Sleep Deprivation as a Deterrent to Human Performance: An Emerging Issue for Safety Professionals
Sleep Deprivation: Trending Topic

THE SLEEP REVOLUTION
TRANSFORMING YOUR LIFE, ONE NIGHT AT A TIME
ARIANNA HUFFINGTON
AUTHOR OF THE #1 NEW YORK TIMES BESTSELLER THRIVE
Sleep Deprivation and Human Performance:

• Sleep deprived workers struggle to overcome powerful physiological forces that reduce cognition, reaction time, multi-tasking ability and more.

• This issue has been directly related to increased accidents, worker’s comp claims, absentee rates and decreased productivity.
Well-Known Disasters Linked at Least Partially to Fatigue

<table>
<thead>
<tr>
<th>Year</th>
<th>Incident</th>
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<tbody>
<tr>
<td>1986</td>
<td>Space Shuttle Challenger Accident</td>
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<tr>
<td>1989</td>
<td>Exxon Valdez Oil Spill</td>
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<td>2005</td>
<td>BP Refinery Explosion, Texas City, TX</td>
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<tr>
<td>2009</td>
<td>Jet Crash in Buffalo, NY</td>
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<tr>
<td>2011</td>
<td>New York City Tour Bus Crash</td>
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Today’s Focus:

1. The physiological impact of sleep deprivation on the body and function.

2. Factors which increase the likelihood of negative outcomes due to sleep deprivation, such as reduced performance, accidents and injury.

3. Strategies to proactively assist workers to adjust to altered sleep patterns including workplace environmental factors, shift scheduling and access to resources.
Sleep Deprivation Causes a Very Real Biological Impact

• Creates a Critical and Continuous State of “INJURY” to the Body and Body Systems.

• The Body’s Reaction is to Compensate and Preserve Vital Processes.

• The Result is a Reduction in Human Performance and Function.
How Sleep Impacts the Body

The Natural Time Clock: Circadian Rhythm Regulates Wakefulness, Sleep Drive and Multiple Body Systems

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The Body’s Powerful Sleep Drive

Sleep/Wake Cycle

Sleep Pressure

Day

Night

Wake/Sleep

Circadian Drive for Wakefulness

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Circadian Clock (SCN) Regulation of Body Systems

- Hypothalamus
  - Body Temperature
  - Thyroid Hormones
  - Appetite

- Aorta/Heart
  - Heart Rate
  - Palpitations
  - Immune Response

- Inflammation
  - Cell Proliferation

- Muscle
  - Contraction
  - Tremors/Aches
  - Insulin Uptake Resistance

- Liver
  - Coagulation
  - Carbohydrate Metab.

- Pancreas
  - Insulin Insufficiency

- Adipose
  - Lipid Metabolism
  - Endocrine

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Sleep Deprivation & Human Function

A Sleep Deprived Person Experiences Very Powerful Forces which lead to Decreased Function & Quality of Life:

- Fatigue, Depressed Mood, Apathy
- Psychomotor Slowing, Activity Avoidance
- Cognitive Impairment, Poor Moral Judgement, ↓ Self Discipline
- Poor Memory, Difficulty Maintaining/Completing Thoughts
- Irritability, Quick to Anger
- Inability to Handle Stress and Multitask (Task Change)
- Lapses in Alertness, ↓ Attention Span
- Weight Gain, Poor Digestion
- Accelerated Onset of Disease: Diabetes, Heart Disease . . .
Focus Body System Impacts
Sleep Deprivation Impact on Health
Focus: Altered Appetite Regulation

Ghrelin = Time to Eat

Leptin = Feeling Full
Sleep Deprivation Impact on Health
Focus: Increased Body Fat Storage

Cortisol Spikes
Conserving Energy

Increase in Adipose Tissue

Gain in Body Fat and Weight
Altered Sleep Impact on Body Weight
Focus: Behavior Patterns

Health Behaviors Contributing to Health Conditions & Higher Risk:

• Poor Eating Patterns
• Lack of Exercise
• Reduced Self-Discipline
• Alcohol Consumption
• Smoking

