The Negative Effects Of Sleep Deprivation on Firefighters and Paramedics

Locution SYSTEMS INC.

Introduction

While it's commonly known that the chronic, intermittent stress experienced by firefighters and paramedics is detrimental to their health and well-being, there is a growing body of medical research that shows chronic sleep deprivation can pose very significant health risks for first responders.

This paper outlines the negative effects of chronic sleep deprivation, and the fire station alerting technology that helps mitigate sleep deprivation for first responders: **Zoned Fire Station Alerting.** In fact, the primary reason why fire-EMS departments deploy zoned fire station alerting is to mitigate sleep deprivation for its firefighters and paramedics.

A chronically exhausted first responder is at risk of many health problems due to sleep deprivation.

Negative Effects of Sleep Deprivation on First Responders

Recent medical research published in one of the most respected medical research databases in the United States reveals the following harmful effects of sleep deprivation:

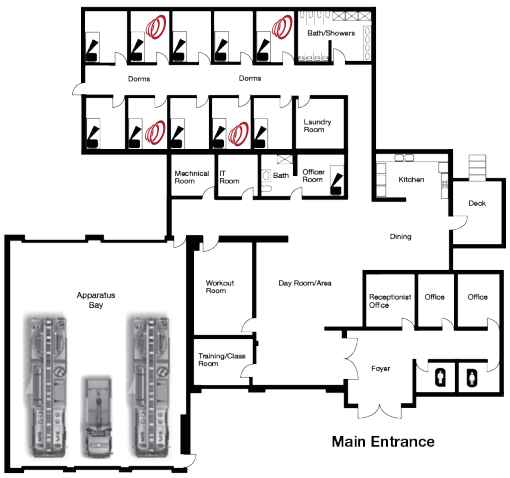
- Diminished brain function & brain shrinkage
- Genetic damage in blood & brain cells
- Accelerated cellular aging
- Impaired cardiovascular system function
- Sudden cardiac death
- Impaired immune system
- High blood pressure
- Chronic inflammation
- Blood sugar issues & insulin resistance
- Impaired working memory
- Higher risk of errors
- Impaired learning ability
- Depression & heightened anxiety
- Impaired endocrine system function

For more information on the specific medical research on the harmful effects of sleep deprivation, please see Section 3 in this document for the abstracts from this medical research.

High blood pressure is one of many negative side effects of sleep deprivation in first responders.

Zoned Fire Station Alerting Developed Specifically To Mitigate Sleep Deprivation For First Responders

Zoned Fire Station Alerting automatically routes dispatch information and alerting directly to the unit assigned to handle the emergency, allowing responders not assigned to the call to continue to sleep.



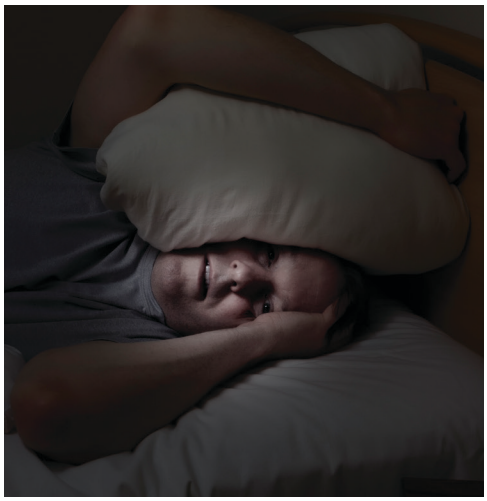
To address and help mitigate sleep deprivation for firefighters and paramedics, zoned fire station alerting has been developed in recent years. What is zoned fire station alerting? A fire station alerting system with zoned fire station alerting will automatically route dispatch information and alerting functions directly to and only to the unit assigned to handle the call, typically for calls that happen during sleeping hours. Automated zoned dispatches are not vocalized on the fire station's PA system, which would wake up all the responders in the fire station. Instead, the dispatch and related alerting functions, such as tones and automated lighting, route directly to zoned areas within the fire station. A zoned area may be individual dorm rooms, or a group dorm room, for those responders who are assigned to handle the particular call.

By only alerting the unit assigned to handle the call, the other first responders in the fire station are able to continue to sleep. This can minimize sleep deprivation, as responders are only awakened for calls that pertain to them and their unit.

