

Sleep in Normal Aging

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KEYWORDS

• Sleep architecture • Circadian rhythm • Sleep homeostasis • Hormone • Normal aging

KEY POINTS

- Age-related changes in sleep include advanced sleep timing, shortened nocturnal sleep duration, increased frequency of daytime naps, increased nocturnal awakenings and time spent awake, and decreased slow wave sleep.
- Most age-related changes in sleep are stable after 60 years of age among older adults with excellent health.
- Aging is associated with less robust circadian rhythms and sleep homeostasis, which contribute to sleep changes in aging.
- Age-related changes in neuroendocrine functions contribute to or correlate with alterations of sleep quality and architecture in normal aging.
- Multiple factors, including medical comorbidities and psychiatric illness, primary sleep disorders, and changes in social engagement, lifestyle, and environment contribute to sleep disturbances in older adults.

INTRODUCTION

Sleep has received increasing attention within the context of geriatric research based on a growing body of evidence that links poor sleep with many adverse health outcomes, especially decline in cognition, in older adults. Along with many other physiologic alterations in normal aging, sleep patterns change with aging, independent of many factors, including medical comorbidity and medications.¹ Total sleep time (TST), sleep efficiency, and deep sleep (slow wave sleep) decrease with aging, and the number of nocturnal awakenings and time spent awake during the night increase with aging.² These age-related changes in sleep are associated not only with changes in the circadian and homeostatic processes, but also with some normal physiologic and psychosocial changes in aging. This article describes age-related changes in sleep,

circadian rhythms, and sleep-related hormones. We focus on changes associated with normal aging rather than changes that accompany common pathologic processes in older adults, which are discussed in detail elsewhere.

AGE-RELATED CHANGES IN SLEEP

There is no doubt that sleep changes as a function of age.³ Aging is associated with decreased ability to maintain sleep (increased number of awakenings and prolonged nocturnal awakenings), reduced nocturnal sleep duration, and decreased deep sleep (slow wave sleep).⁴ Herein we discuss in detail age-related changes in sleep duration, sleep initiation, sleep efficiency, sleep maintenance, sleep stages, daytime sleep behaviors, and self-reported sleep quality. An important aspect of this discussion is to differentiate

Disclosure Statement: N/A.

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Sleep Med Clin ■ (2017) ■-■

<https://doi.org/10.1016/j.jsmc.2017.09.001>

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changes in sleep that occur from childhood to age 60 (or 65), versus those that occur after this point. Ohayon and colleagues² comprehensively reviewed the normative sleep changes from childhood to old age using metaanalysis results from 65 studies (polysomnography or actigraphy) representing 3577 healthy subjects aged between 5 and 102 years of age, and this work informs many of the insights discussed in this review. Older subjects (defined as age >60 years) in this analysis were more representative of older adults with excellent health and who were optimally aging, rather than the general older adult population.⁴

Sleep Duration

The current literature supports that, in general, the TST decreases with age (from pediatric to older adulthood). However, further age-associated decreases in TST have not been observed consistently after entering older age brackets. Campbell and colleagues⁵ in 2007 conducted a laboratory study with 50 healthy adults aged between 19 and 81 years to evaluate the spontaneous sleep across the 24-hour day among young, middle-aged, and older adults. Compared with young adults (10.5 hours), middle-aged (9.1 hours) and older adults (8.1 hours) had significantly shorter average nighttime sleep duration. Data from 160 healthy adults (without sleep complaints) aged between 20 and 90 years from the SIESTA database showed that TST decreased about 8 minutes per decade in males and 10 minutes per decade in females.⁶ Similarly, 3 metaanalysis reviews reported that age was linearly associated with decreased TST, with an approximately 10- to 12-minute reduction per decade of age in the adult population.^{2,7,8} This association was stronger when comparing young adults with middle-aged or older adults, but vanished within older subjects who were 60 years of age and older. These findings indicate that TST plateaued after 60 years of age. Also, the association was stronger in women than men.²

Sleep Initiation

People commonly assume that the ability to initiate sleep decreases significantly with age. However, current evidence does not support this assumption, but suggests that both sleep latency and the ability to fall back to sleep after nocturnal awakenings demonstrate minimal increases after the age of 60 years. Results from 2 metaanalyses, for example, suggest that sleep latency does increase with age. However, the magnitude of change is very modest.^{2,8} In these studies, sleep latency holds constant from childhood to

adolescence. The significant age-related increase in sleep latency was only found between very young adults and older adults. A mathematical modeling, which was conducted using data from 7 laboratory sleep studies (258 subjects aged 17–91 years), suggested that sleep latency increased between the late teens and 20s, remains constant from age 30 until approximate age 50 years, and then increased steadily after age 50 years.⁹ However, the amount or magnitude of changes were not reported. In addition, even though more frequent arousals were found in healthy older adults than young people, older adults maintained their ability to reinitiate sleep and fell back to sleep as rapidly as younger adults.^{3,10}

Sleep Efficiency

Sleep efficiency remains largely unchanged from childhood to adolescence and significantly decreases with age in adulthood. Different from all other sleep parameters that hold steady after 60 years of age, sleep efficiency continues to decline very slowly with advancing age.²

Sleep Maintenance

Aging from birth to older adulthood is associated with a decreased ability to maintain sleep, which presents as the increased number of arousals (arousal index) and longer duration of wake after sleep onset (WASO), but also tends to plateau after age 60.^{2,8} In the metaanalysis performed by Ohayon and colleagues,² age-related change in WASO achieved the largest effect size among all sleep parameters, which yielded a steady 10 minutes increase of WASO per decade of age from 30 to 60 years. WASO remained mostly unchanged after age 60 years.

Sleep Stages

In general, deep sleep (slow wave sleep) decreases with age in the adult population. During nocturnal sleep, the proportion of non-rapid eye movement sleep stage 1 and stage 2 increases with age, and the proportion of slow-wave sleep and rapid eye movement sleep (REM) sleep decreases with age^{2,11} (**Fig. 1**). These changes were not significant among healthy older adults aged more than 60 years.² Also, the association between age and decreased REM latency was minimal.² Floyd and colleagues's⁷ metaanalysis reported a linear decrease in the proportion of REM with a small rate of 0.6% per decade from age 19 until 75 years of age, then small increases were found in the proportion of REM between 75 and 85 years of age.

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