The Brain–Sleep Connection:

GCBH Recommendations on Sleep and Brain Health

Global Council on Brain Health℠

A COLLABORATIVE FROM AARP®

Introduction

Background: About GCBH and Its Work

The Global Council on Brain Health (GCBH) is an independent collaborative of scientists, health professionals, scholars and policy experts from around the world working in areas of brain health related to human cognition. The GCBH focuses on brain health relating to people's ability to think and reason as they age, including aspects of memory, perception and judgment. The GCBH is convened by AARP with support from Age UK to offer the best possible advice about what older adults can do to maintain and improve their brain health. GCBH members come together to discuss specific lifestyle issue areas that may impact people's brain health as they age with the goal of providing evidence-based recommendations for people to consider incorporating into their lives.

We know that many people across the globe are interested in learning what they can do to maintain their brain health as they age. We aim to be a trustworthy source of information, basing recommendations on current evidence supplemented by a consensus of experts from a broad array of disciplines and perspectives. We intend to create a set of resources offering practical advice to the public, health care providers, and policy makers seeking to make and promote informed choices relating to brain health.

When the GCBH launched in 2015, AARP surveyed adults to find out what brain health topics they were most interested in. Sleep was the number one topic for adults aged 50 and older, with 84% of those surveyed wanting to learn more about how sleep relates to brain health. This paper presents the GCBH's consensus and recommendations on sleep and brain health for adults age 50-plus.

Sleep and Brain Health

On July 24-26, 2016, members of the GCBH met to discuss and examine the impact of sleep on brain health for adults 50 and older. A list of participants and GCBH members are included in Appendix 1. The purpose was to interpret current scientific evidence on the relationship of sleep and cognitive health and generate actionable recommendations.

The issue experts agreed that sleep is important to brain health, that natural changes occur in sleep patterns as people age in the absence of disease, and that sleep disorders and a person's lifestyle and behavior choices can significantly impact a person's quality of sleep. The GCBH reached seven major points of consensus listed below, and issued numerous recommendations directed:

- to help people maintain healthy sleep as they age,
- to help people who have trouble falling and staying asleep,
- to help those who may have possible sleep disorders,
- to help people with dementia who have trouble sleeping and their caregivers,
- and to help health care providers.

The recommendations also include practical tips based upon the experts' experience of how to help adults age 50-plus maintain and improve their sleep over their lifespans. This paper summarizes the consensus reached by the experts and describes the major points of discussion that led to the recommendations. It also identifies gaps in our knowledge about sleep and cognition, provides a glossary defining terms used in the document, and lists resources for further information. This paper was not intended to be a systematic, exhaustive review of all pertinent scientific literature on the topic of sleep and brain health. Rather the selected references provided at the end of the document give helpful background material and present a sizeable sample of the current evidence base underpinning the GCBH consensus in this area.

1 Between August 31–September 14, 2016 AARP fielded an online survey of a nationally representative sample of 2,464 Americans age 40 and older plus an additional 353 Hispanic/Latinos, 352 African Americans and 205 Asian Americans to learn more about issues related to adults' sleep and cognition. Selected results are available in Appendix 3. Complete results of this sleep and brain health survey can be found at **www.aarp.org/sleepandbrainhealth**

Following the GCBH's meeting, AARP surveyed a nationally representative sample of adults in the United States about sleep and their brain health.[1] They found that 99% of people age 50 and older believe sleep is important for their brain health, and those who rate their sleep quality better report more hours of sleep a night and greater mental well-being. But 43% say they don't get enough sleep. More than half (54%) reported that they wake up too early in the morning and can't get back to sleep. Forty-four percent said they rarely or never sleep through the night without waking up for more than a few minutes. See Figures 1-4 in Appendix 3, AARP 2016 Sleep and Brain Health Survey, Selected Data for Adults Age 50-Plus.

Given that many older people are interested in sleep and brain health, and have concerns about their sleep; that lack of sleep and poor quality sleep can harm brain health; and there are ways to improve sleep, the GCBH wanted to summarize the available evidence for the public. Understanding normal age-related changes in sleep, ways to improve sleep, and warning symptoms and signs of sleep disorders can help older adults improve cognition, improve overall health, and help detect early treatable conditions.

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Consensus Statements

These consensus statements and following recommendations are based on scientific evidence, from randomized control trials and epidemiological observational studies, which were well-designed with a substantial sample size, published in peer reviewed journals and replicated by other scientists so that the experts have confidence in the results. Because it is difficult to study sleep in the home setting and conduct randomized controlled trials related to sleep in peoples' homes, observational studies and expert opinions played a significant role in the generation of these consensus documents and recommendations.

1. Sleep is essential to overall mental and physical health and well-being.
   a. Sleep is vital to brain health, including cognitive function.
   b. Sleeping on average for seven to eight hours each day is related to better brain and physical health in older people.
2. The sleep-wake cycle is influenced by many different factors. The ability to sleep depends both on how long one has been awake and on the internal clock in the brain.
   a. A regular sleep-wake schedule is related to better sleep and better brain health.
   b. Regular daily exposure to light[2] and physical activity supports good sleep.
3. There are changes to sleep as people age:
   a. Sleep becomes less deep, and there are more awakenings.
   b. Sleep becomes more vulnerable to disturbances. (Box A lists factors that can disturb sleep).
4. People, at any age, can change their behavior to improve their sleep.
5. Persistent, excessive daytime sleepiness is not a normal part of aging.
6. Sleep disorders become more common with age, but they can often be successfully treated. (Box B lists symptoms of sleep disorders, which may merit further evaluation. Box C lists several examples of sleep disorders).
7. People with chronic inadequate sleep are at higher risk for and experience more severe conditions of dementia, depression, heart disease, obesity, diabetes, fall-related injuries, and cancer.