Zoned Fire Station Alerting Is Ideal For Multi-Unit Fire Stations

Multi-unit fire stations benefit the most from zoned fire station alerting. For example, if Fire Station A has both a ladder unit and a medical unit, it's common that the medical unit will be dispatched for more runs during the night, while the ladder unit may be dispatched far fewer times. In a traditional fire station alerting scenario without zoned alerting, the unit not assigned to handle the call would be alerted and wake up for every call. This creates unnecessary sleep deprivation, which takes a heavy toll on first responders.

Many firefighters & paramedics report that, once awoken from a deep sleep, it often takes more than an hour for them to fall asleep again.



Zoned Alerting Comes In Many Forms

Fire stations can vary quite a bit in their architecture, even within the same fire department. The best modern fire station alerting systems are able to handle these differences to provide the right zoned alerting solution for each fire station. New construction, or old, small stations with just a couples of zones to large stations, individual dorm rooms or shared, etc., are all considerations that help determine how to configure the zoned alerting system in each station. However, the primary goal is the same: how to effectively and rapidly alert first responders to their call, while optimizing their health and safety. By only waking responders for their assigned calls during the night, zoned fire station alerting has rapidly become a best practice.

Fire station architectures vary, even within the same department. The best, modern fire station alerting systems are able to be configured appropriately for each fire station.

Understanding The Sleep Cycle Is Key To Understanding The Negative Health Effects Of Sleep Deprivation On First Responders

It's necessary to understand the sleep cycle to understand how and why sleep deprivation is so harmful for first responders. Let's start by understanding the stages of wakefulness & the stages of sleep.

When people are asleep, the electrical impulses occurring in the brain are a direct reflection of the specific sleep stage they are experiencing. By using electro-encephalograph technology, medical personnel can track the types of electrical activity occurring in the brain by viewing brain waves.

3 Stages of Wakefulness

- Waking State-Gamma: Multi-tasking & emergency mode
  (Gamma pattern brain waves)
- Waking state-Beta: General life & work
  (Beta pattern brain waves)
- Waking state-Alpha: Relaxed drowsy state before sleep with eyes closed, or Meditation state *(Alpha pattern brain waves)*

4 Stages Of Human Sleep

- Stage N1 *(Theta pattern brain waves)*
- Stage N2 *(Sleep spindles & K complexes)*
- Stage N3 *(Delta pattern brain waves)*
- Stage 4 = REM Sleep *(Rapid eye movement before waking)*

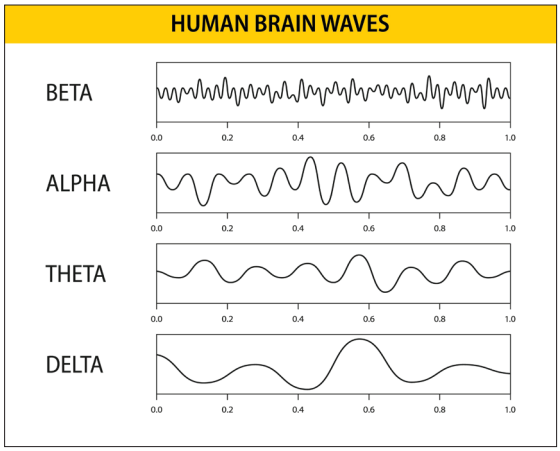
Why Is It Important For Responders To Go Through All 4 Stages Of Sleep?

The number one reason why it's important for first responders to get through all 4 stages of sleep is for **Rejuvenation & Healing**.

There are specific, restorative, rejuvenating processes that occur during various stages of sleep. **For first responders who are awakened again and again during sleep periods, there are 3 negative ramifications:**

1. Exhaustion
2. Loss of the benefit of the rejuvenating processes that occur during various stages of sleep
3. Increased susceptibility to disease and early aging

Human Brain Waves Change & Morph As Sleep Stages Change



As humans go through the sleep stages, their brain wave patterns change significantly.

The **BETA** state *(waking state)* shows a lot of electrical activity in the brain.

The **ALPHA** state *(relaxed waking state before someone falls asleep)* shows less electrical activity in the brain, as the brain & body start to relax.

The **THETA** state corresponds to sleep stage N1—light sleep.

