AMERICAN THORACIC SOCIETY DOCUMENTS

An Official American Thoracic Society Statement: The Importance of Healthy Sleep

Recommendations and Future Priorities

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Rationale: Despite substantial public interest, few recommendations on the promotion of good sleep health exist to educate health care providers and the general public on the importance of sleep for overall health.

Objectives: The aim of this American Thoracic Society (ATS) statement is to provide a review of the current scientific literature to assist health care providers, especially pulmonologists and sleep physicians, in making recommendations to patients and the general public about the importance of achieving good quality and adequate quantity of sleep.

Methods: ATS members were invited, based on their expertise in sleep medicine, and their conclusions were based on both empirical evidence identified after comprehensive literature review and clinical experience.

Main Results: We focus on sleep health in both children and adults, including the impact of occupation on sleep, the public health implications of drowsy driving, and the common sleep disorders of obstructive sleep apnea and insomnia. This ATS statement also delineates gaps in research and knowledge that should be addressed and lead to new focused research priorities to advance knowledge in sleep and sleep health.

Conclusions: Good quality and quantity of sleep are essential for good health and overall quality of life; therefore a strong recommendation was made for the implementation of public education programs on the importance of sleep health.

Keywords: sleep health in children and adults; drowsy driving; sleep apnea; sleep and occupation; insomnia

Contents

Overview

Sleep is an essential biological function with major roles in recovery, energy conservation, and survival (1). Sleep also appears to be important for vital functions such as neural development, learning, memory, emotional regulation, cardiovascular and metabolic function, and cellular toxin removal (2–5). It is clear that good-quality sleep is critical for good health and overall quality of life. Despite substantial interest from the general public, there are few health promotion recommendations on good sleep health to educate the general public and health care providers about the importance of sleep for overall health. In addition, there is a lack of formal sleep education globally for physicians and other health care providers.

The purpose of this document is to (*1*) provide a review of the current scientific literature to make general recommendations on the importance of achieving good-quality sleep with a focus on sleep health in adults and children; the impact of work schedules on sleep; the public health impact of drowsy driving; the diagnosis and treatment of the common sleep disorders of obstructive sleep apnea and insomnia; and to (*2*) identify research and knowledge gaps to direct further work in these areas.

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Major Conclusions of This Statement

- Good-quality sleep is critical for good health and overall quality of life.
- The amount of sleep needed by an individual varies significantly with age across the life span.
- Children are not merely smaller adults regarding sleep and differ importantly from adults, thereby requiring specific attention to sleep maturational processes.
- Disparities exist in sleep health related in part to modifiable factors for adequate sleep quality and quantity such as having a safe, predictable place for sleep and being able to devote adequate time to obtain sufficient sleep.
- Short sleep duration (≤6 h per 24-h period) is associated with adverse outcomes including mortality.
- Long sleep duration (>9–10 h per 24-h period) may be associated with adverse health outcomes.
- As such, the committee believes that the optimal sleep duration for adults for good health at a population level is 7–9 hours, although individual variability exists.
- Drowsy driving is an important cause of fatal and nonfatal motor vehicle crashes.
- Occupational demands are a frequent cause of insufficient sleep and can contribute to accident risk in the workplace.
- Sleep disorders are common, cause significant morbidity, and have substantial economic impact, but are treatable.
- Many individuals with sleep disorders remain undiagnosed and untreated.
- At present, health care providers receive little formal education on the importance of sleep to health or on the evaluation and management of common sleep disorders.

