Increased Sleep Disruption, Reduced Sleepiness in Older Subjects?


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THE ARTICLE BY BUYSSE ET AL. IN THIS ISSUE REPORTS ON A STUDY DESIGNED TO EXPLORE THE INFLUENCE OF THE CIRCADIAN SYSTEM ON SLEEP AND PERFORMANCE IN OLDER SUBJECTS. THIS TOPIC IS ONE OF GREAT INTEREST, ESPECIALLY GIVEN THE RAPIDLY AGING US POPULATION. SLEEP COMPLAINTS ARE A COMMON FEATURE OF AGING, SO COMMON THAT MANY OLDER PEOPLE FAIL TO SEEK HELP FROM A MEDICAL PROFESSIONAL. AS SEVERAL PREVIOUS STUDIES HAVE DEMONSTRATED, POOR QUALITY SLEEP, INCLUDING REDUCED SLEEP EFFICIENCY AND INCREASED NUMBER OF AWAKENINGS, IS A PROBLEM EVEN IN OTHERWISE VERY HEALTHY OLDER PEOPLE. WHILE MANY OLDER PEOPLE MAY SUFFER FROM UNDIAGNOSED SLEEP-DISORDERED BREATHING, MANY OTHERS HAVE REDUCED SLEEP EFFICIENCIES THAT ARE UNRELATED TO SPECIFIC SLEEP DISORDERS.

Given that 2 major regulatory processes, the circadian timing system and the sleep-wake homeostat, interact in humans to regulate our consolidated sleep and wakefulness, age-related changes in either process, both processes and/or in the interaction between them could play a role in the poor sleep associated with aging. Until fairly recently, study protocols that can tease apart these 2 systems were not widely used to quantify age-related changes in sleep in order to answer such questions.

The study by Buysse et al used the “90-minute” paradigm in a group of older and young adults, giving their subjects 30-minute sleep opportunities every 90 minutes for 60 hours. This protocol results in sleep episodes that are scheduled across all circadian phases, and because of the short waking episodes, homeostatic sleep pressure is much reduced. Buysse et al examined sleep stages, measures of sleep quality and continuity, looked at whether significant circadian rhythms in sleep were present, and also measured subjective sleepiness and performance during the waking episodes. They found a lower percentage of REM sleep, lower sleep efficiency, longer sleep latency, and increased frequency and duration of awakenings in the older subjects. They concluded that there is a reduced circadian variation in sleep propensity with age, and that this is especially evident at the time of peak sleep propensity (ie, near the time of the core body temperature nadir).

The results of the study by Buysse et al support and extend other studies that have examined whether there are age-related changes in the circadian sleep-wake propensity rhythm. Richardson et al looked at sleep propensity measured as the ability to fall asleep, in a study in which they performed MSLTs across day and night.

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They found little difference at any circadian phase between the sleep latencies of young and older adults in their study, a finding largely in accordance with Buysse’s findings. Haimov and Lavie used a “7-13” study paradigm in which their subjects were scheduled to sleep for 7 minutes and be awake for 13 minutes across 24 hours. When they summed up all the sleep obtained by their subjects in each nap opportunity, they found that older subjects were less sleepy in the morning (near and just after typical wake time), a time of day consistent with the findings of Buysse et al. Haimov and Lavie also found their older subjects to be sleepier in the late evening (in the wake maintenance zone) than young subjects. In 2 recently published reports, the group of Cajochen and Wirz-Justice used a “75-150” study protocol across 40 hours of bed rest in young and older subjects, a protocol that should have resulted in slightly more sleep pressure buildup prior to each nap than the Buysse study. Similar to the present findings, they found a reduced rhythm of REM sleep in the older subjects, and reduced sleep efficiency in the late morning-early afternoon hours in the older subjects. As in the study by Haimov and Lavie, they also found that their older subjects fell asleep more quickly during the wake maintenance zone, resulting in more total sleep during that time.

