

THE IMPACT OF SLEEP DEPRIVATION ON HUMAN HEALTH

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ABSTRACT

Sleep is one of the essential biological processes required for the normal physiological functioning of the human body. Adequate and high-quality sleep plays an important role in the functioning of the central nervous system, memory and cognitive processes, immune system, cardiovascular system, endocrine regulation, and metabolism. Regular reduction in sleep duration, poor sleep quality, or an irregular sleep schedule can negatively affect human health. For adults, obtaining at least 7 hours of sleep on a regular basis is generally recommended.

This article analyzes the physiological importance of sleep, the major causes of sleep deprivation, and its effects on the cardiovascular, nervous, immune, and endocrine systems, as well as on mental health, metabolism, and cognitive performance. The article also examines sleep requirements and the consequences of sleep deprivation among different age groups. Analysis of modern scientific literature indicates that insufficient sleep is associated with an increased risk of hypertension, cardiovascular diseases, obesity, type 2 diabetes, depressive and anxiety symptoms, impaired attention, and slower reaction time.

KEYWORDS:

sleep, sleep deprivation, insomnia, circadian rhythm, cardiovascular system, immune system, metabolism, obesity, diabetes mellitus, stress, depression, cognitive function.

INTRODUCTION

Sleep is a complex biological process that occupies a significant part of human life and plays an essential role in maintaining physiological and psychological balance. During sleep, a person's interaction with the external environment temporarily decreases; however, the body is not in a completely passive state. On the contrary, important processes take place during sleep, including information processing in the central nervous system, memory consolidation, regulation of hormonal activity, tissue recovery, and coordination of immune responses.

Modern lifestyles have created numerous factors that can contribute to reduced sleep duration. Prolonged use

of computers and smartphones, night-shift work, increasing academic and professional workloads, psychological stress, busy social schedules, and the consumption of caffeine and other stimulants may contribute to shorter or poorer-quality sleep.

Sleep deprivation is not limited to morning fatigue or daytime sleepiness. Prolonged insufficient sleep may negatively affect the cardiovascular system, metabolism, immune function, and mental health. According to the Centers for Disease Control and Prevention (CDC), adequate sleep is associated with maintaining a healthy body weight, reducing stress, and supporting cardiovascular and metabolic health. Insufficient sleep is associated with an increased risk of type 2 diabetes, cardiovascular disease, hypertension, and stroke.

According to data from the 2024 U.S. National Health Interview Survey, approximately 30.5% of adults reported an average sleep duration of less than 7 hours per 24-hour period. This demonstrates that insufficient sleep is a widespread public-health concern.

Therefore, sleep should be considered not only an individual lifestyle issue but also an important factor in preventive medicine and public health.

AIM OF THE STUDY

The main aim of this article is to analyze the effects of sleep deprivation on human health based on modern scientific literature and to develop practical recommendations for preventing insufficient sleep.

Objectives of the Study

To achieve this aim, the following objectives were established:

To examine the physiological characteristics of sleep.

To describe the major stages of sleep.

To determine recommended sleep durations for different age groups.

To analyze the major causes of sleep deprivation.

To examine the effects of sleep deprivation on the cardiovascular system.

To analyze its effects on the nervous system and cognitive performance.

To examine the relationship between sleep and mental health.

To evaluate the effects of insufficient sleep on the immune and endocrine systems.

To analyze the relationship between sleep deprivation and metabolic disorders.

To develop recommendations for preventing sleep deprivation.

MATERIALS AND METHODS

This article is based on a literature review. Scientific publications concerning sleep physiology, sleep deprivation, chronic diseases, mental health, cardiovascular disorders, and metabolic abnormalities were analyzed.

The main sources included scientific publications indexed in PubMed/MEDLINE, information from the Centers for Disease Control and Prevention (CDC), and consensus documents from the American Academy of Sleep Medicine (AASM) and the Sleep Research Society.

The following research methods were used:

- analysis of scientific literature;
- comparison;
- generalization;
- analysis of epidemiological data;
- assessment of potential cause-and-effect relationships;
- analysis of preventive approaches.

A 2025 umbrella review combining 29 systematic reviews and meta-analyses reported associations between sleep deprivation and cardiovascular diseases, hypertension, stroke, ischemic heart disease, obesity, type 2 diabetes, and mental-health problems.

CHAPTER I. PHYSIOLOGICAL BASIS OF SLEEP

Definition of Sleep

Sleep is a physiological state characterized by specific changes in central nervous system activity and reduced responsiveness to the external environment. It is essential for maintaining normal physical and psychological functioning.