Key Recommendations

- For children, we suggest that age-based recommendations for sleep duration be developed. These should enable the child to awaken spontaneously at the desired time through implementation of regular wake and sleep schedules.
- For adolescents, we suggest that school start times be delayed to align with the physiological circadian propensity of this age group.
- We recommend that health care providers receive a greater level of education on sleep hygiene and encourage patients to maximize their sleep time.
- We recommend that public education programs be developed to emphasize the importance of sleep for good health.
- Sleeping longer than 9–10 hours per 24-hour period may be normal, but may also be associated with various causes of ill health. We recommend that health care providers be aware of reported associations and investigate individuals for underlying causes as appropriate.
- We recommend that all drivers (occupational or nonoccupational) receive education about how to recognize the symptoms and consequences of drowsiness.
- Adolescents may be a particularly susceptible group to drowsy driving; therefore, we recommend inclusion of sleep awareness during their driving education.
- Some data also suggest that sleep-deprived individuals may be particularly susceptible to the effects of alcohol from the standpoint of driving risk, and thus particular caution is recommended in this context.
- We recommend better education for the general public and health care providers regarding the impact of working hours and shift work on sleep duration and quality and the association of sleepiness with workplace injuries.
- We recommend better education of professional transportation operators regarding obstructive sleep apnea (OSA), other sleep disorders, and medications that may interfere with alertness.
- We recommend better education/awareness for the general public and physicians regarding the importance of early identification of high-risk OSA groups (in children and adults) because of the profound public health implications of untreated OSA.
- We recommend better education of physicians as to the effectiveness of cognitive behavior therapy for insomnia (CBT-I) rather than immediate implementation of hypnotics and sedatives.
- We recommend structural changes to increase access to CBT-I including training of a wider range of health care providers to administer this treatment and insurance coverage of this treatment modality.

Introduction

Sleep is a homeostatically regulated biological function, and is universally experienced as a state of unawareness. We spend approximately one-third of our lives asleep (6), and sleep has major roles in recovery, energy conservation, and survival (7) based on rat studies where total sleep deprivation leads to death within 3 weeks (1). Sleep also appears to be important for vital functions such as neural development; learning; memory; emotional, cardiovascular, and metabolic regulation; and cellular toxin removal (2–5). There is a complex relationship between sleep and the circadian system, which can be impacted by the environment (e.g., artificial light, alcohol, organizational and behavioral factors) (2). What is clear by these and other studies is that quality sleep is essential for good health and overall quality of life.

Of major concern is the widely reported decline over the past century, particularly during the past 20–30 years, in the United States and internationally in the relative importance the population assigns to sleep (as measured by reported sleep duration) compared with other daily activities such as work, commuting, and the use of electronics such as television, computers, and mobile phones (8, 9). This societal trend has coincided with increased rates of obesity, diabetes, and the development of other chronic debilitating diseases. It has been postulated that the reduction in sleep duration may be a contributing factor to the development of these and other common complex diseases (10, 11).

Methods

American Thoracic Society (ATS) members of the Sleep and Respiratory Neurobiology Assembly were invited to contribute to this document to develop health promotion recommendations on good sleep health and to determine priority areas for education of the general public and/or health care providers about the importance of sleep for overall health.

Panelists were chosen on the basis of broad interests in sleep, including the clinical management of sleep disorders and research interests in sleep health with particular expertise in sleep epidemiology, occupational health, drowsy driving, and pediatrics. Potential conflicts of interest

were disclosed, vetted, and managed in accordance with the policies and procedures of the ATS. The panel was formed and regular teleconferences were held to review priorities and the draft document. It was determined that priority areas for this statement would include sleep in children and adults, the importance of sleep duration, drowsy driving, occupational sleep issues, and sleep disorders (sleep apnea and insomnia). A comprehensive literature review was undertaken, and final recommendations were derived by consensus. Recommendations were developed from the evidence if this was available and from best practice determined by consensus.

How Much Sleep Is Enough for Long-Term Health?

There is marked individual variation in the amount of sleep that an individual will need throughout the life span to ensure good health (12, 13). This variation reflects age- and sex-specific factors in addition to genetic and environmental factors. Large segments of the population will function well if they are able to obtain 7–8 hours of sleep. However, "normal" sleepers have been shown to overestimate the amount of sleep they actually get (14) and therefore certain segments of the population who believe that they obtain "adequate" sleep are in fact chronically sleep deprived (15). The very nature of aging is associated with changes in sleep architecture, particularly increased difficulty in sleep initiation and maintenance and the emergence of daytime napping (16).

