[a] Missing 6 THA & 4 TKA.
[b] Missing 3 THA & 6 TKA.

postoperatively was also broken down into further cohorts based on duration of opioid use: using them less than 1 month, less than 2 months, less than 3 months, or more than 3 months.

A total of 751 patients were enrolled and completed surveys regarding their sleep habits after primary TJA. The average age of the patient population was 65 years, and the average body mass index was 29.1. Of these patients, 305 underwent total hip arthroplasty (THA), while 446 underwent primary total knee arthroplasty (TKA). Women made up 57% of the THA patient population and 60% of the TKA patients. The average age of THA and TKA patients was 64 and 66 years, respectively. Remaining demographics of the patient population are listed in Table 1.

### *Data Analyses*

A descriptive analysis was performed for response rates and patient choices. Statistical analyses were performed using the student's *t*-tests and 1-way analysis of variances. Minitab version 18.0 (Minitab, State College, Pennsylvania) was used for data analysis. The 3-month analysis was excluded as a large population did not complete surveys.

## Results

The majority of patients report a worsening in their sleep habits at the 2-week postoperative visit, with a self-reported sleep score of 4.9 in comparison to 6.0 at their preoperative visit. By 6 weeks however, this score improved close to their preoperative levels with a mean self-reported sleep score of 5.9. It was consistently found that patients woke up more often in the middle of the night at the 2-week mark, both for using the bathroom and other reasons as well. In comparison to THA, patients who underwent TKA were more likely to report less sleep in the postoperative period. Although slightly better, this did not show to be significant ($P = .094$) (Figure 2). Similar trends were noted in relation to sleep quality, albeit that total knee patients were found to have better sleep preoperatively (Figure 3, Tables 2 and 3). When asked directly if their sleep symptoms have improved, worsened, significantly worsened, or stayed the same since the surgery, the majority (47.4%) of TKA patients reported their symptoms were worse at the 2-week postoperative visit (Table 4). In comparison, only 28.9% of THA patients had worse sleep symptoms. By 6 weeks, the differences were still apparent (Table 5).

**Table 3**
Sleep Hours Between Total Hip and Total Knee Patient.

| Hours of Sleep | THA (305) | TKA (446) | *P* Value |
|---|---|---|---|
| Preop | 5.2 ± 2.4 | 5.7 ± 6.2 | .115 |
| 2 Week[a] | 5.3 ± 5.9 | 4.4 ± 1.9 | .007 |
| 6 Week[b] | 5.5 ± 4.5 | 4.9 ± 4.5 | .094 |

Preop, preoperatively; TKA, total knee arthroplasty; THA, total hip arthroplasty.
[a] Missing 6 THA & 4 TKA.
[b] Missing 3 THA & 6 TKA.

**Table 4**
Sleep at 2 Weeks in Comparison to Preoperatively.

| 2 Week Sleep Comparison | THA (308) | TKA (445) | *P* Value |
|---|---|---|---|
| About the Same | **123 (39.9%)** | 132 (29.7%) | <.000 |
| Improved | 84 (27.3%) | 34 (7.6%) | |
| Significantly Worse | 12 (3.9%) | 68 (15.3%) | |
| Worse | 89 (28.9%) | **211 (47.4%)** | |

Bold: Identify the most common response.
TKA, total knee arthroplasty; THA, total hip arthroplasty.

At baseline before surgery, 127 patients (16.8%) were using preoperative opioids before surgery. Worse sleep patterns preoperatively were found in patients who used opioids prior to surgery ($P < .001$), with a sleep score of 4.7 in comparison to 5.9 of 10. A mean change in sleep scores (worse sleep compared to preoperative scores) at 6 weeks was noted in patients with preoperative opioid use, with a decrease in mean scores from −1.17 in the opioid group in comparison to −0.34 in the opioid naïve cohort. This population also had decreased improvement in their sleep status by final follow-up, with sleep scores of 5.97 in comparison to 6.21, but this was not found to be statistically significant ($P = .24$). These differences were seen consistently in subanalysis between TKA and THA. Most of our patient population used opioids in the postoperative period. There were 535 patients who used opioids for less than 1 month (71.1%), versus 76 patients (10.1%) who used opioids for more than 3 months after their primary TJA. Again, postoperative persistent opioid use (more than 3 months) was seen in patients with worse reported sleep quality preoperatively (4.53 versus 5.88, $P < .001$) and postoperatively (5.62 versus 6.28, $P = .04$). Of note, those who were preoperative users of opioids were significantly more likely to be postoperative persistent opioid users (45.7 versus 3%, $P < .001$), highlighting that preoperative opioid use might be an important modifiable risk factor.

