

**Title: Age-related changes in circadian sleep-wake regulation: Impact on cognitive performance and cerebral correlates**

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**Abstract:** The ageing process is variably associated with cognitive decline. Temporal organization of sleep-wake states is fundamental to brain function and prone to disruption by the ageing process. The two-process model of circadian and homeostatic sleep-wake regulation has not only been established as a powerful tool for the prediction of sleep timing and structure, but also accounts for human sleepiness and neurobehavioural performance modulation over day and night. We will first show results providing further functional significance of sleep-wake regulation onto cognition and its underlying cerebral correlates. In a next step, the impact of the ageing process on those modulations will be discussed. There is evidence that performance of older adults is less impaired by sleep deprivation compared to young adults. We will present data indicating that such reduced age-related responsiveness to sleep loss and circadian phase are also detectable at the cerebral level, both by probing task-dependent brain activity using functional magnetic resonance imaging and cortical excitability using transcranial magnetic stimulation coupled to high density electroencephalography. Finally, we will address more specifically the putative role of the temporal framework of sleep-wake regulation on cognitive and brain fitness in the aged. First data reveal large variability in circadian sleep-wake modulation over the 24-h day. They further suggest that this variability is linked to cognitive performance in the aged such that a more distinctive allocation of sleep to night-time and wakefulness to daytime is indicative for better working memory performance. In the same vain, preliminary results suggest an association between circadian integrity and MRI-derived brain volume and surface measures in healthy older participants. Overall, the data suggest that both sleep fragmentation during night-time and wake fragmentation during daytime should be taken into account when assessing a putative link between sleep and cognition in the aged.