Fatigue and Automobile Accident Risk

A Primer For Residents

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Welcome to the Robert Wood Johnson Medical School course on sleep and driving.

During this course you will:

• Complete a pre-course test
• Complete a module about sleepiness and driving
• Complete a post-course test which must be passed.
Pre-Test Questions

1. Drivers can accurately rate their degree of impairment due to drowsiness.
   
   True or False

2. Effective measures to prevent falling asleep while driving are:
   
   A. Cold air in the face
   B. Playing loud music
   C. Stop and take a nap
   D. All of the above

   Choose the best answer
3. In the state of New Jersey, driving sleepy is considered an aggravating factor in a fatal motor vehicle accident.
   True or False

4. Circadian rhythms influence wakefulness independently with or without sleep deprivation.
   True or False

5. Residents are at increased risk for automobile accidents following a night on call.
   True or False
6. The U.S. National Highway Traffic Safety Administration (NHTSA) estimates that drowsy driving accounts for how many traffic fatalities annually?
A. About 750 or 2% of total traffic fatalities
B. About 1500 or 4% of total traffic fatalities
C. About 3000 or 8% of total traffic fatalities

Choose the best answer

7. Sleep related accidents are more common in the elderly than in young people.

True or False
8. There are warning signs that can alert a driver to the danger of falling asleep while driving.
   True or False

9. Twenty four hours of wakefulness impairs psycho-motor performance as much as what level of blood alcohol?
   A. 0.02%
   B. 0.05%
   C. 0.10%
   D. 0.15%
   Choose the best answer
10. The two peak times for traffic accidents are:

A. Late morning (10 AM) and late evening (11PM)
B. Early morning (2AM) and mid-afternoon (2PM)
C. Early morning (2AM) and early evening (7PM)
D. Late morning (10AM) and early evening (7PM)

Choose the best answer
The Purpose of Sleep

Everyone needs sleep. People, animals, even insects. The purpose of sleep remains elusive. Its importance being defined more by the consequences of an inadequate amount of sleep rather than by any defined rejuvenating properties.

The earliest consequence of sleep deprivation is excessive drowsiness. As we are deprived of sleep, the pressure to fall asleep increases, and continues to increase until we pay back this “sleep debt”. Sleep deprivation causes decreases in our ability to react and concentrate. In addition, sleep begins to intrude involuntarily, causing brief “micro-sleeps”, often of only a few seconds in duration. These can have disastrous consequences for those operating motor vehicles.
The Biological Clock

The existence of biological rhythms were well known and were always thought to be due to the daily cycles of light and dark. That these circadian rhythms could be generated from within an organism was demonstrated in 1729 by Jean Jacques d’Ortous de Mairan when he described a heliotrope plant that opened and closed its leaves according to schedule despite being placed in a place where sunlight could not reach it.

These rhythms, including our own sleep-wake cycle, are influenced by environmental cues such as sunlight. This process, entrainment, helps us keep on track with our environment.
The Alertness Cycle

The tendency to fall asleep can be determined by measuring the time it takes to fall asleep in a quiet, relaxed situation. This sleep latency was measured across the twenty four hour cycle in healthy subjects by Richardson et al who found two nadirs of alertness, one from about 2AM to 6AM and another from 2PM to 6PM.

These natural nadirs of alertness correspond to peaks in the occurrence of motor vehicle accidents during the day.
Sleep and Cognitive Function

The effect of sleep deprivation on cognitive psychomotor performance has been measured. An Australian study by Dawson and Reid compared the effects of sleep deprivation to the effects of alcohol consumption. The performance impairment after 17 hours of sustained wakefulness was equivalent to that seen with a blood alcohol concentration of 0.05% and that observed after 24 hours of wakefulness was equivalent to a blood alcohol concentration of 0.1%.
Sleep and Driving

In a European study, Philip et al evaluated the effects of sleep restriction on actual driving performance. They found that reaction time was significantly impaired under sleep restriction conditions. Seven of ten subjects had to be assisted by the experimenter under sleep restricted conditions. Furthermore, there was no correlation between the subject self-assessment and actual driving performance.
Did You Know?

A majority of police officers surveyed report having stopped a driver that they thought was under the influence of alcohol only to find that the driver was simply sleepy.
Automobile Accidents and Sleep

The US Department of Transportation estimates that 100,000 accidents reported are due to drowsiness and/or fatigue. These crashes result in 1550 deaths annually (4% of traffic fatalities) and $12.5 billion in monetary losses. Contrary to popular belief, the elderly are at lower risk for sleep related accidents than young adults.
Call and Automobile Accidents

Barger and colleagues surveyed over 2373 residents about call hours and motor vehicle accidents. They found that the risk of having a documented automobile accident more than doubled after an extended work shift. Near miss accidents were more than five times more likely to occur after extended shifts.
Arnedt and colleagues tested vigilance and performance on a driving simulator in residents on different call rotations. They compared performance during a heavy call rotation with placebo to a light call rotation with alcohol consumption for a blood alcohol level of 0.04% to 0.05%. Performance was similar for the two conditions.
Did You Know?