Box A Factors that can disturb sleep	**Box B** Symptoms of potential sleep disorders	**Box C** Examples of Sleep Disorders
• Shift work • Changing time zones • Hospitalizations • Environmental factors (e.g., noise, light, uncomfortable temperature) • Poor lifestyle patterns (e.g., lack of physical activity, irregular sleep-wake cycles, drinking too much alcohol or caffeinated beverages too late in the day) • Mental health issues (e.g., depression, anxiety) • Physical health issues • Pain • Certain medications • Menopause • Stress	If you experience these symptoms on a regular basis, you should be evaluated for a sleep disorder by a health care provider: • Persistent difficulties falling or staying asleep, which results in impaired daytime functioning or well-being • Daytime drowsiness • Fatigue or low energy • Difficulty paying attention and concentrating • Declining memory • Mood disturbance (irritability, depression) • Behavioral problems (impulsivity, aggression) • Impaired occupational or social functioning • Abnormal behaviors during sleep (e.g., kicking, calling out or shouting, nightmares, snoring, acting out dreams • Uncontrolled snacking during the night • Unusually prone to errors/accidents • Awakening short of breath, snoring, or witnessed apneas • Uncomfortable sensations in the legs at bedtime • Witnessed teeth grinding • Waking up with a headache or aching jaws or ears	• Insomnia • Sleep-related breathing disorders (such as sleep apnea) • Sleep-related movement disorders (such as restless leg syndrome and periodic limb movement disorder) • Hypersomnia (e.g., excessive daytime sleepiness, or excessively long sleep periods usually greater than 10 hours) • Parasomnias [such as acting out dreams, sometimes called Rapid Eye Movement (REM) sleep behavior disorder] • Circadian rhythm sleep disorders • Bruxism (grinding or clenching teeth during sleep)

2 *In the following discussion section, "Light is an Important Factor in Good Sleep," the GCBH provides more information on recommended types of light.*

Recommendations

A. To help people 50-plus maintain healthy sleep as they age:

Aim to get about 7- 8 hours of sleep in a 24-hour period.

Daytime Recommendations

1. Get up at the same time every day, seven days a week.
2. Expose yourself to light during the daytime.
3. Exercise: regular physical activity promotes good sleep.
4. If you are overweight, lose weight.
5. Beginning after lunch, avoid caffeine intake.
6. Don't worry too much about an occasional bad night of sleep.
7. Avoid driving when drowsy or sleep deprived (day or night).

Evening Recommendations

8. Restrict fluids and food three hours before going to bed.
9. Avoid alcohol several hours before bedtime. It can take 2 to 3 hours for your body to eliminate alcohol. Alcohol may help you fall asleep, but it can also cause you to feel awake when it is time to go to sleep or it may cause you wake up during the night.
10. If you have not yet stopped smoking, avoid any smoking and nicotine substances 4 to 6 hours before bed.
11. If you have trouble sleeping at night, but doze off in the evening, (e.g., when watching TV), either:
    a. Listen to your body, go to bed earlier and adopt an earlier sleep schedule, or
    b. If you feel it is too early to go to bed, you can keep yourself more alert by standing up and getting physical activity. More outdoor light exposure during the day and early evening will also keep you alert later into the evening.

Nighttime Recommendations

12. Go to bed only when you feel drowsy enough to fall asleep.
13. Maintain a regular routine in preparation for bedtime.
14. Keep the bedroom quiet and dark at night. If you have to get up in the night, use a soft amber-colored night light rather than turning on overhead lights. Replace cool white or blue-colored night lights with red or orange-colored night lights.
15. Maintain a bedroom temperature that is comfortable to you to promote falling and staying asleep.
16. Avoid using over-the-counter (OTC) medications for sleep as they can have negative side-effects, particularly as we get older.
17. Dietary supplements for sleep such as melatonin may have benefits for some but the scientific evidence on its effectiveness is inconclusive.
18. If you are using prescription medications to help you sleep, be aware that habitual use can limit their effectiveness. Therefore, consider limiting their use to three nights during the week, unless your health provider says otherwise.
19. Keep pets that disturb sleep out of the bedroom.
20. Keep smartphones, TVs, electronics, out of the bedroom. Limit use of the bedroom for sleep (that is, do not watch TV, read, use or play games on your smartphone or tablets, or read emails in the bedroom, etc.).

B. To help people who have trouble falling or staying asleep:

In addition to the recommendations in A, here are some practical tips for those who may be having issues falling or staying asleep:

1. Don't stay in bed if you are not sleepy. Leave the bedroom if you are in bed awake longer than you would like to be. Find a quiet place to relax outside of the bedroom and return to bed only once you feel sleepy.
2. Do not spend too much time in bed awake. Limiting your time in bed may improve the quality of sleep. For example, if you are sleeping 7 hours, you should only be in bed 7.5 hours, not 9-10 hours.
3. A regular warm bath may be beneficial 2-3 hours before bedtime.
4. Wearing socks to bed may be beneficial if you have cold feet.
5. Avoid difficult discussions or arguing in the evening.
6. If you worry a lot while in bed, schedule about 15 minutes each morning as your "worry time" specifically for intentional concentrating on the things you think about at night; this may make nocturnal worrying less.
7. Try relaxation therapies with deep breathing and meditation as these help some to fall and stay asleep.
8. Identify your most comfortable position and sleep environment by investigating how you lie most comfortably in bed (e.g., try different positions and pillows).
9. Avoid long naps; if you must nap, limit to 30 minutes in the early afternoon.
10. It's possible that you are getting more sleep than you think, but it is still worth consulting with your health care provider if your life is being negatively impacted by lack of sleep.

C. To help people who may have a possible sleep disorder:

Having disturbed sleep on a regular basis is not a normal part of aging. If you experience one or more of the warning signs below for an extended period of time, you may have a sleep disorder that could benefit from treatment. Seek evaluation for a sleep disorder if you experience the following:

a. chronic insomnia (difficulty falling asleep or staying asleep at least three times a week for at least three months, resulting in negative consequences in daytime functioning or well-being)

b. frequent snoring and/or waking with a dry mouth

c. cessation of breathing for periods of time during the night

d. daytime sleepiness

e. profuse sweating during sleep

f. discomfort in your legs before sleep

g. frequently kicking your legs or moving your feet during sleep

h. acting out your dreams during sleep

i. witnessed teeth grinding or waking up with a headache or aching jaws or ears

D. To help people with dementia who have trouble sleeping and their caregivers:

1. Follow the recommendations in A, B and C listed above to improve sleep. Improving sleep for people with dementia may have beneficial effects on daytime sleepiness and behavioral symptoms such as irritability, anxiety and agitation.
2. Talk to a health care provider about whether sleep apnea is causing or contributing to cognitive problems. Sleep apnea is common in elderly adults, and can aggravate symptoms of cognitive impairment. However, proper treatment of sleep apnea can improve sleep at night, reduce daytime sleepiness, serve to improve cognition and slow cognitive decline.
3. For people with dementia who wake frequently during the night, monitor daytime activities to assess the need to increase exercise, promote exposure to outdoor light during the day, and avoid excessive napping. This can be particularly challenging in persons with severe dementia, but excessive napping can disrupt adequate, restful nighttime sleep.
4. Be aware that many of the medications used to treat dementia, such as the cholinesterase inhibitors (donepezil, galantamine, rivastigmine) can also impact sleep. Check with your health care provider regarding the best timing of such medication. In some cases, taking the medication in the day can help avoid troubling dreams and nightmares, whereas in other cases, taking the medication during the night may reduce daytime sleepiness.
5. Be cautious of using melatonin or similar supplements. The effect of melatonin on the sleep of people living with dementia has not been extensively tested and the few existing studies have not been conclusive with most suggesting they do not benefit sleep quality. Meanwhile, because older people with dementia metabolize melatonin more slowly, it is likely to have long lasting effects that can worsen daytime functioning.

