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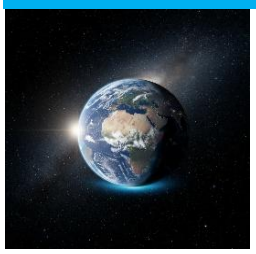

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The impact of sleep apnea on sleep quality – a literature review

Aleksandra Katarzyna Pelczar – AP – Corresponding Author

(email: aleksandraplcr@gmail.com)

Uniwersytet Medyczny w Lublinie, Aleje Racławickie 1, 20-059 Lublin, Poland

ORCID: 0009-0001-9383-3225

Wiktoria Oczkowska – WO

(email: wiktoriaoczkowska01@gmail.com)

Uniwersytet Medyczny w Lublinie, Aleje Racławickie 1, 20-059 Lublin, Poland

ORCID: 0009-0002-4266-6225

Diana Morawska – DM
(email: dianamorawska66@gmail.com)
Uniwersytet Medyczny w Lublinie, Aleje Racławickie 1, 20-059 Lublin, Poland
ORCID: 0009-0009-1424-8860

Przemysław Dominik Drabik – PD
(email: przemyslaw.drabik1@gmail.com)
Uniwersytet Medyczny w Lublinie, Aleje Racławickie 1, 20-059 Lublin, Poland
ORCID: 0009-0000-3482-9704

Alex Malinowski – AM
(email: alexmalinowski64@gmail.com)
Uniwersytet Medyczny w Lublinie, Aleje Racławickie 1, 20-059 Lublin, Poland
ORCID: 0009-0009-0114-4878

Klaudia Marchewka – KM
(email: klaudiamarchewka51@gmail.com)
Uniwersytet Medyczny w Lublinie, Aleje Racławickie 1, 20-059 Lublin, Poland
ORCID: 0009-0003-2356-4247

Radosław Sochocki – RS
(email: sochocki.radek780@gmail.com)
Uniwersytet Medyczny w Lublinie, Aleje Racławickie 1, 20-059 Lublin, Poland
ORCID: 0009-0005-8496-7554

Wiktoria Białek – WB
(email: viki.bialek@gmail.com)
Uniwersytet Medyczny w Lublinie, Aleje Racławickie 1, 20-059 Lublin, Poland
ORCID: 0009-0007-7051-8744

Agata Sadowska – AS
(email: agatasadowsska@gmail.com)
Uniwersytet Medyczny w Lublinie, Aleje Racławickie 1, 20-059 Lublin, Poland
ORCID: 0009-0003-5051-4907

Kacper Bartosik – KB
(email: kacper.bart1@gmail.com)
Uniwersytet Medyczny w Lublinie, Aleje Racławickie 1, 20-059 Lublin, Poland
ORCID: 0009-0005-6133-4623

Abstract

Background:
Obstructive sleep apnea (OSA) is a common yet underdiagnosed disorder characterized by recurrent upper airway obstruction, leading to intermittent hypoxemia and micro-arousals. These disturbances fragment sleep and disrupt normal architecture. OSA affects not only respiration but also both subjective and objective sleep quality, contributing to daytime sleepiness, cognitive impairment, mood disturbances, and reduced quality of life.

Aim:
To evaluate the impact of OSA on sleep quality through a synthesis of clinical, observational, and interventional studies, with emphasis on subjective and objective measures, disease severity, and treatment effects.

Materials and Methods:
A narrative literature review was conducted using PubMed and Google Scholar. Included studies comprised observational, polysomnographic, interventional (CPAP), and systematic reviews. Findings were analyzed qualitatively.

Results:
Approximately two-thirds of OSA patients report poor, non-restorative sleep. Polysomnography shows increased arousals, reduced sleep continuity, and impaired slow-wave and REM sleep. Greater disease severity, particularly higher apnea–hypopnea index and hypoxemia, is associated with worse sleep quality and daytime dysfunction. Subjective

measures often indicate greater impairment than objective findings. Poor sleep quality correlates with fatigue, cognitive deficits, mood disorders, and decreased productivity. CPAP improves sleep parameters and perceived sleep quality, though residual symptoms may persist due to comorbidities such as insomnia.

Conclusions:
Sleep quality impairment is a core feature of OSA. Sleep fragmentation and hypoxemia are key mechanisms driving non-restorative sleep. Discrepancies between subjective and objective measures highlight the need for patient-reported outcomes. While CPAP is effective, individualized, multimodal approaches are needed to fully restore sleep quality.

