Other Medical Conditions or Disorders

Contents

Morbidity and Mortality Associated with Sleep Length

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Glossary

Cross-sectional study: A type of study in which all measurements are taken at a single point in time.
Glucose metabolism: The process in the body by which glucose (sugar) in the blood is processed and used as energy. After consuming food, glucose enters the blood and is eventually taken up into tissue cells (e.g., muscle, fat, and organs) to produce energy or to be stored (in muscles or liver).
Prospective study: A type of study that follows study subjects over time.

Introduction

Although the brain is responsible for the regulation and generation of sleep, sleep is important for the entire body. In fact, a large amount of evidence links sleep duration and quality to numerous different health outcomes. In this article, we will briefly review the association between sleep duration and diabetes, obesity, heart disease, depression, and mortality.

Sleep and Diabetes

Spiegel and colleagues conducted laboratory studies that compared glucose metabolism after only 4 h in bed per night for 1 week and after 10 h in bed per night for 1 week and discovered that the body's ability to dispose of glucose in the blood was impaired after a week of short sleep. If glucose metabolism is impaired over longer periods of time, it could lead to the development of diabetes. Since laboratory studies last only a few weeks, observational, epidemiologic studies can provide insight into the relationship between habitual sleep behavior and disease risk. The majority of the epidemiologic studies did in fact find that people with diabetes were more likely to have shorter sleep durations and worse sleep quality than people without type 2 diabetes. In addition, studies among persons with diabetes have found that worse sleep quality and greater sleep-disturbed breathing are associated with worse glucose control. Of course, these studies cannot determine whether impaired or insufficient sleep is the cause for poor glucose control or diabetes, or whether having diabetes impairs sleep. Both causal directions are possible. Prospective studies can provide the necessary temporal sequence to suggest causal direction if sleep is measured before the development of diabetes. Many of these studies have found that people who sleep less or who report sleep disturbances are more likely to develop type 2 diabetes than people who sleep longer or better. It is important to note that some studies have observed that self-reported long sleepers ($\geq$9 h per night) are also more likely to have or to develop diabetes.

Sleep and Obesity

Several observational studies have reported significant associations between sleep and obesity or body mass index (BMI). In many cross-sectional studies from various countries, a significant association between short sleep duration (generally $<$6 h per

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night) and increased prevalence of obesity or higher BMI in both adults and children has been observed. Some studies also observed higher BMI among long sleep durations (generally >8 h per night). Although most cross-sectional studies relied on self-reported measures of sleep duration, the results have been generally consistent. Of note, however, is that some studies have reported differences in these associations by age group. In particular, the association between sleep and BMI appears stronger at younger ages.

A few prospective studies have examined the relationship between sleep duration and weight gain in both adults and children, but the results are more inconsistent than the cross-sectional studies. A few of these studies found no statistically significant association between sleep duration and change in body size but others did find a significant association between short sleep and greater weight gain.

The laboratory studies by Spiegel et al. have provided clues about how sleep duration could impact weight gain. These studies have examined the effects of sleep restriction on hormones that are involved in appetite regulation. Two hormones that have been studied include leptin and ghrelin. Leptin, which is secreted by fat cells, is primarily a starvation signal and low levels indicate inadequate energy reserves and leads to increased food intake. Ghrelin, which is secreted by gastric cells, stimulates appetite and higher levels lead to increased food intake. Thus, leptin and ghrelin have opposing effects on appetite. For example, a laboratory study compared the effect of 2 days of 4-h bedtimes versus 2 days of 10-h bedtimes on leptin, ghrelin, and subjective appetite. Mean leptin levels were lower, mean ghrelin levels were higher, and subjective appetite, particularly for high-fat, high-carbohydrate foods, was higher after sleep restriction relative to sleep extension. Thus, laboratory studies suggest that short sleep durations may be associated with alterations in appetite regulation that could lead to increased food intake. Recently, some observational studies have found that short sleep durations are in fact associated with increased food intake and an increase in the proportion of calories that come from fat. The mechanisms linking self-reported long sleep duration to increased BMI are not understood.