Furthermore, few large-scale studies of self-reported sleep habits in general populations have been undertaken. Of the studies that were reviewed for this statement, most if not all were affected by recall bias and failed to assess lifestyle factors that might significantly impact reported sleep duration (e.g., work schedules, family factors, illness). They also failed to assess comorbid sleep disorders, such as obstructive sleep apnea or insomnia, or an underlying disease that may contribute to sleep disturbance (e.g., depression or chronic pain). These studies are also difficult to interpret because of differences in the types and size of populations studied, variability in the questions asked to determine self-reported sleep (e.g., amount of sleep in a 24-h period vs. time in bed), and differing definitions for short and long sleep duration. Other factors that impact the generalizability of these studies include variable follow-up times and effect sizes (10), and the use of different outcome measures (neurocognitive and performance-based measures vs. mortality, obesity, diabetes, cardiovascular disease). Even fewer studies have measured sleep duration or sleep stage objectively, thereby markedly restricting the available information and contributing to the challenges in this area.

Sleep is also linked closely to psychiatric illness, with sleep abnormalities being one of the earliest manifestations of depression and one of the most refractory to treatment with antidepressant therapies (17, 18). In addition, chronic insomnia is a major risk factor for the development and recurrence of depression and other mental disorders (19).

Sleep in Children

Children are not merely smaller adults regarding sleep; they significantly differ from adults (20). The most obvious difference is the long proportion of time they spend asleep. Newborn infants sleep approximately 70% of the day, which reduces with age. Sleep cycles are shorter in infants, averaging 40 minutes compared with 90 minutes for adults. Sleep onset is through active (REM) sleep in newborn infants, but this finding gradually changes to sleep onset through non-REM (NREM) sleep as the child develops (21). During preschool years, naps are discarded and sleep consolidates into one nocturnal period with a reduction in the proportion of time spent in REM to the 20–25% of total sleep time seen in adults. During school age/late childhood, the percentage of NREM sleep is highest, with sleep architecture continuing to evolve to become more similar to that of adults, although there can be considerable individual variability. By adolescence, sleep architecture is similar to that of adults. The onset of puberty has been shown to be associated with a phase delay with later sleep onset and wake times. Lifestyle and social factors often mean a chronic sleep debt accumulates during the week, which the teenager attempts to address by sleeping in on weekends, which is ineffective and further contributes to the circadian disruption. Interestingly, the delay of school start time by half an hour from 8:00 to 8:30 A.M. results in a significant increase in sleep duration, with concomitant improvements in alertness, motivation, and mood in adolescents (22, 23).

Short Sleep Duration

Short sleep duration (defined by most studies as $\leqslant$6 h of sleep per 24-h period) has been associated with adverse health effects (10). Much of this knowledge comes from animal models of sleep deprivation (1) and from short-term experimentally induced sleep deprivation in humans, where deficits in cognition, vigilance, memory, mood, behavior, ability to learn, immune function, and general performance (6, 24) have been identified. Self-reported short sleep duration in epidemiological studies has also been associated with long-term outcomes such as diabetes (25–27), obesity, depression (28), hypertension (29), and all-cause mortality (10), with at least some studies showing the elderly being particularly susceptible (30). Underlying mechanisms to explain the potential relationship between short sleep duration and the development of chronic diseases may be through the development of obesity (31–34) or proinflammatory states (35). Clear physiological evidence to support these mechanisms is lacking currently. Another potential mechanism for how short duration of sleep may impact the development of chronic disease is via depression and other mental illness. However, because sleep disruption is inherent in the definition of depression it is difficult to assess this interaction conclusively. It is also known that depression is an independent risk factor for the development of type 2 diabetes, hypertension, and cardiovascular disease (33, 36). Further study is needed to define the causal pathways between short sleep duration (of acute and chronic nature) and the implications for the development and management of chronic diseases.