During sleep, important physiological processes occur, including:

- memory consolidation;
- nervous-system recovery;
- hormonal regulation;
- immune regulation;
- energy metabolism;
- tissue recovery;
- emotional regulation.

Therefore, sleep should not be considered merely a period of rest. It is an active biological process that contributes to maintaining human health.

Stages of Sleep

Sleep is generally divided into non-rapid eye movement (NREM) sleep and rapid eye movement (REM) sleep.

NREM Sleep

NREM sleep consists of several stages. The initial stages represent lighter sleep, while later stages involve deeper sleep.

Deep NREM sleep is particularly important for physical restoration and recovery.

REM Sleep

During REM sleep, brain activity becomes relatively high, and vivid dreaming is more common. REM sleep is associated with memory processing, learning, emotional regulation, and other cognitive functions.

Sleep cycles repeat several times throughout the night. Therefore, not only total sleep duration but also sleep continuity and quality are important.

Circadian Rhythms

The human body has biological rhythms that approximately follow a 24-hour cycle. These are known as circadian rhythms.

Circadian rhythms regulate:

- sleep and wakefulness;
- body temperature;
- hormone secretion;
- heart rate;
- blood pressure;
- metabolic processes.

Light is one of the most important external regulators of circadian rhythms. Exposure to artificial light during the evening and night can interfere with the natural sleep-wake cycle and make it more difficult to fall asleep.

Consequently, prolonged use of smartphones, tablets, and computers at night may contribute to disturbances in sleep timing and duration.

CHAPTER II. MAJOR CAUSES OF SLEEP DEPRIVATION

Stress and Psychological Factors

Stress is one of the common causes of sleep disturbances.

Examinations, occupational problems, family conflicts, financial difficulties, and other stressful circumstances can make it difficult to fall asleep.

Chronic stress may increase sympathetic nervous system activity and keep the body in a state of increased alertness.

As a result, the following cycle may develop:

Stress → physiological arousal → difficulty falling asleep → reduced sleep duration → daytime fatigue → increased stress

Breaking this cycle is important for improving sleep and overall health.

Electronic Devices

Prolonged use of smartphones, tablets, televisions, and computers in the evening may negatively affect sleep.

Several mechanisms may contribute to this effect:

- Exposure to light.
- Increased mental stimulation.
- Social-media use.
- Gaming and other interactive activities.
- Direct displacement of sleep time.

The CDC recommends turning off electronic devices at least 30 minutes before bedtime as part of good sleep habits.

Work and Study Schedules

Night-shift work, early waking, late bedtimes, and studying late into the night can interfere with regular sleep patterns.

This is particularly relevant to university students, who may experience:

- heavy academic workloads;
- examination periods;

nighttime studying;
extensive internet use;
social-media activity;
irregular daily schedules.

CHAPTER III. EFFECTS OF SLEEP DEPRIVATION ON HUMAN HEALTH

Effects on the Cardiovascular System

One of the most important consequences of insufficient sleep concerns the cardiovascular system.

During normal sleep, blood pressure generally decreases. When sleep is disrupted or insufficient, blood pressure may remain elevated for longer periods.

Sleep deprivation may contribute to:
increased sympathetic nervous system activity;
elevated blood pressure;
hormonal changes;
increased inflammatory activity;
metabolic disturbances.

Recent evidence indicates that insufficient sleep is associated with hypertension, stroke, and ischemic heart disease.

Therefore, adequate sleep should be considered an important component of cardiovascular disease prevention.

3.2. Effects on the Nervous System

Sleep is essential for normal functioning of the central nervous system.

Short-term sleep deprivation can result in:
reduced attention;
slower reaction time;
impaired memory;
reduced concentration;
daytime sleepiness;
impaired decision-making;
mood changes.

A systematic review and meta-analysis of one-night sleep restriction found that sleep restriction of approximately 2–6 hours was associated with increased sleepiness, reduced sustained attention, and slower reaction times.

This is particularly important for:

drivers;
physicians;
nurses;
industrial workers;
machine operators;
other professionals whose work requires sustained attention.

Effects on Memory and Learning

Sleep contributes significantly to the processing and consolidation of newly acquired information.

Sleep deprivation can impair:
learning;
concentration;
long-term memory;
problem-solving ability;
academic performance.

Therefore, staying awake all night to study is not necessarily an effective learning strategy. Adequate sleep is

necessary for consolidation of learned material and optimal cognitive performance.

Effects on Mental Health

There is a bidirectional relationship between sleep and mental health.

In other words:

Sleep deprivation → deterioration of mental health and

Mental-health problems → sleep disturbances may both occur.