Key words: obstructive sleep apnea, sleep quality, sleep fragmentation, intermittent hypoxemia, polysomnography, CPAP therapy, daytime sleepiness, sleep architecture, Pittsburgh Sleep Quality Index, quality of life

1.Introduction

Sleep apnea, particularly **obstructive sleep apnea (OSA)**, is a common yet significantly under-recognized sleep disorder characterized by repeated episodes of upper airway obstruction during sleep. These interruptions lead to **disrupted breathing, intermittent hypoxemia (low blood oxygen), and frequent micro-arousals throughout the night**, all of which profoundly undermine restorative sleep processes. [1]

Understanding the impact of sleep apnea on sleep quality is essential because it extends beyond mere snoring or breathing pauses. Patients with OSA often experience **marked sleep fragmentation**, a consequence of repeated arousals that repeatedly interrupt sleep continuity. This fragmentation has been shown to **reduce subjective sleep quality and impair daytime function**, including increased daytime sleepiness, diminished cognitive performance, and altered mood. [2,3]

Clinical evidence demonstrates that the **majority of individuals with OSA report poor sleep quality**, with polysomnography and validated questionnaires like the Pittsburgh Sleep Quality Index indicating that a high proportion of patients suffer from non-restorative sleep.[4] Sleep deficiency in OSA is multifaceted, often involving concurrent disorders such as insomnia and circadian misalignment that further diminish sleep quality.[5] The interplay between sleep fragmentation and intermittent hypoxia also contributes to **daytime symptoms**, including excessive sleepiness and reduced productivity, which degrade overall health outcomes and quality of life. [6]

Importantly, the consequences of sleep apnea extend into broader health domains: chronic sleep disruption is linked with **cognitive impairment, mood disorders like anxiety and depression, increased cardiovascular risk, and diminished quality of life**.[7,8]Current research underscores that effective diagnosis and treatment (e.g., continuous positive airway pressure or other interventions) can **ameliorate sleep quality and associated functional impairments**, highlighting the need for heightened clinical awareness and timely management. [9]

In summary, the **impact of sleep apnea on sleep quality** is profound and multidimensional, affecting nocturnal physiology, daytime functioning, and overall health. By synthesizing findings from polysomnographic studies, patient-reported outcomes, and quality-of-life research, this article explores how sleep apnea disrupts sleep patterns and contributes to widespread health burdens.

2.Materials and methods

This study was conducted as a narrative literature review examining the impact of obstructive sleep apnea on sleep quality. A structured search of the Pubmed and Google Scholar database was performed, using the references provided as the primary evidence base. The included literature comprised observational studies, polysomnographic investigations, interventional studies involving continuous positive airway pressure (CPAP), and systematic reviews addressing sleep quality and related outcomes in OSA.

The reviewed studies included adult and pediatric populations with varying degrees of OSA severity. Diagnosis was generally based on overnight polysomnography, with severity classified using the apnea–hypopnea index (AHI). Additional physiological measures,

including arousal index and oxygen desaturation parameters, were considered due to their established relevance to sleep fragmentation and sleep disruption.

Sleep quality was evaluated using both subjective and objective approaches. Subjective assessment relied on validated questionnaires such as the Pittsburgh Sleep Quality Index and Epworth Sleepiness Scale, as well as quality-of-life instruments. Objective sleep quality parameters were derived from polysomnography and included sleep efficiency, sleep stage distribution, arousal frequency, and markers of sleep fragmentation.

Several studies also examined daytime consequences of impaired sleep quality, including sleepiness, fatigue, cognitive function, mood disturbances, and productivity. Findings were synthesized qualitatively and organized thematically to describe the mechanisms, clinical impact, and treatment-related effects of OSA on sleep quality.

3.Results

3.1. High Prevalence of Poor Sleep Quality in Obstructive Sleep Apnea

Multiple recent clinical studies confirm that **poor sleep quality is a dominant and prevalent symptom in individuals with OSA.** In a large cross-sectional analysis of 505 patients with polysomnography-confirmed OSA, **approximately 68.9% reported poor sleep quality** based on the Pittsburgh Sleep Quality Index (PSQI), with excessive daytime sleepiness and nocturnal hypoxia strongly associated with reports of unsuccessful sleep.[4,30]

In another recent cohort, subjective measures of sleep quality highlighted that **a notable portion of OSA patients rate their sleep as non-restorative**, often irrespective of objective sleep duration metrics, underscoring the **discrepancy between subjective perception and traditional clinical parameters.**[10]

These findings emphasize that poor sleep quality in OSA is not merely common but forms a core component of the patient experience.