Practical Daytime Tips to Improve Sleep for People with Dementia

1. Whenever possible, increase light exposure by going outdoors without sunglasses. Light helps establish healthy sleep cycles as it enters the eyes. Exposure to bright light during the day is very helpful for sleep at night. If you are indoors, sit or stand near windows or in rooms with lights on during the day.
2. Stay out of bed during the day and increase daytime physical activity.

Practical Nighttime Tips to Improve Sleep for People with Dementia

1. Keep the temperatures in the bedroom comfortable—not too cool or warm—while sleeping.
2. If you assist a non-mobile person with dementia to bed, make sure that they get up after the normal 7 to 8 hour sleep cycle and not stay in bed too long.

E. To health care providers:

1. Treat sleep disorders, when existing with other medical illnesses (including psychiatric disorders), simultaneously, not sequentially.
2. Seek training on sleep disorders as well as normal changes to sleep over the lifespan that emphasizes faculty development, integrating sleep content into medical and health professions curricula, and providing continuing education on sleep to all primary care health professionals.
3. Do not over-medicalize sleep problems. Behavioral and environmental interventions can often be more effective than prescription drugs for insomnia.
4. Recognize that sleep is essential to the well-being of the people that you are treating and make time to adequately consult with patients on their sleep patterns and issues.
5. Arrange shifts so that non-mobile residents in health care facilities are not left in their beds too long. Nursing facilities where residents are regularly expected to be in bed for more than 8 to 9 hours are not conducive to establishing sound sleep patterns.

Process Used to Produce the Consensus and Recommendations

Issue specialists were selected to participate with the GCBH because they are considered leaders in their fields who have conducted research that has significantly contributed to the body of evidence connecting sleep with brain health amongst older adults. The diverse areas of their expertise represent different perspectives and disciplines including gerontology, neurology, neurobiology, psychiatry, psychology, sleep medicine, psychogeriatrics, and otorhinolaryngology.

Ten issue specialists from four continents were asked to critically examine the state of the science as of July 2016. They discussed findings from both observational and epidemiological studies to randomized controlled trials. The experts considered the cumulative body of evidence to determine whether it is sufficient to issue sleep recommendations for individuals to maintain and improve brain health.

The issue specialists considered 12 different questions as a framework to guide their deliberations. The complete list is available in Appendix 4, but the major questions they addressed were:

1. Are there changes in sleep patterns, duration, timing and quality as we age, and how does that impact cognitive function?
2. Do certain aspects of sleep (e.g., REM sleep) have an impact on how the brain processes information and, if so, does this change with age?
3. What recommendations would you make to older individuals that might help them reduce problems with sleep?
4. What is the relationship of napping to sleep patterns and quality of sleep as we age?
5. If people are taking prescription or over-counter sleep aides, what should they know about the impact of those medicines on cognition and does that change with age?
6. What are non-pharmacological methods of improving sleep patterns?
7. Are there sleep differences amongst older adults by decade?

After an in-depth moderated discussion, several follow up conference calls, and an exchange and refinement of drafts, the issue specialists arrived at seven consensus statements to summarize the impact of sleep on brain health particularly focusing on cognitive function such as memory, reasoning and thinking skills. Based on their consensus, they made numerous recommendations related to sleep in the context of brain health and cognitive decline. They further agreed on practical tips to help individuals adopt behaviors that could help them sleep better in order to promote their brain health.

Liaisons from civic and nonprofit organizations with relevant expertise in brain health and sleep were invited to provide input and technical feedback during the Issue Experts and Governance Committee's refinement of the draft recommendations.

Eight Governance Committee members participated during the in-person meeting. The entire Governance Committee reviewed and finalized the document during subsequent conference calls and emails in August and November 2016. The Governance Committee issuing the recommendations are also independent health professionals representing diverse expertise across three continents in epidemiology, psychology, public health, neurology, psychiatry, geriatrics, cognitive neuroscience, neuropsychology, pharmacology, medical ethics and health policy, and neurodegeneration.

The Governance Committee applied their expertise to determine whether they concurred with the statements and to evaluate the objectivity and feasibility of the proposed recommendations. The GCBH Governance Committee reviewed this summary document to decide whether it accurately reflected the expert opinions expressed and the current state of science in the field. The Governance Committee approved the document on December 5, 2016.

Discussion

It is normal for sleep to change with age, but poor quality sleep with age is not normal.

Sleep changes as you age. Sleep's structure and duration—both quality and quantity—go through significant changes. Because of this, a person who is 50 should not expect to sleep like they did at age 25. But the need for sleep does not change. It is recommended that most adults, at any age, get 7 to 8 hours of sleep a night throughout their lives to maintain good physical and cognitive health. But sleep is more easily interrupted as you age. Deep sleep decreases in adults between the ages of 30 to 60 years. So you may have to put more effort into getting the sleep you need and maintaining good sleep and lifestyle habits to keep getting the restorative benefits of sleep.

While most older adults find no change in the length of time it takes them to fall asleep, waking during the night or earlier in the morning begins to happen more frequently. The body's internal clock shifts and prompts changes in the timing of sleep. Older people tend to get sleepier earlier in the evening, and staying up late becomes more difficult. They also start to awake earlier in the morning. For example, if you may get sleepy at 8-9PM, go to sleep, sleep your 7-8 hours, and wake up at 4-5 AM. These changes are a normal part of aging and don't mean that a person's sleep quality is worse, or that the person necessarily has insomnia or another sleep disorder. It just means that the timing of your sleep has shifted.

In the 2016 Sleep and Brain Health Survey, 44% of adults 50 and older said their sleep quality is excellent or very good. About 84% said they are well-rested, but only 33% were very satisfied with the amount of sleep they get. See Figure 5, Sleep Quality, Appendix 3.

Other factors begin to impact sleep as you age. Sleep disorders become more common, as do age related diseases. Medications given to treat those diseases may also disturb sleep. Therefore, people who have trouble sleeping and regularly experience the symptoms listed above in Box B, such as daytime drowsiness or difficulty concentrating, should seek evaluation by their health care provider in order to determine if a sleep disorder or other health issue needs treatment. Unfortunately, many people do not pay attention to sleep problems. Too few health care providers consider sleep a serious health issue. Poor sleep should be taken more seriously, rigorously examined, and treated when necessary.