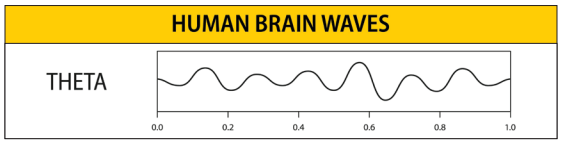
Sleep spindles & K complex electrical bursts characterize N2 stage sleep—deeper sleep.

The **DELTA** state corresponds to sleep stage N3—deepest sleep.

REM *(Rapid Eye Movement)* sleep manifests Beta brain waves that are typical of the waking state.

Sleep Stage N1—Light Sleep

Sleep Stage N1 occurs when someone first falls asleep. Muscle and eye movement slow down. The sleeper will still be somewhat aware of their surroundings and will be easily awakened by noise or other disturbances.



The brain wave pattern at this sleep stage are the relaxed THETA brain waves that show less electrical activity.

Sleep Stage N2—Deeper Sleep

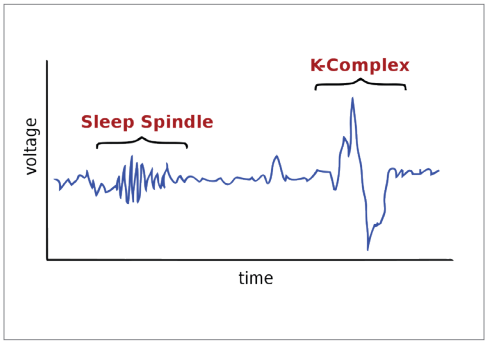
This stage of sleep manifests deeper sleep that's reflected in physiological changes:

- The heart rate slows & steadies
- Breathing slows & steadies
- Body temperature drops

Note: This is the stage of sleep when stress-related teeth grinding occurs.

2 key functions occur during N2 Stage Sleep:

- **Sleep "spindles"**—Brief, powerful bursts of neuronal firing (brain cells) in multiple, various parts of the brain
- **K complexes**—Short, fast energy spikes that last about one second



These electrical bursts play a critical role in memory functions & occur mostly in the frontal lobe of the brain. The frontal lobe of the brain is associated with high-level cognitive skills, personality, and speech processing.

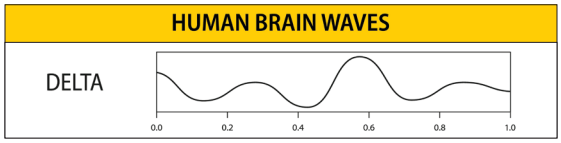
Memory Consolidation Is The Restorative Process That Happens In N2 Stage Sleep

During the N2 sleep stage, the electrical bursts from the sleep spindles and the K complexes are crucial for **MEMORY ENHANCEMENT**.

Both **sleep spindles** and **K complex** energy bursts are needed for **memory consolidation**.

- **Memory Consolidation:** This is the brain's process for converting short-term memories to long-term memories.
- **Memory Consolidation** is needed for general memory & for LEARNING and processing new information.

Sleep Stage N3–Deepest Sleep



Sleep Stage N3 is the deepest stage of sleep, also known as “Delta” sleep because of the long, slow Delta pattern brain waves.

In this deepest stage of sleep, brain waves are basically flat-lined, with a few periodic blips of electrical activity.

Essentially, the brain is in a state of deep rest. As a result, this sleep stage is the most difficult to awaken from, because the brain is basically offline, except for monitoring autonomic nervous system functions that automatically regulate functions such as breathing and heart pumping.

DID YOU KNOW: Medical research shows that those awakened from this sleep stage have impaired mental performance and “brain fog” for 30-60 minutes before their brain reboots to waking state brain waves and processing power.

The N3 DELTA Sleep Stage Brings Significant Rejuvenation & Healing

All the sleep stages perform important functions for the health & wellness of first responders. But the N3 Delta sleep stage is likely the most important stage. **Why?**

Healing that occurs during N3 DELTA sleep includes:

- The body repairs & regrows tissues
- The body builds bones & muscles
- The body strengthens the immune system

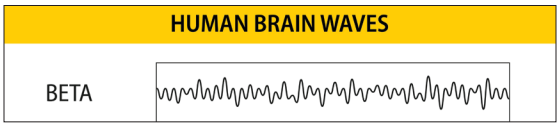
Responders who consistently miss the N3 DELTA sleep stage will experience:

- Reduced tissue, muscle & bone repair (takes longer to heal)
- A compromised immune system

REM Sleep Stage 4

REM sleep could be likened to booting up your computer system. This is NOT a restful state of sleep.