3.2. Sleep Architecture Disruption and Fragmentation

OSA substantially **alters nocturnal sleep architecture**, a factor directly linked to diminished restorative sleep. Polysomnographic measures demonstrate **fragmented sleep with frequent**

arousals and reduced sleep continuity, even when total sleep time may appear preserved. Frequent apneas and hypopneas lead to repeated micro-arousals that interrupt deeper stages of sleep critical for cognitive restoration and memory consolidation.

Although recent studies have not uniformly reported significant differences in basic sleep efficiency measures when comorbid conditions like periodic limb movements are present, the overall disruption from respiratory events remains evident, as OSA patients show higher apnea indices and respiratory arousal frequencies than non-OSA controls.[11]

Additional electrophysiologic research indicates that OSA can **alter specific sleep microstructures such as sleep spindles**, which are important markers of sleep stability and quality, suggesting that fragmentation in OSA goes beyond gross sleep stage disruption into finer aspects of sleep physiology. [12]

3.3. Relationship Between OSA Severity and Sleep Quality Parameters

Severity of OSA, often measured by the apnea-hypopnea index (AHI) and degree of nocturnal oxygen desaturation, has been linked to **worsening sleep quality and increased daytime symptoms.**

For example, patients with REM-predominant OSA exhibit significantly **higher PSQI scores and increased daytime sleepiness**, indicating that the severity and timing of respiratory events contribute to subjective sleep impairment.[13]

Nocturnal hypoxemia and minimum oxygen saturation levels during sleep correlate negatively with aspects of daytime functioning—including bodily pain and social functioning—and may further erode perceived sleep quality in individuals with OSA. [14]

These findings align with broader literature indicating that **worse breathing disruption and desaturation burden translate to poorer sleep quality and associated daytime dysfunction.**

3.4. Impact on Daytime Functioning and Health-Related Quality of Life

Poor sleep quality in OSA is not limited to nocturnal symptoms but profoundly impacts **daytime performance and overall health**. OSA can degrade vigilance, mood, cognitive

function, and overall quality of life through mechanisms tied to disrupted sleep and intermittent hypoxia.

In a cross-sectional assessment focusing on active adults with OSA, increased severity was associated with pronounced **daytime sleepiness, decreased mental health functioning, and reduced productivity**, all of which are downstream effects of poor sleep quality. [6]

Further research in pediatric populations has shown that **eself-reported poor sleep quality, rather than the mere presence of OSA, more strongly predicts reduced health-related quality of life** in children with obesity, suggesting that sleep perception itself is a critical determinant of well-being. [15]

These studies underscore that impaired sleep quality in OSA extends beyond subjective restlessness to **measurable deficits in daily functioning and psychosocial health**.

3.5. Response of Sleep Quality to OSA Treatment

Treatment with **continuous positive airway pressure (CPAP)** - the gold standard therapy for OSA—can significantly improve sleep quality by reducing apneic events, arousals, and oxygen desaturations.

A controlled analysis of CPAP effects in adults with OSA and comorbid type 2 diabetes revealed improvements in EEG sleep architecture—indicating enhanced depth of sleep and reduced neurophysiological arousal—following initiation of CPAP treatment compared with sham therapy. [16]

Longitudinal observational data further support that **CPAP adherence improves subjective sleep quality and cognitive outcomes**, including attention, memory, and executive function, demonstrating that targeting the respiratory disturbances of OSA can restore restorative processes essential for overall sleep health. [17]

However, a portion of patients continues to experience poor subjective sleep quality despite adequate CPAP use, suggesting additional factors (e.g., comorbid insomnia, circadian rhythm disturbances) contribute to persistent sleep disruption.