Good sleep routines help promote good brain health.

Having a regular sleep-wake schedule is related to better brain health. Getting up at the same time each day helps maintain a regular sleep cycle. Instituting good sleep routines (sometimes called sleep hygiene) by getting 7 to 8 hours of sleep a night, creating an environment conducive to sleep, keeping regular bed-time routines, and getting enough exercise and outdoor light exposure during the day can help people maintain good sleep patterns throughout their lives. If a person begins to experience significant insomnia and instituting good sleep practices is not a sufficient remedy, sleep specialists can recommend behavioral therapies and sometimes medication that can be of assistance. However, for most people, the most important practices to promote good brain health through adequate sleep is to maintain regular duration and timing of sleep.

While over half (56%) of adults 50 and older say they wake up at the same time every morning, less than half (48%) go to bed at the same time every night. About one-third (33%) say they get 7 to 8 hours of sleep per night. Twenty-five percent report getting between 8 to 9 hours of sleep, 23% say they get between 6 and 7 hours. Ten percent report less than 6 hours a day and 8% report more than 9 hours of sleep a day. See Figure 6, Sleep Routine, Appendix 3.

Numerous studies have demonstrated that loss of sleep impairs attention, memory and executive function, and increases the frequency of cognitive complaints in middle-aged adults. However, while many studies have suggested that maintaining good quality sleep benefits brain health, and some scientists believe improving sleep can delay or reverse cognitive aging, there is no definitive study establishing that for certain. It is still an open question whether better sleep improves cognitive function or whether better cognitive function improves sleep, or both. Interestingly, evidence from sleep deprivation experiments indicates that fewer hours of sleep and fragmented sleep appear to affect young adults more than middle-aged and older adults. Even taking into account the mixed results of the sleep deprivation research, the overall body of evidence in this area leads the members of the GCBH to conclude that maintaining good sleep quality throughout your life-span promotes better cognitive functioning in aging adults. The GCBH therefore recommends that adults 50 and older practice good sleep hygiene and that they should take steps to maintain and/or improve their sleep as they age.

Light is an important factor in good sleep.

Light helps establish healthy sleep cycles as it enters the eyes. Exposure to bright light during the day can be helpful for sleep at night. Outdoor sunlight is the most beneficial, but bright indoor light can be beneficial as well. Consider spending time outdoors without sunglasses to get more light exposure during the day. If older adults must stay indoors, they should sit or stand near windows or in rooms with lights on during the day. Even if you can't spend time outside, studies have shown that bright indoor light provided through phototherapy lamps and indoor light enhancement can improve sleep and cognition in older individuals.

Medications can disturb your sleep patterns.

As important as it is to practice good sleep hygiene by creating the right opportunities and environment to sleep, it is also important to avoid medications that can disturb your sleep where possible. Many people are unaware that many prescription drugs and common over-the-counter medications can cause side effects that pose problems for regular, restful sleep. Even medications commonly taken or prescribed to help you sleep may not be helpful if taken too often. The American Geriatric Society has created guidance called the Beers Criteria for Potentially Inappropriate Medication Use in Older Adults and is available at http://www.healthinaging.org/medications-older-adults/. The Beers Criteria identifies potentially inappropriate medications for people 65 and older—such as benzodiazepines, anticholinergics, hypnotics, barbiturates, antipsychotics, and some of the antidepressants—that can harm sleep over time and increase confusion and mental decline and even cause delirium. Before such medications are prescribed and taken, providers and consumers should take great care to evaluate that the risks to impairing sleep and cognitive function do not outweigh the benefits. Furthermore, they should conduct a re-evaluation whenever adding or prescribing a new medication.

Older adults should discuss any over-the-counter sleep medication or supplement they take with their health care provider. If people take an over-the-counter sleep aid to help deal with occasional sleeplessness, they should not take it every day. Diphenhydramine (commercial names vary by country such as Benadryl, Difedryl, Meridryl, etc.) is an over-the-counter antihistamine usually used for allergies or colds, causes drowsiness, and some people take it as a sleep aid. It surprises many people that over-the-counter medications commonly sold as sleep aids such as TylenolPM or MotrinPM contain diphenhydramine as the active ingredient to cause sleep. However, diphenhydramine can impair cognitive functioning, cause confusion and disrupt the quality of sleep. Its use may even potentially lead to problems such as sleep-walking. And if taken too frequently, people quickly build up a tolerance so that it loses its effectiveness. If adults want to improve their sleep, they should first try the recommendations listed above

Lack of sleep can be dangerous for your health and others' safety.

Insufficient or poor quality sleep has been shown to be a risk factor for cognitive impairment, as well as diabetes, heart disease and stroke. Insomnia increases risk for depression in both males and females. There can be serious, even fatal, consequences for people who do not get enough sleep. The National Highway Traffic Safety Administration reports that drowsy driving is a serious problem that leads to thousands of automobile crashes each year. People with sleep disorders who work at night are even more prone to serious traffic accidents.

Insomnia is a common sleep problem amongst older adults, but therapies can help.

Many older adults find that their sleep becomes more fragmented. Rather than falling asleep in the evening and sleeping through until the morning, many older adults go in and out of sleep. Frequent nighttime awakening is the most common age-related sleep complaint. If your difficulties falling asleep or staying asleep happen at least three times a week for at least three months and if you feel that your sleep affects your daytime functioning or well-being, you may have Insomnia Disorder. Insomnia Disorder is the most common of all sleep disorders.

Large studies suggest insomnia and its primary symptom of fragmented sleep can harm brain function. Older adults who have fragmented sleep have increased risks of cerebral small vessel disease as well as of poor cognitive and emotional functioning. Older adults with fragmented sleep are at greater risk for faster cognitive decline and have a higher risk of Alzheimer's disease than older adults without fragmented sleep. Insomnia is also a risk factor for stroke and the primary risk factor for the development of depression.

If your health care provider diagnoses you with Insomnia Disorder, ask about receiving cognitive behavioral treatment for Insomnia (CBT-I). CBT-I improves sleep and daytime well-being and has been shown to improve mood in people with depressive symptoms. CBT-I has also been shown to be more effective and safe than the use of sleeping pills.

Sleep apnea is pervasive amongst older adults, disrupting sleep and causing chronic sleep deprivation for some people.

As many as two-thirds of older adults (65 years and older) experience mild to severe symptoms of sleep apnea, a sleep related breathing problem where the airway collapses during sleep thus making it difficult to breathe. This is called obstructive sleep apnea because the airway is obstructed. Sleep apnea can have symptoms that impact daily life. About one-quarter of those with sleep apnea have severe symptoms. Severe sleep apnea has been shown to negatively impact brain function and physically harm the brain's tissue and the brain stem. Encouragingly, however, successful treatment of sleep apnea, which improves sleep quality and increases the amount of oxygen in the blood, has been shown to lead to repair of the brain damage thus positively impacting brain health.