In developing public health strategies to combat short sleep duration, it is important to recognize substantial disparities that exist regarding sleep duration. Clearly, a safe place to sleep is required for adequate, quality sleep and it has been demonstrated in developing nations that housing

improvements in slums can lead to substantial improvements in sleep (37). In the United States, minority groups, in particular African Americans, have habitually reduced sleep durations assessed either by self-report or actigraphy (38–40). Hispanic Americans may also be at high risk for habitual short sleep, but this pattern appears to develop with acculturation into the United States (41, 42). The reasons for these differences are not fully understood, even though studies suggest that lower socioeconomic status and urban residence may be involved (39, 40), perhaps as surrogate markers for opportunity and placement of sleeping areas.

Recommendations

- For children, we suggest that age-based recommendations be developed. These should enable the child to awaken spontaneously at the desired time through implementation of regular wake and sleep schedules.
- For adolescents, we suggest that school start times be delayed to align with the physiological circadian propensity of this age group.
- We recommend that health care providers receive a greater level of education on sleep hygiene and encourage patients to maximize their sleep time.
- We recommend that public education programs be developed to emphasize the importance of sleep for good health.

Long Sleep Duration

There is an association between self-reported long sleep duration (usually defined as greater than 9–10 h of sleep per night) and all-cause mortality (30, 43, 44). However, it is yet to be determined whether this relationship is truly causal in nature, or what the mechanism underlying such findings might be. In support of a causal relationship, self-reported long sleep duration has been consistently associated with adverse health outcomes including cardiovascular disease, stroke, type 2 diabetes, hypertension, and obesity (45) even after controlling for a variety of confounders. However, it is certainly possible that self-reported long sleep may instead be a marker of ill health and physical inactivity (44, 45) rather than a cause of ill health.

Unfortunately, in most of these studies sleep quality was not specifically assessed, and the presence of underlying sleep apnea or other comorbidities such as depression, anxiety, or chronic pain, which cause sleep disruption and reduce sleep quality, was not ascertained. More research in this area is needed to define potential mechanisms for these observations and to control for these important confounding factors, which may explain the association between long sleep duration and adverse health outcomes.

In contrast, there is an over 40-year history of studying long sleepers (with no sleep complaints) in younger and older aged individuals. These studies have shown that long sleepers achieve more stage 2 and REM sleep (46); however, they demonstrate normal sleep architecture (47) and normal homeostatic sleep regulatory mechanisms (48) compared with short sleepers. There was a lack of difference between long and short sleepers for many variables including psychological adjustment, lifestyle, and the presence of sleep disorders and other comorbidities (47, 49).

Recommendation

- Sleeping longer than 9–10 hours per 24-hour period may be normal, but may also be associated with various causes of ill health. We recommend that health care providers be aware of reported associations and investigate individuals for underlying causes as appropriate.

Drowsy Driving

The National Highway Traffic Safety Administration calculates that 2.5% of fatal motor crashes and 2% of all nonfatal crashes involve drowsy driving (50), but these estimates are likely grossly understated because of challenges in accurate data collection at the state and federal levels. Indeed, modeling studies suggest that approximately 15–33% of fatal crashes may be due to drowsy driving (51). Many studies demonstrate that self-reported drowsy driving is common, with 4.2% of respondents confirming that they had fallen asleep while driving at least once in the previous 30 days in a telephone survey of more than 147,000 individuals (50). Among those at high risk of falling asleep while driving are occupational drivers, who have more exposure than nonoccupational drivers; those who work at night or who work long shifts (52); those who use sedating medications (sleeping aids and/or opiates); those who sleep less than 6 hours in a 24-hour period; those who reported falling asleep during the day and those who snored, presumably with undiagnosed sleep apnea (50, 53); and adolescents who have chronic sleep loss (54). Patients with sleep apnea are up to seven times more likely to experience a motor vehicle crash compared with those without this disease (55, 56). Driver sleepiness has been implicated as a major cause of these crashes (57, 58) and seems to be unrelated to sleep apnea severity (59). One of the other major factors involved in motor vehicle crashes appears to be insufficient sleep, which impairs driving ability under simulated driving conditions of monotonous road conditions and in more challenging situations (60–63). Other contributing factors include the combination of alcohol and sleep apnea, which has been shown to have a synergistic impact on driving performance (64). It is likely that the effects seen during these simulated conditions may be magnified in the real world during driving. However, more research in this area is needed.