3.6. Integrated Perspective on OSA and Sleep Quality

Taken together, recent evidence from 2020–2026 indicates that:

- **Poor sleep quality is highly prevalent in OSA** and affects a substantial majority of patients.[4]
- OSA leads to **sleep architecture disruption and fragmentation**, undermining restorative sleep stages.[12]
- Greater severity of OSA is associated with **worse subjective and objective sleep quality metrics.[13]**
- Individuals with OSA suffer **daytime functional deficits and reduced quality of life** that relate to poor sleep. [6]
- **CPAP therapy improves sleep quality**, though not always completely, highlighting the need for multifaceted treatment approaches.[16,17]

These outcomes emphasize that **sleep quality impairment is a core pathological feature of OSA**, not merely a secondary complaint. Addressing this deficit is essential for effective disease management and improving both nocturnal function and daytime health.

4.Discussion

The findings presented in this article demonstrate that obstructive sleep apnea exerts significant adverse effects on both subjective and objective measures of sleep quality. These effects are multifactorial, rooted in the pathophysiology of OSA, and have broader consequences for daytime functioning, health-related quality of life, and long-term health outcomes.

4.1.Pathophysiological Mechanisms Underlying Sleep Quality Impairment

Sleep quality in OSA is fundamentally compromised by the recurrent collapse of the upper airway during sleep, leading to repeated episodes of apnea and hypopnea. These episodes precipitate **sleep fragmentation**, frequent arousals, and intermittent hypoxemia, which together disrupt normal sleep continuity and architecture. Polysomnographic research has confirmed that individuals with OSA exhibit more fragmented sleep, with elevated arousal indices and frequent transitions out of deeper sleep stages, contributing to non-restorative sleep despite adequate sleep duration.[4,29]

Sleep fragmentation is particularly significant: repeated arousals—often more subtle than full awakenings—can profoundly degrade the restorative quality of sleep by interrupting slow-wave and REM sleep, stages essential for physiological restoration and memory consolidation. Despite their subtlety on EEG, these micro-arousals cumulatively result in a perceived loss of sleep quality, with patients reporting unrefreshing sleep and daytime fatigue.[18]

Additionally, **intermittent hypoxia**, a hallmark of OSA, may further degrade sleep quality by triggering neurophysiological stress responses. Although ongoing research is exploring the precise mechanisms, hypoxemia has been independently associated with adverse outcomes such as cognitive dysfunction and mood disturbances, which can feedback negatively on sleep perception and regulation.[18,19,20]

4.2.Subjective Perception vs. Objective Measures of Sleep Quality

An important theme in the literature is the **discordance between subjective reports of sleep quality and conventional objective sleep metrics**. Tools like the Pittsburgh Sleep Quality Index (PSQI), which capture patients' perceived sleep experience, often reveal widespread sleep dissatisfaction in individuals with OSA, even when objective measures such as total sleep time or sleep efficiency do not seem severely impaired.[4]

This discrepancy likely reflects the complexity of sleep quality as a multidimensional construct, encompassing satisfaction, continuity, timing, and daytime functioning—not merely sleep duration or efficiency. For example, individuals with OSA may have adequate measured sleep durations yet suffer frequent micro-arousals that diminish the restorative value of that sleep.[10,21]

In pediatric cohorts with obesity and OSA, self-reported poor sleep quality was more closely linked to reduced health-related quality of life than the mere presence of apneic events, indicating that **subjective sleep experience may drive functional impairment beyond objective disease markers**.[15,22,23]

4.3.Clinical and Psychosocial Impacts of Poor Sleep Quality

Poor sleep quality in OSA is strongly associated with a range of daytime impairments, including excessive daytime sleepiness, cognitive dysfunction, mood disturbances, and reduced social and work performance. In adults, quality of life measures such as vitality, mental health, and

daily functioning are frequently worse in individuals with OSA compared to healthy sleepers. This relationship is partly mediated by impaired sleep quality and associated symptoms like fatigue and mood disorders.[24,25]

Psychosocial consequences extend beyond general well-being. Poor sleep can exacerbate anxiety and depressive symptoms, which in turn may further distract from nocturnal rest. This bidirectional relationship can perpetuate a cycle of sleep disturbance and daytime dysfunction common in OSA populations.[15]

4.4.Moderators and Co-morbid Factors

A range of clinical and lifestyle factors modulates the extent to which OSA affects sleep quality. For instance, comorbid conditions such as chronic heart failure and metabolic disorders can amplify perceived sleep disruption and daytime fatigue in OSA patients. Factors like sex differences, hydration status, alcohol use, and irregular sleep schedules have also been implicated in modifying sleep quality outcomes in OSA populations.[4,26]

