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Sleep-deprived motor vehicle operators are unfit to drive: a multidisciplinary expert consensus statement on drowsy driving☆

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ABSTRACT

Objectives: This article presents the consensus findings of the National Sleep Foundation Drowsy Driving Consensus Working Group, which was an expert panel assembled to establish a consensus statement regarding sleep-related driving impairment.
Methods: The National Sleep Foundation assembled a expert panel comprised of experts from the sleep community and experts appointed by stakeholder organizations. A systematic literature review identified 346 studies that were abstracted and provided to the panelists for review. A modified Delphi RAND/UCLA Appropriateness Method with 2 rounds of voting was used to reach consensus.
Results: A final consensus was reached that sleep deprivation renders motorists unfit to drive a motor vehicle. After reviewing growing evidence of impairment and increased crash risk among drivers who obtained less than optimal sleep duration in the preceding 24 hours, the panelists recognized the need for public policy guidance as to when it is certainly unsafe to drive. Toward this end, the panelists agreed upon the following expert consensus statement: "Drivers who have slept for two hours or less in the preceding 24 hours are not fit to operate a motor vehicle." Panelists further agreed that most healthy drivers would likely be impaired with only 3 to 5 hours of sleep during the prior 24 hours.
Conclusions: There is consensus among experts that healthy individuals who have slept for 2 hours or less in the preceding 24 hours are too impaired to safely operate a motor vehicle. Prevention of drowsy driving will

☆ Endorsed by the National Sleep Foundation, AAA Foundation for Traffic Safety, American College of Chest Physicians, American College of Occupational and Environmental Medicine, and Society for Research on Biological Rhythms.

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require sustained and collaborative effort from multiple stakeholders. Implications and limitations of the consensus recommendations are discussed.

Introduction

More than 1 in 4 Americans report obtaining insufficient sleep on most nights, and less than 1 in 3 Americans report consistently obtaining sufficient sleep,[1] adversely affecting health, performance, and safety.[2] Insufficient sleep impairs neurobehavioral performance[3,4] and diminishes a driver's ability to safely operate a motor vehicle.[5,6] Drowsy individuals demonstrate diminished neurocognitive performance across virtually all domains related to performing an overlearned task such as driving. These performance decrements include delayed reaction time;[7–10] impaired visual-perceptual ability;[10–16] increased distractibility;[10,17] reduced ability to focus attention;[10,18] increased probability of eyelid closure and the risk of loss of situational awareness, even when the eyes remain open;[10] slowed cognitive processing;[19–22] memory impairment;[18] and deterioration in vigilance with time-on-task.[6,23] Indeed, the degree of impairment from sleep loss can be comparable to that of alcohol intoxication,[3,5,24] with 24 hours of continuous wakefulness resulting in impairments in neurobehavioral performance[7,25,26] similar to that induced by a blood alcohol concentration of 0.10 g/dL,[3,5,27–30] which is beyond the legal limit in all 50 US states. Just as with alcohol, sleep deprivation impairs judgment[31–33] and decision making,[34] such that sleep-deprived individuals often underestimate the impact that sleep deprivation is having on their performance. Ironically, instead of slowing response times to preserve accuracy, sleep-deprived individuals often increase speed at the expense of making more mistakes (ie, become "fast and sloppy") and take greater risks.[12,35,36]

Multiple lines of evidence indicate that sleep-related impairment places drivers at increased risk for motor vehicle crashes and harm to others, causing about 20% of motor vehicle crashes and serious crash injuries.[37–41] In the United States, methodologically rigorous analyses of a nationally representative sample of crashes involving a passenger vehicle towed from the scene found sleepiness to be associated with 21% of all motor vehicle crashes in which a person was killed and 13% of those requiring hospitalization, causing 328,000 police-reported crashes, 109,000 injuries, and 6,400 deaths in the Unites States annually.[39] Given that these analyses did not include single-vehicle, fatal-to-the-driver truck crashes, an estimated one-third of which are fatigue related, the injury and death toll from drowsy driving crashes is likely much higher. Although robust evidence clearly establishes risks of drowsy driving, no expert consensus panel has previously been assembled to review the evidence and provide guidance to policy makers as to whether or not sleep deprivation alone can render an individual unfit to drive and, if so, the point at which sleep-related driving impairment categorically renders an individual unfit to operate a motor vehicle. This lack of a clear definition of when an individual is categorically too sleep deprived to drive has contributed to insufficient public awareness regarding the risks of this preventable behavior. Furthermore, in the absence of an easily quantifiable threshold for sleep-related driving impairment, drowsy driving as a factor in crash assessment or litigation can be argued to be a relative rather than absolute risk, despite the robust biological evidence that lack of sleep adversely effects driver neurocognitive performance. To advance education and prevention initiatives, clear direction is needed from the scientific community on what quantity of sleep deprivation would categorically result in healthy drivers being too sleep deficient to operate a motor vehicle safely. Hence, the purpose of the current effort has been to review the evidence and develop such an expert consensus statements from the National Sleep Foundation's Drowsy Driving Consensus Working Group.

Methods

Participants

In order to ensure a wide range of perspectives regarding the impact of sleep deprivation on driving fitness, the National Sleep Foundation assembled an expert panel comprised of sleep experts as well as experts in other areas of science and medicine. The 16-member panel included representatives selected by stakeholder organizations (n = 9) as well as sleep experts selected by the National Sleep Foundation (n = 7). Stakeholder organizations that appointed representatives included the AAA Foundation for Traffic Safety, American Academy of Sleep Medicine, American College of Occupational and Environmental Medicine, American College of Preventive Medicine, American College of Chest Physicians, American Thoracic Society, Sleep Research Society, and Society for Research on Biological Rhythms.

Procedures

Literature review

The National Sleep Foundation performed a systematic review of peer-reviewed literature from the years 2005 to 2015 using PubMed, Web of Science, and EBSCO CINAHL Plus databases. Search terms were agreed upon by the panel (see Table 1). Inclusion criteria for individual studies included English language and human participants of legal driving age (ie, >15 years). Because the objective was to define drowsy driving in the general population, studies of individuals with sleep, medical, or psychiatric disorders were excluded. Study data (ie, sample characteristics, driver age, country, study design, measures, and results) were extracted and summarized in alphabetical tables. These tables and the corresponding full-text articles were distributed to panelists for review.

Panel deliberations and consensus voting

Panelists were first tasked with the question of whether acute sleep deprivation, when extended for long enough, would definitively render an individual unfit to drive. If this question were answered affirmatively, panelists were to be tasked with answering the question, "When considering the past 24 hours, how appropriate is it to say an individual is too impaired to drive if they only slept 'X' hours?" To answer these questions, panelists reviewed the assembled scientific literature, met a total of 4 times over a 3-month interval to discuss scientific findings, and participated in 2 rounds of voting. The first round of voting took place independently. The second round took place at a subsequent in-person meeting. During the in-person meeting, panelists heard presentations from nonpanelist experts in highway safety and law enforcement and reviewed the results from the first round of voting, which formed the basis for discussion.