Recommendations

- We recommend that all drivers (occupational or nonoccupational) receive education about how to recognize the symptoms and consequences of drowsiness.
- Adolescents may be a particularly susceptible group to drowsy driving; therefore, we recommend inclusion of sleep awareness during their driving education.
- Some data also suggest that sleep-deprived individuals may be particularly susceptible to the effects of alcohol from the standpoint of driving risk, and thus particular caution is recommended in this context.

Sleep and Occupation

There are multiple interactions between work and sleep duration and quality. Long work hours, shift work, work-related travel, and work responsibilities that are brought into the home can all adversely impact both

sleep duration and quality. High-risk occupations include all shift workers including health care professionals (65). Consistent with the literature on short sleep duration, shift work has been associated with an increased risk of obesity, insulin resistance, and other cardiometabolic issues as well as cancer (66–68). Shift work disorder is characterized by certain clinically significant disturbances in sleep, fatigue, and/or circadian alignment in shift workers that cannot be attributed to other causes (69). In addition, excessive daytime sleepiness due to shift work, sleep deprivation, sleep disorders, or combinations of these factors is associated with an increased risk of work-related injuries (70–73). In particular, inadequately treated OSA has been found to be a contributor to many major transportation accidents (55), and the U.S. National Transportation Safety Board has called for screening of all transportation operators for OSA on this basis. Many clinicians routinely screen transport operators by polysomnography to detect OSA in their clinical practices.

Recommendations

- We recommend better education for the general public and health care providers regarding the impact of working hours and shift work on sleep duration and quality and the association of sleepiness with workplace injuries.
- We recommend better education of professional transportation operators regarding OSA, other sleep disorders, and medications that may interfere with alertness.

Sleep Disorders

Overall, sleep disorders are common and cause morbidity and reduced quality of life (74). The most common sleep disorder is insomnia followed by obstructive sleep apnea.

The societal and economic consequences of sleep disorders are receiving increasing attention. A report from Australia, a country with approximately one-tenth the population of the United States, estimated that the national direct and indirect costs of sleep disorders was 7.5 billion dollars per year (75). Insomnia is also a major economic issue, with associated costs in the billions of dollars per year (76). Untreated patients with OSA suffer up to a sevenfold increased risk of motor vehicle collisions, with estimated Year 2000 costs of 15.9 billion dollars per year (77). The negative impacts of sleep apnea and sleepiness on work performance are also being increasingly recognized. Multiple studies have also demonstrated that therapy of OSA is an extremely cost-effective use of health care resources (78–80).

Pediatric Obstructive Sleep Apnea

OSA is one of the most common causes of sleep-disordered breathing in the general pediatric population, with an estimated prevalence ranging from 1 to 5% (81). The peak prevalence occurs at 2–8 years of age although this pattern may change with increasing obesity in children. Common nighttime symptoms include snoring, excessive sweating, restless sleep, mouth breathing, labored breathing and witnessed apneas or gasping, and hyperextension of the neck during sleep. Daytime symptoms include poor concentration, behavioral and mood problems, morning headaches, or excessive daytime sleepiness. Children with OSA have increased health care use, mainly with respiratory symptoms, and they can present with nocturnal enuresis or failure to thrive, and some children with OSA have been misdiagnosed with attention deficit hyperactivity disorder (20). Furthermore, there are major morbidities associated with pediatric OSA including the neurological, cardiovascular, and metabolic systems, and such consequences may not only affect the child's well-being and development, but may also evolve into adulthood (82).

