The Effects of Insomnia and Sleep Loss on Cardiovascular Disease

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KEYWORDS

• Short sleep duration • Insomnia • Hypertension • Diabetes • Prediabetes • Cardiovascular disease

KEY POINTS

- Chronic insomnia is a pervasive issue in the general population. It is associated with poor quality of life, increased use of heath care resources, and poor mood.
- Those who are sleep deprived or have insomnia have elevated cortisol levels, increased markers of sympathetic system activity, increased metabolic rate, and endothelial dysfunction; all of which are correlated with increased risk of cardiovascular disease and risk factors.
- Both short sleep duration and insomnia are linked to the development of diabetes and hypertension.
- Insomnia is associated with increased risk of cardiovascular disease and mortality, although not all studies show consistent findings of a positive association.
- Evaluation of sleep health may be an important part of the management of those with cardiovascular disease.

INTRODUCTION

Sleep and its impact on health has been increasingly explored over the past few decades. Sleep loss has negative impacts on quality of life, mood, cognitive function, and health. Insomnia and difficulty sleeping are prevalent issues as well, affecting up to 35% of the population at some point in their lives. Insomnia is linked to poor mood, increased use of health care resources, and decreased quality of life as well as possibly cardiovascular risk factors and disease. Studies have shown increased cortisol levels, decreased immunity, and increased markers of sympathetic activity in sleep-deprived healthy subjects and those with chronic insomnia. The literature also shows that subjective complaints consistent with chronic insomnia and shortened sleep time, both independently and in combination, can be associated with development of diabetes, hypertension, and cardiovascular disease. This article explores the relationship and strength of association between insufficient sleep and insomnia with these health conditions.

SLEEP AND HEALTH

Various sleep disorders, such as obstructive sleep apnea and insomnia, have been associated with a variety of health problems and impaired quality of life. Chronic sleep loss can lead to impaired vigilance and performance, slowing of cognitive processes, depressed mood, and poor attention.[1,2] Sleep quality and duration can effect cellular

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immunity and cytokine levels, such that a person's immunity can be impaired with even mild sleep loss.[3,4] Impaired sleep is also linked to changes in metabolism, increased caloric intake, and obesity.[5,6] Short sleep duration is associated with deleterious effects on health, such as increased incidence of all-cause mortality, coronary artery disease, type 2 diabetes mellitus, obesity, and hypertension.[7–11] Short sleep duration has multiple causes, including behavior-induced sleep deprivation, obstructive sleep apnea, shift work syndrome, and insomnia.

Insomnia is a sleep disorder plaguing an estimated 15% of the population[12] and often goes untreated. Chronic insomnia is defined by the *International Classification of Sleep Disorders – Third Edition* (**Box 1**) as a patient, or caregiver, describing difficulty falling asleep, maintaining sleep, waking up earlier than desired, resistance to going to bed on an appropriate schedule, or difficulty sleeping without parent or caregiver intervention, associated with at least 1 symptom that is a consequence of the insomnia, for 3 months or more. The 2005 US National Health and Wellness Survey showed that insomnia is associated with a subjective feeling of decreased quality of life and increased mental health symptoms as well as increased absenteeism from work and decreased work productivity.[13] Insomnia is associated with increased reports of heart disease, high blood pressure, chronic pain, and development of depression and anxiety[14–16] as well as increased use of medical resources and economic burden.[17] Subjective complaints of insomnia and increased sleeping pill use are associated with increased mortality.[18,19] Although the link to mortality has not been demonstrated in all studies,[20–22] this possible association emphasizes the importance of sleep on health.

Box 1
Diagnostic criteria of chronic insomnia

Need A–F to be met

A. The patient reports, or the patient's parent or caregiver observes, 1 or more of the following:
   1. Difficulty initiating sleep
   2. Difficulty maintaining sleep
   3. Waking up earlier than desired
   4. Resistance to going to bed on appropriate schedule
   5. Difficulty sleeping without parent or caregiver intervention

B. The patient reports, or patient's parent or caregiver observes, 1 or more of the following related to the nighttime sleep difficulty:
   1. Fatigue/malaise
   2. Attention, concentration, or memory impairment
   3. Impaired social, family, occupational, or academic performance.
   4. Mood disturbance/irritability
   5. Daytime sleepiness
   6. Behavioral problems
   7. Reduced motivation/energy/initiative
   8. Proneness for errors/accidents
   9. Concern about or dissatisfaction with sleep

C. The reported sleep/wake complaints cannot be explained purely by inadequate opportunity or inadequate circumstances for sleep.

D. The sleep disturbance and associated daytime symptoms occur at least 3 times per week.

E. The sleep disturbance and associated daytime symptoms have been present for at least 3 months.

F. The sleep wake difficulty is not better explained by another sleep disorder.

From American Academy of Sleep Medicine. The International classification of sleep disorders, 3rd edition. Darien (IL): American Academy of Sleep Medicine; 2014; with permission.

SLEEP AND ITS EFFECTS ON IMMUNITY AND METABOLIC ACTIVITY

Sleep can influence measures of immunity as well as metabolism and inflammation. There are several possible mechanisms of how insomnia and sleep loss may lead to cardiovascular disease and associated risk factors. Immunity can be divided into adaptive and innate immunity, both of which are regulated by circadian rhythms as well as by sleep. Adaptive immunity refers to immunity that is acquired against a live pathogen to which the organism was previously exposed. Innate immunity refers to defense mechanisms against any foreign body that develop within hours of exposure. The distribution of immune cells is circadian related. Leukocytes, granulocytes, monocytes, and major lymphocytes reach peak levels in the early evening and decline throughout the night.[23] Alternatively, the immune cells responsible for the adaptive immune system are regulated by sleep, during which the levels of interleukin (IL)-2, interferon-∞, and IL-12[24–26] increase. Nocturnal sleep also