Just as our skin begins to sag with age, so do the tissues in our airway. This makes the airway smaller, which can contribute to the airway collapse and thus sleep apnea. The most common cause of obstructive sleep apnea is excess weight and obesity. Therefore, body-mass index (our weight to height ratio) is the best predictor of sleep apnea, with overweight people at far greater risk. If you have sleep apnea and are overweight, any treatment should ideally include losing weight. People 65-plus with sleep apnea show substantially higher rates of cognitive impairment and dementias such as Alzheimer's Disease than those without sleep apnea. In one research study, three weeks of treatment of sleep apnea with nasal continuous positive airway pressure (CPAP) was shown to improve some aspects of cognitive function for people with Alzheimer's disease.

The surprise about napping: it can be both good and bad.

Forty-five percent of adults 50-plus in the United States nap once a week or more (2016 Sleep and Brain Health Survey). Many cultures take daily afternoon siestas or naps, and some of the healthiest, long lives are in places where the afternoon nap is part of the daily ritual, such as the riposo in Italy. The experts recommending adults get 7 or 8 hours of sleep within a 24 hour period do not specify that it should be taken all at once.

But amongst the GCBH sleep experts, the question of whether napping is good or bad for adults' brain health is surprisingly controversial. Awareness of most of the positive effects associated with napping—improved performance, less sleepiness, and improved daytime alertness and mood—has emerged from small studies on younger adults, shift workers, and long-distance drivers. There have not been many large sample size studies testing the effects of napping on the cognitive functioning of middle-aged to older adults. Recent studies, however, have shown that taking an afternoon nap improves cognitive functioning such as memory in middle-aged adults, but the impact on older adults is less clear. AARP's 2016 Sleep and Brain Health survey revealed that those adults 50-plus who nap do not feel more well-rested than non-nappers. See Figure 7, Napping, Appendix 3.

Afternoon naps of 30 or minutes or less in the early afternoon are unlikely to disrupt nighttime sleep. Naps can help older people stay alert until later in the evening than they normally would. However, long, late naps can be hazardous to sleep at night because it is likely to decrease the ability to fall asleep and then stay asleep. If you suffer from persistent insomnia, or feel you are not getting restful sleep at night, you may want to avoid naps all together. It is clear that excessive daytime sleepiness is not normal for adults of any age. If an older adult is dozing off all the time, or at inappropriate times, a medical evaluation is advisable.

Like all other health issues, socio-economic factors play a big role in quality of sleep.

Socioeconomic factors can affect sleep whereby sleep problems occur more often in people who have low socio-economic status (SES). Obesity, which is more likely in people with lower incomes and lower educational levels, increases the risk of obstructive sleep apnea. People, typically of lower SES, who work at night or in shift jobs with irregular schedules, have greater issues with getting sufficient quality and quantity of sleep. Living in disadvantaged neighborhoods can also greatly affect sleep duration and quality. For example, in a study known as the Hispanic Community Health Study/Study of Latinos, some evidence showed that low socio-economic factors were associated with poorer quality sleep and that noise level (and perhaps light) negatively impacted participants' sleep.

Women & sleep (or lack thereof).

The change in hormones accompanying a woman's transition through perimenopause and menopause can cause insomnia and sleep disturbances. Hot flashes, or surges of adrenaline waking your brain from sleep, may produce drenching sweat and changes of temperature, disrupting sleep and comfort levels. Relaxation at night and exercise during the day can help, as does keeping the bedroom cool, and following the recommendations above for improving sleep. Note that a comfortable room temperature for a woman going through menopause may not be the same for her sleeping partner. Some women opt for hormone replacement therapies.

While historically sleep apnea has been thought of primarily as an issue in overweight men, we now know that sleep apnea is also common in women, particularly post-menopause. Previously, women were less likely to be diagnosed and treated for sleep apnea, perhaps in part due to differences in symptoms between men and women. While women may also snore and be sleepy during the day, women may also present with symptoms such as fatigue, insomnia, morning headaches, disturbed mood, or other generalized issues that may suggest causes other than sleep apnea.

The importance of sleep is often not taken seriously by health care professionals (and just about everyone else).

Most people with sleep problems do not mention it to their health care providers. Despite the large number of adults with concerns about how well they sleep and the increasing prevalence of sleep disorders in adults as they age, primary care providers often do not often ask questions about sleep during physicals or wellness visits for older adults. Although there are exceptions, medical and health professions schools generally do not provide enough training on the importance of sleep to physical and mental well-being. In fact, within the medical and health professions itself, and particularly during training for doctors' residencies, sleep deprivation has been a badge of honor and sign of dedication to one's profession. In many occupations, hard work, long hours, and pride in surviving on minimal sleep has been reason for bragging rights.

We should prioritize sleep more in today's go-go society.

Moreover, the fear of missing out on the increasingly 24/7 society, perpetuated by social media and different time zones operating on one Internet, causes people to continually miss out on sleep. Because we have not fully recognized the adverse consequences of sleep deprivation in the past, inadequate sleep simply has not been an issue of focus. Culturally, we need to shift the perception that lack of sleep is something of which to be proud. Instead, we need to recognize that getting sufficient sleep of good quality is fundamental to our brain and body's health and well-being.

Knowledge Gaps Where More Research is Needed

GCBH members identified areas where more research is needed to better understand the impact of sleep on brain health in adults.

Expansive and integrated clinical trials—There was strong consensus among the panel that many of the important and significant questions in the area of sleep and brain health could be best addressed in a long-term (e.g., 5-year) study in which different types of interventions to treat different types of sleep problems could be evaluated. The types of interventions are broad and might include any or all of the following: behavioral strategies designed to improve sleep, treatment for specific sleep disorders such as CPAP treatment for sleep apnea, medications of different types that impact sleep, and/or interventions that target the timing of when sleep occurs. Such research could test whether sleep interventions in the older population might impact cognition, mood, physical functioning, and other medical conditions such as diabetes and pain. As a more immediate need, a shorter-term (3-12 month) study could be conducted to determine feasibility of approach, defining the population to be studied and to decide upon the most relevant outcomes. It is important to conduct studies that consider older adults' multi-morbidities simultaneously and differences by gender.

Basic science—Exciting new discoveries in neuroscience imply that sleep impairment or sleep loss may be a causative factor for neurodegenerative diseases involving, for example, deposition of amyloid and/or protein misfolding and cell death. The recent description of the role of the glymphatic system in the brain as a means whereby sleep can serve to flush toxins deserves greater attention. New developments in neuroimaging may herald a way to examine sleep's functions in the sleep of aged animals and humans.