During REM sleep, the brain shifts from the deep, slow DELTA brain waves to BETA brain waves (waking state brain waves).



While the brain is booting up, the body is booting up too. During REM sleep:

- Eyes move rapidly behind the eyelids
- Breathing becomes faster and more shallow
- Blood pressure and heart rate increase

This also is the stage when vivid dreams occur.

What's The Length Of The Sleep Cycle?

The typical human sleep cycle lasts from 90-110 minutes, with 4-5 cycles per sleep during a sleep period.

However, as the sleep period progresses through multiple sleep cycles:

- The deep sleep stages get shorter
- The REM sleep stages get longer

The typical sleep cycle of a first responder is both too short (not enough hours of sleep) and fragmented (multiple awakenings during the sleep period).

This is why Zoned Fire Station Alerting technologies are so important. Zoned station alerting helps first responders get more total hours of sleep and get more hours of contiguous sleep.

As a result of broken sleep cycles, first responders typically do not gain the healing, restorative processes that occur during a typical sleep period.

Learning Point

Zoned fire station alerting promotes health & wellness for first responders who already have a very tough job—physically, mentally & emotionally.

Medical Research On The Negative Effects Of Sleep Deprivation

The following is an overview of medical research studies that highlight the negative effects of sleep deprivation.

The negative effects of sleep deprivation on first responders are as harmful, or worse, than the negative effects of stress.

That's why it's so important to deploy fire station alerting technologies to mitigate sleep deprivation for firefighters and paramedics such as zoned fire station alerting.

Negative Effects Of Sleep Deprivation On The BRAIN

The Sleep-deprived Human Brain = Inability To Focus & Memory Loss

Weblink: https://pubmed.ncbi.nlm.nih.gov/28515433/

Learning Point

Sleep deprivation impairs ability to focus, working memory, and diminishes compassion for others.

Abstract Excerpt

This research studied the effects of sleep deprivation on specific areas of the brain including the midline front-parietal region. Previous research shows that this region often disengages when an individual performs an external, goal-driven task, and then re-engages when the task is completed. (Suppression of the Default Mode Network is necessary to mobilize appropriate on-task brain networks.) However, in a sleep-deprived state, both the Fronto-Parietal Network and Default Mode Network are diminished, **which leads to a whole host of cognitive performance issues including attention deficit, impaired working memory & less ability to register and perceive emotions in others.**

Effects Of Sleep Deprivation On Cognition: High-level Cognitive Functioning Is Degraded

Weblink: https://pubmed.ncbi.nlm.nih.gov/21075236/

Abstract Excerpt

While there is broad consensus that insufficient sleep leads to a general slowing of response speed and increased variability in performance, researchers need to answer the question of whether sleep deprivation affects nearly all cognitive capacities in a global manner through overall degraded alertness and attention, or whether sleep loss specifically impairs specific aspects of the brain and cognition more than others. **Neuroimaging evidence has implicated the prefrontal cortex as a brain region that may be particularly susceptible to the effects of sleep loss.** (The pre-frontal cortex is associated with high-level cognition, personality, and speech.) Emerging evidence suggests that some aspects of higher-level cognitive capacities remain degraded by sleep deprivation despite restoration of alertness and vigilance with stimulant countermeasures. Finally, the role of emotion as a critical facet of cognition has received increasing attention in recent years and mounting evidence suggests that sleep deprivation may particularly affect cognitive systems that rely on emotional data.

Learning Point

Higher-level cognitive function remains degraded, even after restoration of alertness with stimulant count-er-measures (caffeine).

Learning Point

Stimulants may restore alertness in sleep-deprived people, but the subjects still exhibited impaired decision making.