Sleep and Cardiovascular Disease

Sleep duration has also been associated with blood pressure in several cross-sectional epidemiologic studies. In general, these studies reported that self-reported short sleep durations are associated with higher blood pressure or higher prevalence of hypertension. A few studies also observed higher blood pressure among long sleepers (>8 h). Two studies observed a significant association in women but not men, which suggests that sex may mediate the association. Age may also mediate this association because no association between sleep and blood pressure was observed in two studies among elderly adults and in one among children aged 3–10 years. Thus, cross-sectional studies generally support a relationship between disturbed or insufficient sleep and higher blood pressure, but the causal direction cannot be determined and the strength of these associations may vary by gender and age. Prospective studies have also linked short sleep to the development of hypertension, predictors of cardiovascular disease, and incident coronary heart disease events. Overall, there is some evidence that insufficient or impaired sleep is associated with cardiovascular disease and hypertension, but more rigorous studies are required to fully understand this association.

Sleep and Depression

Recent literature has reported a strong association between abnormal sleep patterns and the prevalence or development of depression. Given that depression affects about 121 million people worldwide according to the World Health Organization, analyzing the effects of sleep on depression may improve outcomes and treatments of this prevalent disorder.

Insomnia is a common complaint of patients seeking treatment for depression. Individuals with insomnia experience elevated symptoms of depression and anxiety as well as widespread physical pain. Additionally, those with insomnia are more likely to remain depressed compared to individuals without this sleep disturbance. Along with this, individuals with a diagnosed breathing-related sleep disorder, such as obstructive sleep apnea (OSA), are predisposed to developing major depressive disorder (MDD). Of those with OSA, women and the elderly population experience higher rates of depression than men with OSA. Patients diagnosed with OSA and treated with continuous positive airway pressure (CPAP) therapy experienced a decrease in their depressive symptoms, which suggests a causal relationship between the sleep-disturbed breathing and depression.

The relationship between sleep disturbances and depression appears to be bidirectional. Individuals diagnosed with depression commonly experience disturbances in sleep hygiene and neurological sleep patterns. Circadian and sleep abnormalities are also associated with the pathophysiology of mood disorders. A literature review on circadian rhythms and depression found that patients with depression exhibit abnormal circadian rhythms and diurnal mood variations. Other research found that those with depression exhibit alterations in their sleep architecture, including sleep continuity disturbances, reduced slow-wave sleep, shortened rapid eye movement (REM) latency, prolongation of the first REM period, and increased REM density. Therapeutic efforts, such as manipulation of sleep–wake cycle, cognitive behavioral therapy, and certain drug therapies, are helpful in improving sleep patterns along with alleviating depression symptoms. Examining and implementing treatments for sleep disorders may suggest valuable improvements in screening, clinical care, and quality of life for individuals with depression.

Sleep and Mortality

Several studies have reported an association between sleep duration and risk of all-cause mortality. Specifically, both short (generally <6 h) and long (generally >8 h) self-reported sleep durations have been associated with increased risk of early death. These studies have had follow-up periods that ranged from 2 to 25 years, and come from numerous countries including the United States, Sweden, and Japan. A few studies have examined cardiovascular disease mortality in relation to

sleep duration, but none has found an association in fully adjusted models. Subjective insomnia or insomnia symptoms have been associated with increased cardiovascular disease events or mortality.

The mechanisms underlying increased risk of mortality among short sleepers could include the increased risk of diseases described above, including hypertension, diabetes, obesity, and depression. The association between long self-reported sleep duration and increased mortality risk is not as well understood. Patel et al. conducted an analysis to try to determine the factors that may account for the association between long sleep duration and increased mortality risk. They examined numerous factors including medical, psychiatric, lifestyle, and socioeconomic factors. Depressive symptoms and unemployment were the two most likely explanations for the association between long sleep and mortality.

Summary

Several studies have demonstrated associations between short sleep duration and increased prevalence or incidence of obesity, diabetes and cardiovascular disease. Many of these studies also found associations between these diseases and long sleep duration. An important limitation is that the majority of these studies relied on self-reported sleep duration, which may not be particularly accurate. In order to better understand whether and how short or impaired sleep increases disease risk, future studies need to include objective measures of sleep and incorporate a prospective design. Intervention studies that improve sleep duration or quality will also help to elucidate the role of sleep in disease risk.

See also: **Associations and Consequences of CRSD:** Health Consequences of Circadian Disruption; **Associations and Consequences of Hypersomnias:** Morbidity and Mortality; **Associations and Consequences of SRBD:** Morbidity and Mortality of Obstructive Sleep Apnea.

Further Reading

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Relevant Websites

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http://www.diabetes.org/ – American Diabetes Association.
http://www.heart.org/ – American Heart Association.
http://www.cdc.gov/nchs/nhanes.htm – National Health and Nutrition Examination Survey (NHANES).
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