Mechanisms of insomnia—Whereas there is a considerable knowledge of mechanisms involved in sleep apnea and REM sleep behavior disorder, brain mechanisms underlying the most common sleep disorder of insomnia remain elusive and require more extensive studies.

External impacts—We need more evidence on socioeconomic differences in sleep and its effects on the cognitive function of diverse groups.

Food and sleep—We need to understand more about the relationship between timing of sleep and food intake to be able to better advise people on optimal timing of food in relation to sleep.

Conclusion

As the population ages, more and more people are interested in what they can do to maintain their brain health. An abundance of sources are now available for people to find information, but it can be difficult to ascertain what the weight of current science says when new and sometimes conflicting studies are reported. The GCBH makes its recommendations to help people know what practical steps they can take to foster better brain health and feel confident they are taking them based upon reliable and scientifically credible information.

The consensus statements and recommendations above are based on the current state of science as of July 2016. As further developments occur in the study of the impact of sleep on brain health, the GCBH will periodically revisit these recommendations and provide updates when appropriate.

List of Appendices

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Members of the Global Council on Brain Health are independent health care professionals and experts coming from a variety of disciplines. The sleep issue specialists and Governance Committee members formulated these recommendations, the Governance Committee approved them.

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Other experts from relevant public agencies and nonprofit associations provided guidance and feedback to help shape of these recommendations. Grateful acknowledgment goes to:

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Participants and Liaisons' List of Additional Resources

American Geriatric Society (AGS) Beers Criteria for Potentially Inappropriate Medication Use in Older Adults. See: http://www.healthinaging.org/medications-older-adults

"A Good Night's Sleep" from the National Institute on Aging (NIA). See: https://www.nia.nih.gov/health/publication/good-nights-sleep

"Recommended Amount of Sleep for a Healthy Adult: A Joint Consensus Statement of the American Academy of Sleep Medicine and Sleep Research Society." See: http://www.aasmnet.org/resources/pdf/pressroom/Adult-sleep-duration-consensus.pdf

General information about sleep and sleep disorders from the Centers for Disease Control and Prevention (CDC). See: http://www.cdc.gov/sleep/index.html

The website of the Alzheimer's Drug Discovery Foundation. See: www.cognitivevitality.org

**Participation in this activity by these individuals does not necessarily represent the official viewpoint of the U.S. Department of Health and Human Services, the National Institutes of Health, or the National Institute on Aging.*

2. Glossary

The glossary highlights how the GCBH used these terms within the context of their discussions and in this document.

Brain Health. The mental process of cognition including the abilities to think, reason, learn, remember, concentrate, use judgment and plan.

Circadian Cycles. A term, also known as the circadian rhythm, which describes the 24-hour repeating cycle of the internal "body clock." The cycle controls when you're awake and when your body is ready for sleep.

Circadian Misalignment. A term that describes a variety of circumstances, such as inappropriately timed sleep and awakening, misalignment of sleep/wake with feeding rhythms, or misaligned central and peripheral rhythms. The predominance of early research focused on misalignment of sleep to the biological night.

Cognitive Decline. The Institutes of Medicine (IOM) in 2015 defined a similar term, cognitive aging, as the lifelong process of gradual and ongoing, yet highly variable, change in cognitive functions that occur as people get older. Cognitive decline is a term used by the experts to describe losing cognitive abilities over time as people age absent a specific disease or condition.

Confounder. A situation in which the effect or association between an exposure and outcome is distorted by the presence of another variable.

Dementia. Dementia isn't a specific disease. Instead, dementia describes a group of symptoms affecting memory, thinking and social abilities severely enough to interfere with daily functioning. Though dementia generally involves memory loss, memory loss has different causes. So memory loss alone doesn't mean you have dementia. Alzheimer's disease is the most common cause of a progressive dementia in older adults, but there are a number of causes of dementia. Depending on the cause, some dementia symptoms can be reversed.

Extreme Sleepiness. A condition formally called 'idiopathic hypersomnia,' where the person may suffer either constant or recurrent episodes of extreme or excessive sleepiness. Described as being so sleepy you cannot stay awake when you want to.

Epidemiological studies *(which can be cross-sectional or longitudinal)*. In these studies, which are observational in nature, scientists try to establish a link between lifestyle activities over time (e.g., rsleep) and long-term outcomes (brain health with aging).

Glymphatic system. The waste clearance pathway of the central nervous system.

Insomnia. A sleep disorder characterized by difficulty falling asleep or staying asleep, even when a person has the chance to do so at least three times a week for at least three months, that results in the person feeling that he or she has impaired daytime functioning or well-being, such as reduced cognitive performance or fatigue. The complaints should persist even in optimal circumstances; that is, not be secondary to limitations of time or a disruptive environment.

Light. The natural agent that stimulates sight and makes things visible.

Longitudinal studies. In longitudinal research, scientists observe changes over an extended period of time to establish the time-sequence in which things occur or the effect of a factor over time.

Mental. Relating to the mind, including reasoning, thinking, mood, attention, feelings, emotion and interest in activities.

Randomized Controlled Trial (RCT). In a typical randomized controlled trial, people are randomly selected to receive either the intervention or a control condition. In a double-blind trial, both the participants and the researchers are unaware of (or "blinded" to) which person received the intervention until after the results are analyzed.

REM sleep behavior disorder (RBD). A sleep disorder in which a person physically acts out vivid, often unpleasant dreams with vocal sounds and sudden, often violent arm and leg movements during REM sleep — sometimes called dream-enacting behavior.

Restless Leg Syndrome. Restless legs syndrome (RLS) is a neurological disorder characterized by throbbing, pulling, creeping, or other unpleasant sensations in the legs and an uncontrollable and sometimes overwhelming, urge to move them.

Risk. Risk is the chance or probability of a particular event happening in a group of people with similar characteristics or traits, compared with not having that characteristic or trait. An individual's overall risk of having a condition is the cumulative effects of factors that increase the chance of developing the condition (risk factors) as well as factors that decrease the chance of developing the same condition (protective factors).