Making Decisions When Sleep Deprived: Don't Bet On Stimulants

Weblink: https://pubmed.ncbi.nlm.nih.gov/22217100/

Abstract Excerpt

Sleep deprivation leads to poor decision-making–even if higher alertness is induced by stimulants. Following stimulant administration on the second night of sleep deprivation, groups receiving caffeine, dextroamphetamine, or modafinil showed significant reduction in subjective sleepiness and improvement in psychomotor vigilance, but decision-making remained impaired for all stimulants and did not differ from placebo. These findings are consistent with prior research showing that **sleep deprivation leads to suboptimal decision-making on some types of tasks, particularly those that rely heavily on emotion processing regions of the brain. Moreover, the deficits in decision-making were not reversed by commonly used stimulant counter measures, despite restoration of psychomotor vigilance and alertness.** These three stimulants may restore some, but not all, aspects of cognitive functioning during sleep deprivation.

Sleep Deprivation Reduces The Density Of Connective Tissue In Brain Cells

Weblink: https://www.ncbi.nlm.nih.gov/pubmed/10749778

Abstract Excerpt

Sleep deprivation has a negative impact on hippocampus-dependent memory. Previous research has showed that 5 hours of sleep deprivation robustly decreases the density of connective tissue in the brain cells in the hippocampus area of the brain in adult male mice. Research findings indicate that sleep deprivation leads to reduction in the density of individual spine types of the connective tissue in brain cells.

Learning Point

Sleep deprivation decreases the density of the connective tissue of brain cells, which send & receive information from brain cell to brain cell.

The Tired Hippocampus: The Molecular Impact Of Sleep Deprivation On Hippocampal Function

Weblink: https://pubmed.ncbi.nlm.nih.gov/28242433/

Abstract Excerpt

Memory consolidation, the process by which information is stored consists of synaptic consolidation and systems consolidation. It is widely acknowledged that sleep deprivation has a profound effect on synaptic consolidation, particularly for memories that require the hippocampus. In this review, we highlight recent studies showing that sleep deprivation impairs the hippocampus area of the brain.

Learning Point

Sleep deprivation impedes memory consolidation – i.e., turning information stored in short-term memory into long-term memory.

Negative Effects of Sleep Deprivation On The HEART

Negative Effects Of Acute Sleep Deprivation On Left Ventricular Functions And Cardiac Repolarization In Healthy Young Adults

Weblink: https://pubmed.ncbi.nlm.nih.gov/25353305/

Learning Point

Even one night of sleep deprivation can lead to changes in the function and structure of portions of the heart.

Abstract Excerpt

It is commonly known that sleep deprivation (SD) is associated with an increased incidence of adverse cardiovascular events. This study reviews the impact of SD on structural and functional alterations of the left ventricle (LV) in healthy subjects after a night of sleep deprivation. The study consisted of 40 healthy young adults and 21 females. **This crossover study revealed the presence of diastolic functional changes in the left ventricle after one night of sleep deprivation.**

Effects Of Sleep Deprivation On Coronary Heart Disease

Weblink: https://pubmed.ncbi.nlm.nih.gov/36039730/

Abstract Excerpt

Sleep deprivation (SD) is a severe health problem in modern society. Meanwhile, as with cardiometabolic disease, there was an obvious tendency of coronary heart disease (CHD) to become a global epidemic chronic disease. Specifically, SD can significantly increase the morbidity and mortality of CHD. However, the underlying mechanisms responsible for the effects of SD on CHD are multilayered and complex. **Inflammatory response, lipid metabolism, oxidative stress, and endothelial function all contribute to cardiovascular lesions.** In this review, the effects of SD on CHD development are summarized, and SD-related pathogenesis of coronary artery lesions is discussed. In general, early assessment of SD played a vital role in preventing the harmful consequences of coronary heart disease.

Learning Point

Sleep deprivation can cause a variety of conditions that all contribute to lesions in the lining of blood vessels.

Sleep Duration and Cardiovascular Disease Risk: Epidemiologic and Experimental Evidence

Weblink: https://pubmed.ncbi.nlm.nih.gov/26972035/

Abstract Excerpt

Inadequate sleep is increasingly pervasive, and the cardiovascular consequences alone appear to be substantial. This review summarizes epidemiologic evidence regarding the association between extremes of sleep duration and the prevalence and incidence of cardiovascular diseases. The adverse effects of experimental sleep loss on physiological functions are discussed, along with cardiovascular risk factors that may underlie the association with increased morbidity and mortality. **Current data support the concept that inadequate sleep duration confers heightened cardiovascular risk.** Thus, implementation of preventative strategies may reduce the potential disease burden associated with this high-risk behavior.