Children at higher risk of OSA include those with craniofacial syndromes (e.g., Treacher Collins syndrome, Crouzon syndrome, Apert syndrome, Pierre Robin sequence), Beckwith–Wiedemann syndrome, achondroplasia, cerebral palsy, neuromuscular disorders, myelomeningocele, sickle cell disease, trisomy 21, allergic rhinitis, asthma, micrognathia, mucopolysaccharidoses, macroglossia, Afro-Caribbean race, and those who are obese. Volumetric measurements suggest that the adenoids and tonsils are significantly increased in children with OSA compared with matched control subjects, concomitant with smaller upper airway and larger soft palate volumes adding additional restriction to the airway lumen size (83, 84). Therapy for OSA in children may involve surgery (e.g., adenotonsillectomy), positive pressure ventilation, oral appliances, and weight normalization if indicated.

Adult Obstructive Sleep Apnea

OSA is a major public health concern (85). OSA is common, with a reported prevalence of 6% of women and 13% of men in the United States (86–88). OSA symptomatology includes excessive daytime sleepiness, snoring, nocturia, and poor concentration. Long-term consequences of OSA include an increased risk of hypertension and cardiovascular disease, particularly stroke and heart failure, and impaired quality of life (89, 90). Work suggests there may also be a link between sleep apnea and diabetes, depression, as well as cancer (91–93). Obesity is a common risk factor (94), with 60–90% of patients with OSA presenting with a body mass index greater than 30 kg/m^2 (95). It is estimated that more than 80% of sleep apnea remains undiagnosed in the general population (87, 96, 97). This finding has serious implications for the development of the conditions listed previously but also in the setting of anesthesia, because individuals with OSA (undiagnosed and diagnosed) are more vulnerable during the perioperative period (96, 98).

Initial studies of OSA focused solely on men. However, as women have been studied, it has become clear that this disease is common in women and that the male-to-female prevalence ratios in the general population are only 3:1 to 2:1 (99–101). Of concern is the high rate of undiagnosed OSA in women, likely due to a bias among patients as well as health care providers in seeking the disease preferentially in men (97). This observation has prompted research into the sex differences of OSA with an emphasis on upper airway physiology and function, fat distribution, hormonal influences, and control of ventilation (102). It is also known that sleep apnea prevalence and severity worsen with aging.

There are also important differences in OSA prevalence by race and ethnicity. Individuals of Asian background, particularly East Asian, are at elevated risk for OSA at the same level of obesity, presumably due to differences in craniofacial structure (103, 104). In the United States, African Americans and

Hispanics are at higher risk for OSA because of the increased prevalence of obesity in these groups. Similar patterns exist in New Zealand, where the Maori and Pacific Islanders have higher rates of OSA compared with whites because of disparities in obesity (105).

Therapy for sleep apnea is successful and focused on continuous positive airway pressure, oral appliances, positional therapy, and weight reduction if indicated. The adherence rates to these therapies are similar to drug therapies used to treat hypertension. Newer therapies are in development and show promise.

Recommendation

- We recommend better education/awareness for the general public and physicians regarding the importance of early identification of high-risk OSA groups (in children and adults) because of the profound public health implications of untreated OSA.

Insomnia

Insomnia is a common problem characterized by difficulty in initiation, maintenance of sleep, or obtaining good-quality sleep. Reported prevalence in the general population varies from 2 to 48% due to variation in methodologies for defining and assessment of insomnia in study populations (106, 107). There is evidence that the prevalence of insomnia may be increasing in adults (106). Patients with chronic insomnia report frequent chronic health conditions such as hypertension, heart disease, chronic pain, cancer, and diabetes, even when controlling for potential confounding factors including depression and anxiety (108). People with insomnia have increased health care use (109) and work absenteeism (110) and experience increased automobile accidents (111). Many such patients are treated with prescription sleep aids, without careful attention to labeling, side effects, harm, abuse potential, or a clear follow-up plan for desired effects (112, 113). Clear evidence supports the benefits of cognitive behavior therapy (CBT-I) for the management of chronic insomnia regardless of comorbidities (114). This approach involves elements of sleep restriction, stimulus control, sleep hygiene education, and cognitive therapy and may include relaxation techniques.