Risk reduction. Reducing risks for cognitive decline or impairment in the abilities to think, reason, and remember means lowering your chances of experiencing loss in those abilities. A person's overall risk may also be reduced by increasing factors that protect against cognitive decline or dementia. Dementia (due to Alzheimer's disease or another related disorder) is one condition, and cognitive decline (the slowing of thinking and memory in the absence of a major

brain disease) is another condition. When scientists study risk-reduction strategies for cognitive decline, they are looking for factors that can reduce the risk of impairment to cognitive functions in the population in general. Therefore, some activity or intervention that reduces risk for a particular condition or disease means that a smaller proportion of people who engage in that activity are likely to have the condition or disease. However, risk reduction strategies are not the same as preventing any one individual from getting the condition or suffering from disease. For example, wearing a seatbelt reduced—but did not eliminate—the chance of injuries among people who were involved in automobile accidents, and we nevertheless now recommend people wear seatbelts while they are driving.

Sleep Deprivation. Not allowing or obtaining a sufficient duration of sleep.

Sleep Disruption. An episode where normal sleep is interrupted.

Sleep Duration. The amount of time between when one falls asleep and when one wakes up.

Sleep Fragmentation. A symptom of disturbed sleep in that sleepers can generally get to sleep pretty quickly after going to bed, but have a hard time staying asleep.

Sleep Hygiene. Sleep hygiene is a variety of different practices that are necessary to have normal, quality nighttime sleep and full daytime alertness.

Sleep Latency. The length of time it takes to fall asleep, from full wakefulness to the lightest form of non-REM sleep.

Sleep Quality. A subjective term in which the sleeper describes his or her quality of sleep (sleeping usually well/not so well).

Sleep-Related Breathing Disorders. A sleep disorder commonly identified as sleep apnea, in which breathing is briefly and repeatedly interrupted during sleep. The 'apnea' in sleep apnea refers to a breathing pause that lasts at least ten seconds.

Central Sleep Apnea (CSA). A form of sleep apnea in which the brain fails to properly control breathing during sleep.

Obstructive Sleep Apnea (OSA). Obstructive sleep apnea occurs when the muscles in the back of the throat fail to keep the airway open, despite efforts to breathe.

Sleep Restriction. A term, often used in cognitive behavioral therapy, in which the number of hours of sleep is restricted.

Sleep-Wake Schedule. A regular pattern of sleep and waking that is regulated by circadian cycles.

Toxins. Harmful substances accumulated in brain tissues.

Well-being. Self-judgment of life satisfaction often described as the state of being comfortable, healthy or happy.

3. AARP 2016 Sleep and Brain Health Survey, Selected Data for Adults Age 50-Plus

Full Survey results available at www.aarp.org/sleepandbrainhealth

Figure 1. Better Sleep = Better Perceptions of Brain Health

Significantly more adults 50-plus with better sleep habits (e.g., get 7-8 hours of sleep, sleep through the night, say they are very well-rested, etc.) report their brain health is excellent or very good.

Adults who say they…	% who say their brain health is excellent or very good
Sleep 7-8 hours a night	**69%★**
Sleep less than 7 hours a night	57%
Sleep more than 8 hours a night	64%
Sleep through the night most of the time	**73%★**
Sometimes/rarely/never sleep through the night	61%
Are very well-rested	**78%★**
Are somewhat/not very/not at all well-rested	60%
Have excellent/very good sleep quality	**78%★**
Have good/fair/poor sleep quality	54%
Get the right amount of sleep	**71%★**
Don't get enough sleep	58%
Get too much sleep	41%
Sleep with a partner, pet, infant, or child	**68%★**
Sleep by themselves	59%

Figure 2. Better Sleep = Better Perceptions of Well-Being

Adults 50-plus who have no trouble with waking up too early and those who sleep through the night, average more sleep and have higher mental well-being scores.

How often do you have trouble waking up too early and not being able to fall back to sleep…	Avg. hours of sleep	Avg. mental well-being
Most of the time	6.1	46.5
Sometimes	6.9	50.9
Rarely	7.2	52.2
Never	**7.3**	**54.4**

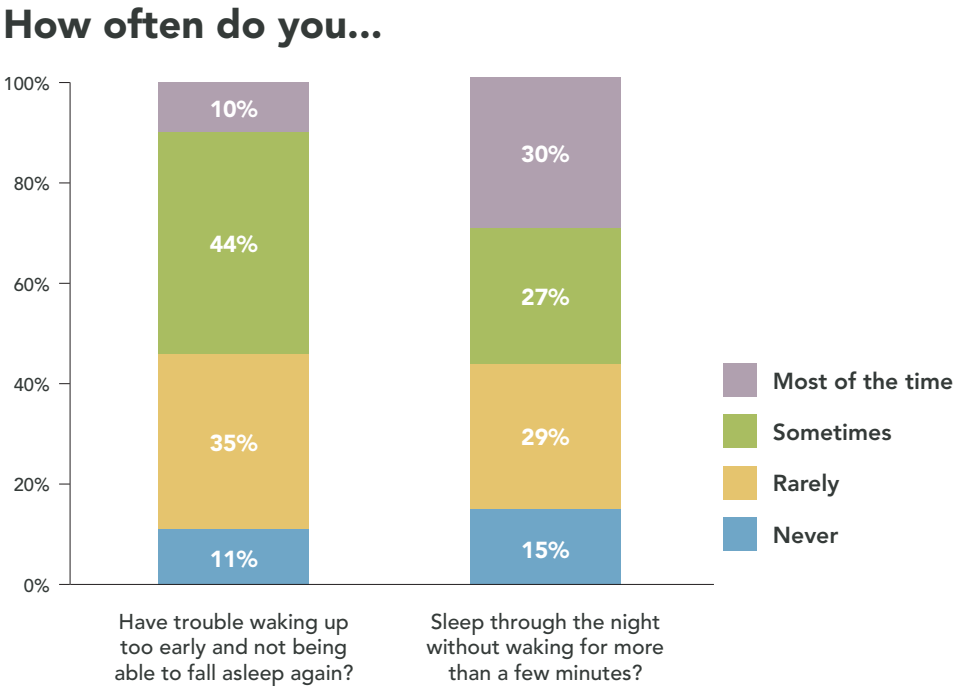
How often do you sleep through the night without waking up for more than a few minutes…	Avg. hours of sleep	Avg. mental well-being
Most of the time	**7.2**	**52.9**
Sometimes	7.0	51.5
Rarely	6.9	50.6
Never	6.8	49.1

Figure 3. Amount of Sleep

50+ adults who say they get...		Avg. hours of sleep
Too much sleep	2%	8.1
Right amount of sleep	55%	7.4
Not enough sleep	43%	6.3

Figure 4. Better Sleep = Better Perceptions of Well-Being

Many adults 50-plus have some difficulty sleeping or staying asleep. Over four in 10 (44%) say they rarely or never sleep through the night and over half (54%) say they cannot fall back to sleep when they wake up.