Learning Point

Current research data support the concept that sleep deprivation leads to increased risk of cardiovascular health issues.

Acute Sleep Deprivation: Impairment Of Biventricular Function Assessed By Speckle Tracking Echocardiography In Healthy Subjects

Weblink: https://pubmed.ncbi.nlm.nih.gov/37099093/

Abstract Excerpt

Sleep deprivation (SD) has been found to be associated with an increased incidence of adverse cardiovascular disease (CVD) events. The aim of this study was to investigate whether or not acute SD has a pathological effect on the geometry and the systolic and diastolic functions of the right and left heart chambers. 52 nurses with no history of acute or chronic diseases underwent testing after working a night shift, a sleepless period of 24 hours and 7 days of normal sleep after the night shift. Before and after measurements were taken. **The findings showed that acute sleep deprivation leads to deterioration in function of both ventricles and left atrium.** Speckle tracking echocardiography demonstrated subclinical diminished heart function.

Learning Point

24 hours of sleep deprivation resulted in deterioration of the function of the left and right ventricles of the heart, and the left atrium of the heart, i.e., diminished heart function.

Negative Effects of Sleep Deprivation—LOSS OF BONE & MUSCLE MASS

Sleep, Circadian Biology And Skeletal Muscle Interactions: Implications For Metabolic Health

Weblink: https://pubmed.ncbi.nlm.nih.gov/36272396/

Learning Point

Sleep deprivation can push the body into a catabolic state, causing loss of bone & muscle mass.

Abstract Excerpt

Disturbances to sleep patterns impart widespread and adverse effects on numerous cells, tissues, and organs. Insufficient sleep causes circadian misalignment in humans, including perturbed peripheral clocks, leading to disrupted skeletal muscle and liver metabolism. **Fragmented or insufficient sleep also disturbs hormonal balance, shifting the body into a catabolic state, resulting in reduced rates of skeletal muscle protein synthesis.**

Negative Effects of Sleep Deprivation—SYSTEMIC BACTERIAL INVASION

Systemic Bacterial Invasion Induced By Sleep Deprivation

Weblink: https://www.ncbi.nlm.nih.gov/pubmed/21102988

Abstract Excerpt

Studies of sleep-deprived animals previously have shown a progressive, chronic negative energy balance and gradual deterioration of health, which culminate in fatal bloodstream infection without an infectious focus.

The present study investigated the conditions antecedent to advanced morbidity in sleep-deprived rats by determining the time course and distribution of live microorganisms in body tissues that are normally sterile. The tissues cultured for microbial growth included the blood, four major organs, six regional lymph nodes, the intestine, and the skin. The principal finding was early infection of the mesenteric lymph nodes by bacteria presumably translocated from the intestine and bacterial migration to and transient infection of extraintestinal sites. Presence of pathogenic microorganisms and their toxins in tissues constitutes a septic burden and chronic antigenic challenge for the host. Bacterial translocation and pathogenic sequelae provide mechanisms by which sleep deprivation appears to adversely affect health.

Learning Point

Past research studies have shown that sleep-deprived animals developed sepsis (blood poisoning) without an obvious cause of infection. In this study, sleep deprivation caused a migration of intestinal bacteria to other parts of the body, causing sepsis.

Negative Effects of Sleep Deprivation—GENETIC DAMAGE

Distinct Effects Of Acute And Chronic Sleep Loss On DNA Damage In Rats

Learning Point

Sleep deprivation has been found to cause DNA damage and damage to brain tissue.

Weblink: https://pubmed.ncbi.nlm.nih.gov/19258023/

Abstract Excerpt

The aim of this investigation was to evaluate genetic damage induced in male rats by experimental sleep loss for short-term (24 and 96 h) and long-term (21 days) intervals. **The results showed DNA damage in blood cells and damage to brain tissue.** Collectively, these findings reveal that sleep loss was able to induce genetic damage in blood and brain cells, especially following acute exposure.