Similar to the present study by Buysse et al, they also found that there is a decreased circadian arousal signal in older subjects, as evidenced by the increased sleep during the wake maintenance zone, shorter REM durations and increased subjective sleepiness in the late afternoon/evening (something not seen in the Buysse study). Dijk et al used a 28-hour forced desynchrony protocol in which subjects were scheduled to be awake for 18:40 and then scheduled to sleep for 9:20 for 4 weeks. They also found evidence for age-related changes in circadian sleep-wake rhythms. Similar to the present study by Buysse et al, they found reduced sleep efficiency at all circadian phases in older subjects and increased frequency of awakenings in older subjects. While that study protocol was similar to the Buysse study in that it scheduled sleep episodes across all circadian phases, the longer day length (28 hours vs. 1.5 hours) allowed greater levels of homeostatic sleep pressure to build up prior to each scheduled sleep episode. This allowed Dijk et al to explore interactions between circadian and sleep-dependent influences on sleep. They found significant interactions between circadian phase and time-within-sleep, especially on the ability to maintain sleep. Their older subjects had higher levels of wakefulness within sleep at all circadian phases regardless of whether the sleep occurred at the beginning or end of the scheduled opportunity. However, towards the end of the scheduled sleep opportunity, the older people showed greater levels of sleep disruption, especially when the end of sleep was scheduled at an adverse circadian phase. Buysse’s results are in agreement with this, in that they found overall changes in circadian sleep propensity with...
age, with phases just after the core body temperature nadir most affected. The study of Buysse et al therefore adds to the growing evidence that changes in sleep with age are due at least in part to changes in the circadian sleep-wake propensity rhythm, and to interactions between the circadian system and the sleep-wake homeostat.

One very interesting finding from the study by Buysse et al was that despite the fact that the older subjects slept less than the young across the 60 hours of the study, their subjective responses did not reflect this. In fact, during the nighttime hours on the second night of the study, while the subjective sleepiness of the young subjects was higher than on the first night, that of the older subjects was slightly (although not significantly) reduced. The finding that older subjects do not feel as sleepy despite more disrupted sleep is in accordance with several previous studies in older people using other methods, including a previous study by Buysse et al that examined inadvertent sleep episodes during 36 hours of continuous wakefulness in young and older subjects. In that study they found that objective sleepiness (as measured by unintended sleep) was lower during the nighttime hours in the young across the 60 hours of the study, their subjective responses did not reflect this. In fact, during the nighttime hours on the second night of the study, while the subjective sleepiness of the young subjects was higher than on the first night, that of the older subjects was slightly (although not significantly) reduced. The finding that older subjects do not feel as sleepy despite more disrupted sleep is in accordance with several previous studies in older people using other methods, including a previous study by Buysse et al that examined inadvertent sleep episodes during 36 hours of continuous wakefulness in young and older subjects. In that study they found that objective sleepiness (as measured by unintended sleep) was lower during the nighttime hours in the older subjects than in the young subjects.

These results may at first glance seem surprising, because the sleep of older people in general is so disrupted and because of the widely-held view that older people are sleepier during the daytime. In questionnaire studies, 15% of older adults report that their daytime sleepiness is so severe it interferes with their daytime functioning at least a few days a week and an additional 12% reported suffering from severe daytime sleepiness several days per month. One possibility is that in the general population, high levels of undiagnosed sleep-disordered breathing, chronic medical disorders, and medication use contribute to the increased daytime sleepiness reported by so many older people. Middle-aged and older adults also report chronic sleep restriction levels similar to that of younger adults, and it is possible that their reports of daytime sleepiness are an expected consequence of that self-imposed sleep restriction. Laboratory-based sleep studies on aging, in contrast, typically screen out participants with sleep disorders and chronic medical conditions, and schedule young and older subjects for one or more baseline nights of at least 8 hours time in bed. It is therefore possible that this apparent discrepancy is due to the subjects in sleep studies being healthier than their age-matched counterparts in the general population. However, that still does not explain why older sleep study subjects, who still exhibit reduced sleep efficiencies, seem to tolerate acute sleep deprivation better than their younger counterparts. Buysse et al conclude that “different subjective responses to the sleep deprivation inherent in this protocol suggest that poor sleep may have different – and perhaps lesser – subjective consequences in healthy older adults.”

Whether older adults can indeed better tolerate sleep loss than younger adults is an important unanswered question in the debate about whether older people need less sleep or are instead less able to obtain the sleep they need. Studies in young adults have shown that deficits in alertness and performance ability associated with insufficient sleep can lead to greater risk for automobile accidents, home and workplace accidents and on-the-job errors. Insufficient sleep can also have a negative effect on the quality of life, increasing irritability, decreasing motivation and affecting short-term memory. There is also increasing evidence in younger adults that insufficient sleep can have endocrine and immune consequences. Despite our increasing knowledge of the medical, safety and quality-of-life consequences of chronic poor quality and/or insufficient sleep duration in young adults, the impact in middle-aged and older adults is not at all well-understood. Additional studies in older subjects to better-understand the causes and consequences of sleep disruption and sleep restriction will have important implications for individual health and safety and for ensuring that older adults remain productive members of society, especially as greater numbers remain in the workforce.

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