National Institute for Occupational Safety and Health (NIOSH) Division of Applied Research and Technology, April 26, 2016
Underlying Health as a Contributing Factor
Underlying Health and Sleep

- Obesity
- Low Back Pain
- Cancer
- Stress
- Heartburn
- Heart Attack
- High Blood Pressure
- Sleep Disorders
- Dialysis
Further Advancement of Decline in Health: 
Coexistence of Sleep Issues | Health Conditions

Health Conditions often Present with Sleep Issues
• Hypertension
• Obesity
• Heart Disease

Health Conditions Influence Sleep Quality/Quantity
• Stress
• Pain
• Mood Disturbances
• GI Reflux
• Lung Disease
Prevalence of Co-existing Sleep Issues | Health Conditions

Percent of Patients who also have Sleep Apnea

- Drug-Resistant Hypertension: 83%
- Obesity: 77%
- Congestive Heart Failure: 76%
- Type 2 Diabetes: 72%
- Pacemakers: 59%
- Atrial Fibrillation: 49%
- All Hypertension*: 37%
- Coronary Artery Disease*: 30%

*Male subjects only
Capturing Higher Levels of Human Function through Modifiable Factors
Coping Strategies Do Not Work

- People often use methods such as **physical activity** or **dietary stimulants** to cope with sleep loss, masking their level of sleepiness.

- When a sleep deprived person sits still, performs repetitive tasks (such as driving long distances), gets bored, or lets down their coping defenses, SLEEP COMES QUICKLY.

- It is virtually impossible to fight the biological pressure to sleep.

*Mitler et al., 1998, National Transportation Safety Board, 1995*
Impaired Judgement

"No need to stop, I feel fine. I can handle this!"
“Researches reported that sleep deprived participants did not recognize how poorly they were performing”
Building the Tool Box: Key Factors that Promote Fatigue

Certain Factors Increase the Force and Power of Sleep Drive:

- Time of Day
- Time Awake + Sleep Debt
- Time on Task
The Drive to Sleep is Stronger When a dip in Circadian Wakefulness Drive Occurs

- 2 to 5 pm
- 12 to 2 am
- 2 to 6 am

Fall Asleep

Wake up

Sleep Pressure

Wakefulness

7am 11pm 7am

Awake Sleep Awake

National Institute for Occupational Safety and Health (NIOSH), Division of Applied Research and Technology, April 26, 2016
Time Awake:

Fatigue-Related Impairment Vs Alcohol Intoxication

Being awake for 17 hours is similar to having a BAC of 0.05%

Being awake for 24 hours is similar to having a BAC of 0.10%

Participants’ performances were tested and compared under two separate conditions:

1. After staying awake for extended periods
2. After reaching a certain blood alcohol concentration (BAC).
Time on Task:

• Spending Consecutive Time on Tasks That are:
  • Monotonous
  • Boring
  • Require Little Effort or Thought Process
• Increases the Likelihood of Succumbing to Sleep Pressure
Repetitive Drive Home after Night Shift is an example of the combination of the Three T’s:

- Time of Day
- Time Awake
- Time on Task
Workforce Populations at Risk:

• Risk Critical Jobs:
  • Impaired Cognitive Function
  • Memory Impairment
  • Delayed Reaction Time
  • Impaired Task Changing Ability
  • Irritability, Low Motivation
  • Impaired Moral Judgement
  • Inability to Judge Degree of Sleepiness

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Workforce Populations at Risk:

- Shift & Extended Shift Workers:
  - Higher Risk for Workers New to Shift Work
  - End of Shift Highest Probability of Risk
  - Workers with Pre-existing Health Conditions

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Additional Known High Risk Factors

Additional Factors Contributing to Higher Risk for Accidents Related to Sleep Deprivation:

- Age/Gender: 16 to 29, Males
- Untreated Sleep Disorders
- Medications/Alcohol
Warning Signs of Drowsy Driving

- Yawning or blinking frequently.
- Difficulty remembering the past few miles driven.
- Missing your exit.
- Drifting from your lane.
- Hitting a rumble strip on the side of the road.
Questions?

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