Use of tobacco, alcohol, and cannabis was also evaluated to see if they contributed to worsening sleep habits throughout the perioperative period. Only a small proportion of the patient population was current smokers (5.2%). Prior smokers comprised 34.3% while the remaining 60.5% were never smokers. It was found that patients who were current smokers were found to have worse preoperative sleep scores (4.33 in current smokers versus 5.82 in never smokers, $P < .001$). Patients who were current smokers (compared to nonsmokers or previous smokers) had worse sleep quality that persisted at 6 weeks ($P = .014$). On subanalysis, the difference in sleep scores in current smokers only trended toward significance in TKA patients ($P = .059$), in comparison to THA patients ($P = .006$). No sleep differences were found at any time point in patients who self-reported alcohol or cannabis.

Age and comorbid conditions were investigated. Nearly a third of our patient population had a preoperative diagnosis of depression or anxiety (262 of 751 patients). A preoperative diagnosis of sleep disorder was found in 148 patients. Both conditions were found to influence sleep patterns preoperatively (5.11 versus 5.81, $P = .009$ with prior sleep disorder, and 5.14 versus 5.96, $P < .001$ for prior anxiety and depression). Interestingly, when looking at the diagnosis of sleep apnea alone, there was no difference in preoperative sleep scores (5.64 versus 5.69, $P = .793$). Postoperatively, patients who had a sleep disorder were found to have significantly worse sleep scores at final follow-up (5.75 versus 6.27, $P = .012$). Those with anxiety and depression trended to having worse postoperative sleep scores (5.98 versus 6.28, $P = .069$). Interestingly, a mean change in sleep scores (worse sleep compared to preoperative scores) at 6 weeks was noted in patients aged less than 65 years ($P = .001$).

**Table 5**
Sleep at 6 Weeks in Comparison to Preoperatively.

| 6 Week Sleep Comparison | THA (307) | TKA (445) | *P* Value |
|---|---|---|---|
| About the Same | 123 (40.1%) | 171 (38.4%) | <.000 |
| Improved | **131 (42.7%)** | 66 (14.8%) | |
| Significantly Worse | 8 (2.6%) | 34 (7.6%) | |
| Worse | 45 (14.7%) | 174 (39.1%) | |

Bold: Identify the most common response.
TKA, total knee arthroplasty; THA, total hip arthroplasty.

## Discussion

Sleep is a vital component of well-being. Postoperative sleep disturbance represents an important research field as sleep disturbance in the early postoperative period has a negative impact on health-related quality of life and can adversely affect the outcomes of surgery [15,16]. As shown in this study, sleep quality around the time of surgery appears to be multifactorial, affected not only by prior sleep disturbances but also by prior opioid use, tobacco use, age, and mental health. Identifying these risk factors of poor sleep will allow surgeons to better counsel their patients on their postoperative recovery, and possibly modify the risk factors to improve their early outcomes.

Cigarette smoking has been repeatedly shown to be associated with worse outcomes after TJA [17,18]. Cigarette smoking has been correlated with worse wound healing and increased risk of postoperative infection [19,20]. This is one of the first reports demonstrating an association between cigarette smoking and postoperative sleep disturbances after TJA. Still, this should not be surprising as smoking has been associated with insufficient sleep. In a study in *Sleep Medicine* published in 2011, Sabanayagam demonstrated that both current smokers and current smokeless tobacco users had twice the odds of insufficient sleep [21]. Insufficient sleep was also found in individuals who were exposed to secondhand tobacco. Fortunately, smoking cessation initiatives in TJA have proven to be successful and can drastically change patient outcomes [22]. Not only have they proven to be cost-effective in both the short and long term but smoking cessation can also provide long-term abstinence that can provide multiple medical benefits [23]. Our data showing sleep improvement is another data point that can be provided to patients in advising smoking cessation prior to TJA.

Opioid use is also known to affect sleep physiology but has not clearly been associated in the TJA literature until this publication. There has been a clear association between pain from osteoarthritis and poor sleep quality in the geriatric population, with many publications hypothesizing that nocturnal pain is the strongest contributing factor [24–26]. Opioids have also been shown to affect the sleep cycle. This includes, but is not limited to, changes in the duration of rapid eye movement sleep, increased wakefulness in the middle of the night, and worsening in respiratory depression [27–29]. These physiologic changes certainly could contribute to increased sleep deprivation in preoperative opioid users and explain why patients on prolonged postoperative opioids also report worse sleep scores as seen in this study. Therefore, providers should attempt to transition patients to an opioid-sparing pain regimen, including medications such as nonsteroidal anti-inflammatory drugs and pregabalin, to obtain less sleep disturbance.

