



# Editorial: Obstructive Sleep Apnea and the Brain

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## Editorial on the Research Topic

### Obstructive Sleep Apnea and the Brain

There is accumulating evidence that sleep disturbance, including sleep disorders such as obstructive sleep apnoea, can adversely affect restorative brain processes and function (1–5). In this interdisciplinary Research Topic, the interplay between clinical diseases of the central nervous system (CNS) such as multiple sclerosis Hensen et al. and stroke Stevens et al. and sleep disordered breathing is highlighted. Both of these reviews discuss potential shared mechanisms, consequences, and novel treatment approaches. In addition, a review of the clinical challenges of managing patients with comorbid insomnia and obstructive sleep apnoea and treatment modalities, including the role of cognitive behavioural therapy, is presented Bahr et al.. In the final piece in this series, original research findings provide insight into a novel computerised test battery to examine neurobehavioural function in adults with and without obstructive sleep apnoea D’Rozario et al..

From a mechanistic perspective, the coining of the concept of at least four phenotypic traits that cause sleep disordered breathing has recently emerged (6). Namely, high loop gain, low respiratory arousal threshold, poor pharyngeal muscle responsiveness during sleep, and upper airway anatomic compromise (6–8). This new framework has provided insights into this common condition. Clinical phenotypes to define the different clinical manifestations and consequences of sleep disordered breathing have also recently been described (9). These mechanistic and clinical concepts pave the way for targeted therapy or “precision sleep medicine” to reduce the adverse health, safety, and social impact of untreated sleep disordered breathing (10). Indeed, the framework to provide personalised therapy for sleep disordered breathing in those without major comorbid disease has been set (11). Non-CPAP interventions that show promise in small physiological studies or clinical trials include pharmacologic, surgical, oral appliance, positional, oxygen, myofunctional training, or combinations thereof (11).

In accordance with these concepts, Hensen et al. detailed review highlights the differences in clinical presentation of sleep disordered breathing in people with MS. While the prevalence remains unclear, the available evidence suggests that sleep disordered breathing is likely at least as common in people with MS if not more so. This is despite clear differences in the clinical manifestation of sleep disordered breathing in this patient population that would tend to favour lower risk of sleep apnoea (i.e., predominantly non-obese females). This suggests that the causes, and by extension the ideal therapy or therapies for sleep apnoea, is likely to be quite different in people with MS compared to typical sleep apnoea patient populations. Concepts of bidirectionality between the causes and consequences of sleep disordered breathing and MS (e.g. inflammation, hypoxia, depression, fatigue/sleepiness, and neurocognitive impairment) are also proposed. These new concepts pave the way for an important research agenda that has the potential to lead to

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targeted therapies to reduce the common consequences of both conditions and potentially MS disease progression.

Another example of CNS disruption and high rates of sleep disruption/sleep apnoea is stroke. Neuroimaging studies after acute neurologic impairment (e.g., in the acute phase after stroke) combined with sleep investigations may provide important insight into the central nervous system mechanisms of sleep disordered breathing. In their mini review, Stevens et al. discuss the need for new knowledge into the specific causes of sleep disordered breathing post stroke using mechanistic phenotyping concepts. Similar to MS, the size and location of CNS lesions is likely crucial in determining the type and extent to sleep disordered breathing that occurs post stroke. Despite evidence that functional recovery outcomes post stroke improve after treatment of sleep disordered breathing (12, 13), CPAP therapy is particularly poorly tolerated in this patient population. Thus, there is a need to test and develop new therapeutic approaches for sleep disordered breathing to improve post stroke outcomes Stevens et al.. The same may apply to other disorders that affect central locomotor control such as Parkinson's disease (14–16).

Bahr et al. highlight the treatment challenges when two common unwanted bedfellows co-exist, namely insomnia and sleep apnoea. It is clear that when insomnia, which is characterised by cortical hyperarousal, combines with sleep disordered breathing there are additive or potentially synergistic adverse consequences (17–19). The goal remains to better understand the specific causes of each and different phenotypic presentations so that therapies can be tailored accordingly.

In the final original research contribution in this series, D' Rozario et al. highlight the shortcomings of sleep study parameters using gold standard polysomnography to accurately identify neurobehavioural dysfunction. Indeed, there is currently no standardised neuropsychological test battery to assess daytime dysfunction which can be administered in a timely manner in a sleep laboratory setting. The 30 min computerised test battery

that they developed was used to examine neurobehavioural function in over 200 people with untreated sleep apnoea versus a control group of 50 healthy participants. People with OSA had impaired neurobehavioural performance in all domains. Consistent with previous findings, polysomnography disease severity measures were only weakly associated with performance. The authors conclude that the test battery provides a sensitive method of assessing daytime dysfunction in patients with sleep apnoea. Nonetheless, there remains a need to further test and develop instruments to assess cognition, attention, alertness, short-term and long-term memory and executive function in the context of sleep disruption (20–23). There is increasing evidence that a possible gender-specific dimension of sleep disordered breathing should also be taken into account (20, 24–26).

In summary, there may be important bidirectional relationships between sleep disruption/sleep disordered breathing and a range of disorders that adversely affect brain/CNS function. Sophisticated approaches to better understand these links are required along with simple, accurate testing tools that can be used in the clinical setting to inform treatment decision making. This will then facilitate targeted strategies to improve sleep disruption/sleep disordered breathing across a range of CNS/brain disorders. This approach has the potential to also reduce the numerous shared disease consequences which often coexist in people who have sleep disordered breathing and a CNS/brain disorder. Given the increasing rates of sleep apnoea and disorders of the CNS/brain and considerable gaps in knowledge and treatment, these topics remain research priorities.

## AUTHOR CONTRIBUTIONS

Both HG and DE drafted and revised the manuscript and gave approval for publication of this manuscript.

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