Sleep deprivation and metabolic consequences

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The ‘24/7’ culture of Western societies, whereby wakefulness is extended due to work or social pressures, has implications for our quality of sleep, and perhaps our risk of obesity and diabetes, according to research.

What is sleep for?

Sleep is essential for life, and supports many physiological and psychological functions including tissue repair, growth, memory consolidation and learning. While adults differ in their need for sleep, experts believe that less than 7 hours per night continually over time may have negative implications for the brain and body.

Sleep and the metabolism

When examining the relationship between sleep and metabolism, it is often hard to determine whether particular metabolic circumstances drive sleep, or whether the quality and length of sleep drives the metabolism. For example, longer periods of deep sleep are observed in physically active people and in those with an over-active thyroid gland, both associated with a faster metabolism. In contrast, people with an underactive thyroid gland, and thus a slower metabolism, enjoy fewer hours of deep sleep.

Turning the relationship around, one observes that sleep deprivation is related to a number of undesirable changes in metabolic activity. For example, levels of cortisol (hormone involved in the response to stress) in the blood increase, the immune response is affected, the body’s ability to handle glucose diminishes, and appetite control suffers. Similar changes are seen in those whose sleep patterns have been disrupted, e.g. by young children or illness. The end result is that the body’s normal function is disturbed by lack of sleep, leading to certain metabolic consequences.

Does lack of sleep influence health?

Laboratory and epidemiological studies suggest that sleep loss may play a role in the increased prevalence of diabetes and obesity. The relationship between sleep restriction, weight gain and diabetes risk may involve alterations in glucose metabolism, upregulation of appetite, and decreased energy expenditure.¹

Sleep and glucose metabolism

Shorter sleeping periods are associated with decreased glucose tolerance and increased concentrations of blood cortisol. Glucose tolerance is a term used to describe how the body controls the availability of blood glucose to tissues and the brain. At fasting state, high circulating levels of glucose and the hormone insulin indicate that the body’s handling of glucose is inadequate. There is evidence that poor glucose tolerance is
a risk factor for type 2 diabetes. Research has suggested that long-term sleep restriction (< 6.5 hours per night) may cause a 40% fall in glucose tolerance.

**Upregulation of appetite**

An association between short habitual sleep time and increased body mass index (BMI) has been reported in large populations. Short sleep was associated with changes in hormones that control hunger: leptin levels (reducing appetite) were low, while ghrelin levels (stimulating appetite) were high. Effects were seen when sleep duration fell below 8 hours.\(^1\,^3\) This suggests that sleep deprivation is a risk factor for obesity. One controlled study with healthy males found that a sleep time of around 4 hours was associated with significantly greater craving for calorie-dense foods with high carbohydrate content (sweets, salty foods, and starchy foods). Reported hunger was also higher.\(^2\)

Less time spent sleeping leaves more time available for eating and drinking – there is some research that shows this is a factor contributing to the obesogenic aspects of shorter periods spent sleeping.

**Decreased energy expenditure**

On the other side of the energy equation, sleep deprived people are less likely to be physically active, resulting in lower energy expenditure.

Taken together, the increases in appetite and food craving, and decreases in activity, create a compelling argument for the role of sleep in weight management.

**Vicious circle of disordered sleep and obesity**

The disorder, sleep apnoea, affects around 24% of men and 9% of women. It is characterised by pauses in breathing during sleep, resulting in disturbed sleep and daytime fatigue. There is a strong association between the condition and obesity. Studies have found that people with sleep apnoea experience abnormal sleeping patterns that could exacerbate the metabolic disturbances associated with sleep deprivation, e.g. increased hunger. Thus, sleep apnoea brought on by obesity, could in turn influence appetite and energy expenditure in a way that promotes obesity. More research is needed to fully understand these relationships.

**Conclusion**

A lack of high quality sleep appears to impact on physiological drivers of energy balance, namely appetite, hunger and energy expenditure. Alongside this, sleep deprivation adversely affects the body’s ability to handle glucose and may increase the risk of type 2 diabetes. It is not clear, as yet, how changes to sleep patterns could be used to create a favorable environment for weight management and related-diseases risk reduction.
References