Sleep deprivation may be associated with:

anxiety;
emotional instability;
irritability;
depressive symptoms;
reduced tolerance to stress.

Modern evidence indicates associations between insufficient sleep, anxiety, impaired emotional regulation, and depressive symptoms.

Effects on the Immune System

Sleep is also important for normal immune-system function.

Adequate sleep supports appropriate immune responses, whereas chronic sleep deprivation may adversely affect the body's ability to respond to infections and maintain normal immune function.

The AASM consensus recommendations note that regularly sleeping less than 7 hours is associated with impaired immune function.

Therefore, adequate sleep may be considered one component of maintaining normal immune health.

Effects on the Endocrine System

Sleep and hormonal regulation are closely interconnected.

Sleep deprivation may affect:

cortisol;
insulin;
growth hormone;
appetite-regulating hormones.

These changes can influence energy balance, appetite, glucose metabolism, and body weight.

Obesity and Metabolic Disorders

Sleep deprivation is associated with an increased risk of weight gain and obesity.

Possible mechanisms include:

increased appetite;
greater preference for high-calorie foods;
reduced physical activity;
metabolic changes;
impaired insulin sensitivity.

Insufficient sleep is particularly important in children and adolescents because they require more sleep than adults.

Relationship with Diabetes Mellitus

Insufficient sleep can adversely affect glucose metabolism.

Chronic sleep deprivation may contribute to:

reduced insulin sensitivity;
impaired glucose regulation;
changes in appetite;

increased body weight.

These factors may contribute to an increased risk of developing type 2 diabetes.

The relationship between sleep and metabolic disease has been documented in numerous epidemiological and experimental studies.

CHAPTER IV. SLEEP DEPRIVATION IN DIFFERENT AGE GROUPS

Children

Children require substantial amounts of sleep because their bodies and brains are undergoing rapid growth and development.

Adequate sleep is important for:
brain development;
memory;
learning;
immune function;
physical growth.

Children aged 6–12 years are generally recommended to obtain 9–12 hours of sleep, while adolescents aged 13–17 years are recommended to obtain 8–10 hours.

Adolescents

During adolescence, biological changes, academic demands, social activities, and electronic-device use may contribute to insufficient sleep.

Sleep deprivation among adolescents may result in:
reduced attention;
poorer academic performance;
mood changes;
daytime sleepiness;
increased stress.

The combination of late-night electronic-device use and early school schedules may further reduce sleep duration.

University Students

University students represent an important population at risk for insufficient sleep.

Common contributing factors include:
academic workload;
examinations;
nighttime studying;
internet use;
social media;
irregular schedules.

Sleep deprivation may negatively affect academic performance, concentration, memory, and emotional well-being.

Therefore, universities should consider educational programs that promote healthy sleep habits among students.

Persistent or severe sleep problems should be evaluated by a healthcare professional.

CONCLUSION

Sleep is one of the fundamental physiological needs of the human body. Adequate and high-quality sleep plays an important role in maintaining the normal functioning of the central nervous, cardiovascular, immune, and endocrine systems and in regulating metabolism.

The scientific literature reviewed in this article indicates that insufficient sleep can negatively affect human health in multiple ways. Short-term sleep restriction may cause daytime sleepiness, impaired attention, and slower reaction times. Chronic sleep deprivation is associated with hypertension, cardiovascular disease, obesity, type 2 diabetes, and mental-health problems.

The importance of adequate sleep is particularly significant among children, adolescents, university students, night-shift workers, and healthcare professionals.

Therefore, healthy lifestyle promotion should include three major components:

healthy nutrition + regular physical activity + adequate sleep.

Preventing sleep deprivation requires maintaining a regular sleep schedule, reducing electronic-device use before bedtime, engaging in regular physical activity, limiting caffeine in the evening, and creating a comfortable sleeping environment.

Overall, sleep should not be viewed as “free time” or simply as time left over after daily activities. It should be regarded as a fundamental component of human health and disease prevention.

PRACTICAL RECOMMENDATIONS

Adults should aim to obtain at least 7 hours of sleep every night on a regular basis.

Maintain consistent bedtimes and wake-up times.

Reduce smartphone, computer, and television use before bedtime.

Keep the bedroom quiet, dark, comfortable, and cool.

Limit caffeine consumption during the evening.

Maintain regular physical activity.

Pay particular attention to sleep duration among children and adolescents.

University students should avoid regularly staying awake all night to study.

Work-rest schedules should be appropriately organized for night-shift workers.

Individuals with persistent sleep problems should consult a healthcare professional or sleep specialist.

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