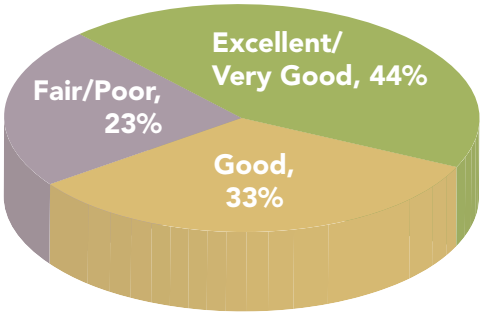


Q13: How often do you have trouble with waking up too early and not being able to fall asleep again?
Q14: How often do you sleep through the night without waking for more than a few minutes?

Figure 5. Sleep Quality

Adults 50-plus average seven hours of sleep per night and most are getting the amount of sleep they think they need.

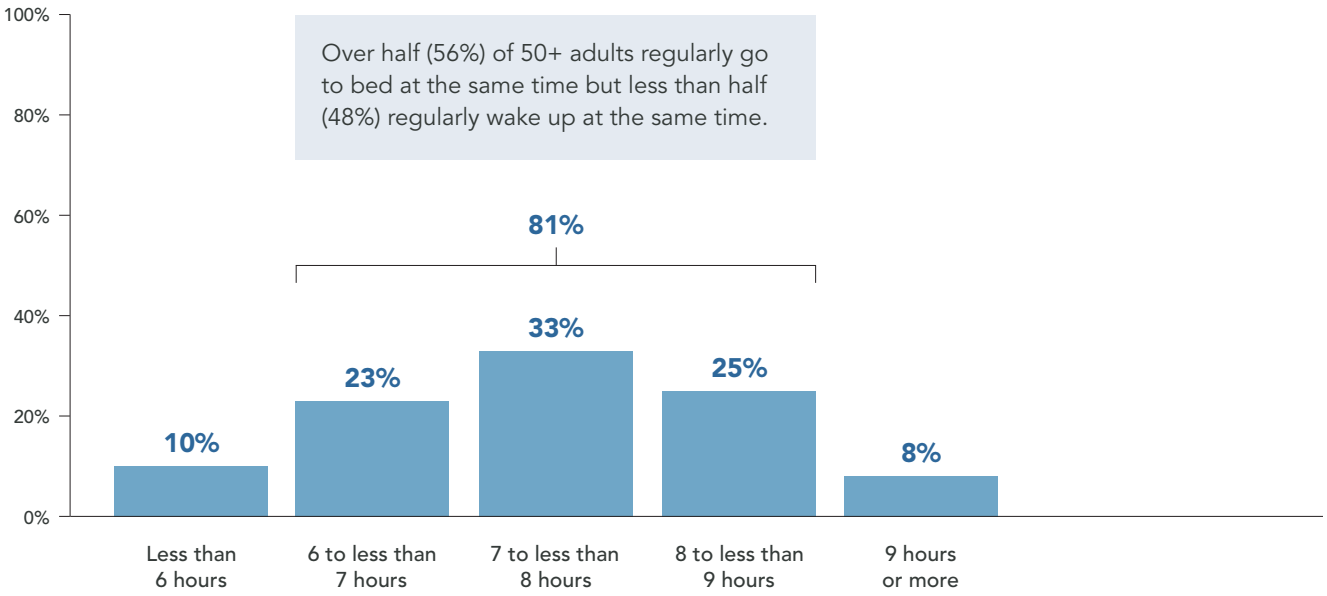
Overall, how would you rate the quality of sleep you get?



The 23% who say their sleep quality is fair or poor represents approximately 22.8 million adults 50-plus in the U.S.

Figure 6. Sleep Routine

Adults 50-plus average seven hours of sleep per night and most are getting the amount of sleep they think they need.



Q11: Without counting naps, how many hours of sleep do you get per day?
Q12: How many hours of sleep do you need to function at your best during the day?
Q16: How often do you…? (Wake up at the same time every morning, Go to bed at the same time every night)

Figure 7. Napping

The percentage of adults who nap increases with age. Additionally, for people 50-plus, more retired adults, men, and African Americans are nappers.*

Among the 50-plus, non-nappers have small but significantly higher average mental well-being scores (52.1 vs. 50.5) compared to nappers.

Among the 50+, nappers are no more well-rested than non-nappers:

- 24% of nappers are very well-rested
- 30% of non-nappers are very well-rested

** Nappers are adults who nap once per week or more often*

Age, retirement status, gender, race/ethnicity	Non-Nappers	Nappers
Total	**58%**	**41%**
Age 50-54	57%	37%
Age 55-64	64%	42%
Age 65-74	73%	47%
Age 75+	61%	**59%**
Not retired	78%	41%
Retired	60%	**50%**
Male	78%	**52%**
Female	54%	38%
African American	71%	**55%**
Hispanic/Latino	58%	44%
Asians	41%	37%

4. Discussion Questions Framing the Deliberations

1. Are there changes in sleep patterns as we age?
2. Do certain aspects of sleep (e.g., REM sleep) have an impact on how the brain processes information and, if so, does this change with age?
3. Are there changes in the amount of sleep an individual needs as they grow older?
4. Is disrupted sleep or insomnia more common as people get older?
5. What recommendations would you make to older individuals that might help them reduce problems with sleep?
6. Are there specific activities you would encourage or discourage prior to going to sleep (e.g., things they should eat or drink, types of exercise, types of electronic communication or listening to the news)?
7. When people are given advice about ways to minimize problems with sleep, are they generally good at implementing these changes in their daily life?
8. Does disrupted sleep or poor quality sleep have an impact on cognitive function?
9. Does napping during the day have an impact on cognitive function? If so, do the impacts change as we age? Does taking a nap make it harder to sleep through the night?
10. If people are taking prescription or over-counter sleep aides, what should they know about the impact of those medicines on cognition? Is the impact of sleep medications more pronounced as people get older?
11. What are non-pharmacological methods of improving sleep patterns? How are they best implemented?
12. What do we know about sleep for 50 year olds, and for 60, 70, 80, and 90 year olds? The National Sleep Foundation treats adults as 26 to 64, and older adults 65-plus. Are there differences amongst older adults by decade?

5. Disclosure Statement of Potential Financial Conflicts of Interest

All of the twenty-three GCBH experts participating in the formulation of this paper were asked to disclose potential conflicts of interest. Fifteen of the experts who participated in the meeting and contributed to the formulation of the recommendations attested they had no conflicts of interest. Eight disclosed potential conflicts of interest involving consulting with pharmaceutical companies, participating in new drug investigations, stock ownership in drug companies, and/or speaking at or participating in scientific advisory organizations. These disclosures are available upon request by contacting staff of the Global Council on Brain Health.

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