An interesting finding in our study population was that younger individuals reported worse sleep scores after TJA. It is known that changes in sleep physiology occur as a result of aging [30]. Elder individuals have decreased sleep efficiency and slow-wave sleep, contributing to increased prevalence of sleep disorders [31]. It was

therefore interesting to note that individuals aged less than 65 years reported worse change in sleep habits in comparison to their geriatric peers. Further research is warranted to determine if there are confounding factors that contributed to this finding.

This is one of the first studies to directly compare sleep recovery in patients who underwent TKA versus THA. Most prior studies have directly observed sleep disturbances in patients after a knee arthroplasty [32,33], with minimal works demonstrating poor sleep quality up to 1 month after hip arthroplasty [34]. One of the only studies that examined sleep in both cohorts was from a group out of Denmark, looking at recovery after "fast-track" joint arthroplasty in 2014. The average length of stay was 2.6 days, and therefore this group was able to perform actigraphs in the early postoperative period (up to 9 days postoperative), in combination with a few patients who had polysomnography measurements performed both 1 night at home prior to surgery and on the first night after surgery [35,36]. With a small sample size, the group concluded they were not powered to detect differences in early sleep architecture between the 2 cohorts, but did should that both THA and TKA had normalized sleep levels by postoperative day 9. This differs from the results of the present study, which showed TKA patients consistently had less hours of sleep in comparison to THA patients, significantly at 2 weeks postoperatively but even slight differences at the 6-week mark. This is also seen with subjective sleep differences at 6 weeks as well, with 46.7% of TKA patients still report worse or significantly worse sleep at that time. Further studies are needed to draw conclusion why these differences might have occurred. However, it is our hypothesis that the change in TJA protocols, especially the push to discharge to home over the past decade, could attribute the disparate conclusions with recall survey bias also playing a factor.

There are potential limitations to this study that should be addressed. Although we were able to capture a large population using a relatively short but comprehensive survey, there was a large population that could not be included as proper follow-up surveys were unable to be obtained. A large population was excluded as they did not contribute postoperative sleep scores, including the limited surveys at 3 months that limited our follow-up period. This could introduce selection bias into the study, as those who volunteered to contribute may have higher sleep disturbance than those who opted out. These surveys were only sent out at set intervals (preoperative, 2 weeks, 6 weeks, etc.), and therefore could not assess daily or weekly changes of sleep habits. For example, our study noticed improvement in sleep habits between 2 and 6 weeks; however, we are unable to determine if this change occurred at 4 weeks or 5 weeks due to the nature of the survey intervals. The survey format also lends itself to recall bias, which could also amplify the rates of reported sleep disturbance in this population. Several factors analyzed in this study were self-reported, including use of preoperative opioids, marijuana, alcohol, and tobacco products. Patient history of sleep disorders was also self-reported. Our institution does not perform standardized preoperative drug screening or nicotine testing to verify patient's self-reported substance use so we may not have captured all patients in each cohort accurately. Furthermore, postoperative opioid usage was based on number of prescriptions and pills dispensed based on a state-run drug-monitoring database. It is certainly possible that patients may have filled prescriptions but not taken all the pills dispensed so our postoperative opioid usage may be overestimated. Finally, we did not correlate sleep scores to overall pain scores as this could be an independent risk factor for poor sleep. Future studies should focus on the interplay between sleep, pain, and opioid use.

Our survey, while novel, has never been validated compared to gold standard sleep studies, and therefore might not an accurate measure of sleep habits and correlate to clinically significant changes. We felt this survey was more applicable to this patient population than some of the other standardized surveys available as it addresses questions and issues specific to postoperative recovery from TJA. For example, the Pittsburgh sleep quality index asks about sleeping temperature, bad dreams, and breathing conditions, which typically are not altered after TJA, rather than wearables devices like TED hose and knee braces. Finally, this investigation was performed at an urban tertiary care center, and thus, may not be generalizable across all practice settings.

## Conclusions

In conclusion, sleep quality disturbances around the time of surgery are common after TJA, with slightly higher rates in TKA. This sleep disruption typically resolves by 6 weeks after THA surgery, but is still present in TKA population. Certain risk factors, including preoperative opioid use, cigarette smoking, and sleep disorders may predispose patients to worse sleep quality during the perioperative period. Patients should be counseled regarding these risk factors before surgery. Further research is warranted to see if these risk factors are modifiable to improve patient's recovery after this effective surgery.

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