Negative Effects of Sleep Deprivation—HIGH BLOOD PRESSURE

Blood Pressure Increases During A Simulated Night Shift In Persons At Risk For Hypertension

Weblink: https://pubmed.ncbi.nlm.nih.gov/20878512/Abstract

Abstract Excerpt

Shift work with sleep disruption is a systemic stressor that may possibly be associated with blood pressure dysregulation and hypertension. The study examined the effects of a simulated night shift on resting blood pressure in 51 diurnal young adults without current hypertension. Resting blood pressure was monitored throughout a 24-h period of total sleep deprivation with sustained cognitive work. Twelve participants (23.5%) reported one or more parents with a diagnosis of hypertension. Ten participants were classified as prehypertensive by JNC-7 criteria. Only two prehypertensive subjects reported parental hypertension. **Results indicate that, as the night shift progressed, participants with a positive family history of hypertension showed significantly higher resting diastolic blood pressure than those with a negative family history of hypertension (p = 0.007).** Prehypertensive participants showed elevated blood pressure throughout the study.

Learning Point

These data suggest that rotation to a simulated night shift with sleep deprivation may contribute to high blood pressure in persons with a positive family history of hypertension.

Negative Effects of Sleep Deprivation—INSULIN RESISTANCE & DIABETES

Effects Of Sleep Manipulation On Markers Of Insulin Sensitivity

Weblink: https://pubmed.ncbi.nlm.nih.gov/35189549/

Learning Point

Lack of deep, DELTA (slow wave) sleep can cause insulin resistance and increase the risk for Type 2 Diabetes.

Abstract Excerpt

Poor sleep habits are associated with increased risk of developing type 2 diabetes. In this review and meta-analysis, we aimed to investigate the effects of sleep manipulation on markers of insulin sensitivity from randomized, controlled trials. Sleep manipulation was defined as reduction in sleep duration, sleep quality, and circadian misalignment. Sleep restriction reduced insulin sensitivity assessed by oral or intravenous glucose tolerance test and homeostatic model assessment of insulin resistance. Whole-body insulin sensitivity also was reduced after sleep deprivation. **In addition, lack of slow-wave DELTA sleep leads to insulin resistance, a precursor to diabetes.**

Negative Effects of Sleep Deprivation—INCREASED RISK-TAKING BEHAVIOR

Insufficient Sleep Can Lead To Increased Risk-Taking Behavior

Weblink: https://pubmed.ncbi.nlm.nih.gov/28833531/

Abstract Excerpt

Chronic sleep restriction is highly prevalent in modern society, with substantial negative impact on health and community burden. The study assessed financial risk-taking behavior after 7 consecutive nights of sleep restriction and after 1 night of acute sleep deprivation compared to a regular sleep condition in a within-subject design. **Results showed that chronic sleep restriction increases risk-seeking.** This study provides evidence that insufficient sleep restoration over circumscribed cortical areas leads to aberrant behavior. In chronically sleep restricted subjects, low slow-wave sleep intensity over the right prefrontal cortex-which has been shown to be linked to risk behavior-may lead to increased and subjectively unnoticed risk-seeking.

Learning Point

Sleep deprivation has been shown to cause behavior in which people seek out risk, and also exhibit risky behaviors.

Negative Effects of Sleep Deprivation—CHRONIC INFLAMMATION

Immune, Inflammatory, And Cardiac Consequences Of Sleep Restriction And Recovery

Weblink: https://pubmed.ncbi.nlm.nih.gov/21835655/

Learning Point

Sleep deprivation causes chronic, low-level inflammation that has harmful effects on the heart, and which does not abate once a person "catches up on their sleep."

Abstract Excerpt

In addition to its effects on cognitive function, compelling evidence links sleep loss to alterations in the neuroendocrine, immune, and inflammatory systems with potential negative public-health ramifications. Evidence suggests that shorter sleep is associated with detrimental health outcomes. The data obtained indicate non-specific activation of white blood cells populations and a state of low-level systemic inflammation after sleep loss. Furthermore, one night of recovery sleep does not allow full recovery of a number of these systemic immune and inflammatory markers.

Locution SYSTEMS INC.

For more information on how Locution Systems' PrimeAlert® Zoned Fire Station Alerting can reduce sleep deprivation in first responders, please contact Locution Systems at:

www.Locution.com

Thank you!