Migratory geese in flight can sleep with one side of their brain at a time.
The Law

• In 1997 Maggie McDonnel, a 20 year old college student was killed in a head-on collision with a driver who admitted to having been sleepless for 30 hours, as well as drug use. He was given a suspended jail sentence and a $200 fine.

• Criminal homicide constitutes vehicular homicide when it is caused by driving a vehicle or vessel recklessly.
Maggie’s Law

• In 2003 Maggie’s Law was passed in New Jersey. This law establishes driving while fatigued as recklessness under the vehicular homicide statute.
• Proof that the defendant fell asleep while driving or was driving after having been without sleep for a period in excess of 24 consecutive hours can give rise to a charge of vehicular homicide.
Warning Signs

- Trouble keeping your eyes open
- Trouble keeping your head up
- Daydream or wandering thoughts
- Drifting across lanes
- Missed signs or exits
Warning Signs

• Frequent yawning or rubbing your eyes
• Irritability or restlessness
• Drifting off the road or hitting rumble strips
Counter Measures

• Ineffective
  – Rolling down the window
  – Loud music
  – Caffeine – takes 30 minutes to work, can still get micro sleeps

• Effective
  – Sleep – pull over and take a 15 – 30 minute nap
References

• Richardson GS, Carskadon MA, Orav EJ, Dement WC; Circadian variation of sleep tendency in elderly and young adult subjects. Sleep 5:S82-S94, 1982
• Philip et al; Fatigue, Sleep Restriction, and Performance in Automobile Drivers: A Controlled Study in a Natural Environment. SLEEP 26:277-80 2003
• Arnedt JT et al. Neurobehavioral performance of Residents After Heavy Night Call vs After Alcohol Ingestion. JAMA 294:1025-1033, 2005
Post Test

Please answer the test questions again. The correct answer follows each question.
Question 1
True or False

Drivers can accurately rate their degree of impairment due to drowsiness.
Question 1

Drivers can accurately rate their degree of impairment due to drowsiness.

False – Phillip et al. Sleep 2003
Effective measures to prevent falling asleep while driving are:

A. Cold air in the face
B. Playing loud music
C. Stop and take a nap
D. All of the above
Effective measures to prevent falling asleep while driving are:

C. Stop and take a nap.
Cold air and loud music are not effective in keeping sleepy drivers awake.
Question 3
True or False

In the state of New Jersey, driving sleepy is considered an aggravating factor in a fatal motor vehicle accident.
In the state of New Jersey, driving sleepy is considered an aggravating factor in a fatal motor vehicle accident.

TRUE – Maggie’s Law
Question 4
True or False

Circadian rhythms influence wakefulness independently with or without sleep deprivation.
Question 4

Circadian rhythms influence wakefulness independently with or without sleep deprivation.

TRUE
Question 5
True or False

Residents are at increased risk for automobile accidents following a night on call.
Question 5

Residents are at increased risk for automobile accidents following a night on call.

TRUE
The U.S. National Highway Traffic Safety Administration (NHTSA) estimates that drowsy driving accounts for how many traffic fatalities annually?

A. About 750 or 2% of total traffic fatalities
B. About 1500 or 4% of total traffic fatalities
C. About 3000 or 8% of total traffic fatalities
Question 6

The U.S. National Highway Traffic Safety Administration (NHTSA) estimates that drowsy driving accounts for how many traffic fatalities annually?

B. About 1500 or 4% of total traffic fatalities
Question 7
True or False

Sleep related accidents are more common in the elderly than in young people.
Question 7

Sleep related accidents are more common in the elderly than in young people.

FALSE
Question 8
True or False

There are warning signs that can alert a driver to the danger of falling asleep while driving.
Question 8

There are warning signs that can alert a driver to the danger of falling asleep while driving.

TRUE
Question 9
Choose the best answer

Twenty four hours of wakefulness impairs psycho-motor performance as much as what level of blood alcohol?

- 0.02%
- 0.05%
- 0.10%
- 0.15%
Twenty four hours of wakefulness impairs psycho-motor performance as much as what level of blood alcohol?

C. 0.10%
Question 10
Choose the best answer

The two peak times for traffic accidents are:

A. Late morning (10 AM) and late evening (11PM)
B. Early morning (2AM) and mid-afternoon (2PM)
C. Early morning (2AM) and early evening (7PM)
D. Late morning (10AM) and early evening (7PM)
Question 10

The two peak times for traffic accidents are:

B. Early morning (2AM) and mid-afternoon (2PM)