Furthermore, *sleep deficiency*—a broader construct encompassing poor sleep quality, shortened sleep duration, circadian disruption, and comorbid sleep disorders such as insomnia—frequently co-exists with OSA and complicates the clinical picture. Addressing only apneic events may therefore fail to fully restore restorative sleep in many patients without complementary strategies targeting sleep continuity and circadian health.[5]

4.5.Response to Treatment and Clinical Implications

Continuous positive airway pressure (CPAP) therapy remains the mainstay of OSA treatment and has been shown to improve subjective sleep quality, daytime sleepiness, and health-related quality of life in many patients. Although systematic monitoring of sleep architecture changes post-treatment suggests improvements in sleep continuity and arousal indices, residual sleep quality impairment persists in some individuals, potentially due to incomplete adherence or coexisting sleep disorders such as insomnia.[27,28]

This observation highlights the need for **personalized and multimodal management approaches** that integrate treatment of respiratory disturbances with behavioral interventions, sleep hygiene optimization, and lifestyle modification to achieve more complete restoration of sleep quality.

5.Conclusion

The accumulated evidence reviewed in this work clearly demonstrates that obstructive sleep apnea has a substantial and multifaceted negative impact on sleep quality, affecting both subjective sleep perception and objective sleep physiology. Across diverse populations and study designs, poor sleep quality emerges as a central feature of OSA rather than a secondary or incidental complaint. The literature consistently shows that a majority of patients with OSA report non-restorative sleep, frequent nocturnal awakenings, and dissatisfaction with sleep, even in cases where total sleep time or sleep efficiency appears relatively preserved on polysomnography.

One of the most important conclusions from recent research is that sleep fragmentation and intermittent hypoxemia, rather than apnea frequency alone, are key drivers of impaired sleep quality in OSA. Recurrent respiratory events trigger repeated micro-arousals that disrupt sleep continuity and alter sleep architecture, particularly by reducing slow-wave and REM sleep. These disturbances undermine the restorative function of sleep and contribute to the persistent perception of poor sleep quality. Importantly, indices such as arousal burden and hypoxic exposure often show stronger associations with subjective sleep quality than the apnea–hypopnea index, highlighting the limitations of relying solely on traditional severity metrics.

The literature also emphasizes a frequent discordance between subjective and objective measures of sleep quality. Many individuals with OSA report poor sleep quality despite near-normal objective sleep duration, suggesting that patient-reported outcomes capture clinically meaningful aspects of sleep disruption that are not fully reflected in standard polysomnographic variables. This finding reinforces the importance of incorporating validated subjective instruments, such as the Pittsburgh Sleep Quality Index, into routine clinical assessment and research protocols.

Impaired sleep quality in OSA has significant downstream consequences. Poor nocturnal sleep is strongly associated with excessive daytime sleepiness, cognitive dysfunction, mood disturbances, reduced work productivity, and diminished health-related quality of life. Several studies indicate that subjective sleep quality predicts daytime functioning and quality-of-life outcomes more robustly than respiratory event frequency alone. These observations position

sleep quality as a critical mediator linking OSA to broader neurocognitive and psychosocial impairments.

Therapeutic interventions, particularly continuous positive airway pressure (CPAP), generally improve sleep quality by reducing respiratory events, arousals, and oxygen desaturations. However, a substantial proportion of treated patients continue to report residual sleep quality impairment, often due to comorbid insomnia, circadian disruption, or persistent sleep fragmentation. This underscores the need for comprehensive and individualized treatment strategies that address both respiratory and non-respiratory contributors to poor sleep.

In conclusion, the current body of evidence firmly establishes that OSA is a disorder of sleep quality as much as of disordered breathing. Effective management of OSA should therefore extend beyond reduction of apneas and hypopneas to include systematic evaluation and treatment of sleep quality impairment. Future research should prioritize longitudinal studies, refined physiological metrics of sleep disruption, and integrated therapeutic approaches aimed at fully restoring restorative sleep and improving patient-centered outcomes.

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Author's contribution:

Conceptualisation: AP,KB,AS,WB,RS,AM,PD,WO,DM

Methodology: DM,WO,PD

Software: AM,KM,RS

Check: WB,AS,AP

Formal analysis: AP,KB,AS

Investigation: WB,RS

Resources: KM,AM,WO

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Writing – rough preparation: AP,WO,KB

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