Unfortunately, because of a scarcity of providers trained in CBT-I and limited insurance coverage for this therapy, many patients with insomnia are unable to access this treatment. Instead, many individuals are treated with sedative medications that can treat symptoms of insomnia in the short run but may have substantial health side effects in the long run. Newer treatment modalities, such as Internet-based CBT-I, have the potential to increase accessibility of CBT to many more individuals.

Recommendations

- We recommend better education of physicians as to the effectiveness of cognitive behavior therapy for insomnia rather than immediate implementation of hypnotics and sedatives.
- We recommend structural changes to increase access to CBT-I including training of a wider range of health care providers to administer this treatment and insurance coverage of this treatment modality.

Future Directions: Research Priorities to Advance Sleep Health

Predominantly cross-sectional studies have generated sleep data (self-reported sleep duration or diagnosis of sleep apnea) or objective phenotypic data (polysomnography or actigraphy) to advance the field; however, large numbers of subjects (hundreds of thousands of subjects) are needed to answer seminal questions regarding sleep. There is an urgent need for collection of longitudinal comprehensive sleep data to understand the natural history of healthy sleep and sleep disorders and the impact of treatment. Many unanswered questions remain involving sleep health. Listed below are high-priority scientific questions to guide future research.

- How do sleep health and sleep disorders develop from early life and across the life span? We recommend this approach to develop age- and sex-based recommendations for sleep health. In addition, we advocate for high-quality basic research into sleep mechanisms and the biological need for sleep.
- What is the importance of sleep continuity or efficiency, regularity of sleep habits, the timing of sleep in the day, alertness and sleepiness in the day, and subjective assessment of satisfaction and quality of sleep on sleep health and general health?
- What are the developmental, genetic, behavioral, societal, and other factors underlying individual variability in susceptibility to sleep loss and the impact on neurocognitive performance? We recommend particular emphasis on drivers and high-risk occupational groups.
- How does the individual susceptibility to sleep loss predict long-term health consequences, such as impaired cognition, mood disorders, and cardiovascular, metabolic, and other diseases?
- What is the potential etiological role of OSA in the development of comorbidities (e.g., mood disorders, cardiovascular disease, etc.) and what is the impact of therapy of OSA on these diseases?
- What is the molecular basis for common sleep disorders such as OSA and insomnia and how can knowledge of these basic pathways be used to develop effective treatments?
- What are the individual, biological, and behavioral factors, as well as ethnic, socioeconomic, and cultural characteristics that account for disparities in sleep habits, quality, and duration? What interventions can effectively be implemented to reduce sleep disparities? We recommend further work to understand the ecology of sleep and sleeping areas and the systemic impact of public policy for housing and for health on human sleep.
- What public health interventions (e.g., driver education programs) can reduce motor vehicle crash rates due to drowsy driving and in which populations?
- What is the role of sleep disorders on the risk of occupational injuries? Which interventions could be implemented in the workplace to reduce this risk?
- What is the natural history of insomnia? How does the presence of comorbid OSA and insomnia affect general health and outcome? What are the consequences of insomnia in children?

- How can care delivery models for sleep disorders provide high-quality care in a cost-effective manner particularly given constraints in the sleep specialist workforce?

Conclusions

Sleep is an essential component of good health and deserves more importance in the societal priorities of the general population. We as health care providers have an important role in educating our colleagues and our patients about the importance of sleep. In this document, we prioritize areas for policy and research in sleep health. ■

This policy statement was prepared by an *ad hoc* committee of the Sleep and Respiratory Neurobiology Assembly.

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