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SUMMARIES BY THE NUTRITION • PHYSICAL ACTIVITY • WEIGHT TEAM

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In this issue

The role of sleep in weight gain

The impact of the environment and lifestyle on sleep quality

And answers to the following questions

- What is the relationship between sleep and weight gain?
- What is the ideal sleep duration?
- How can we make our environment more conducive to quality sleep?
- What daily behaviours favour or hinder sleep?

What is *Topo*?

The *Topo* collection is produced by the multidisciplinary team on nutrition, physical activity, and weight problem prevention (Nutrition, activité physique et prévention des problèmes reliés au poids or NAPP)[1] at the Institut national de santé publique du Québec (INSPQ). The collection disseminates knowledge to inform the choices of practitioners and decision makers in the prevention of weight-related problems. Each issue addresses a theme and combines a critical analysis of the relevant scientific literature with observations or illustrations that can assist in applying this knowledge in the Quebec context. The *TOPO* collection may be found at http://www.inspq.qc.ca/english/default.asp.

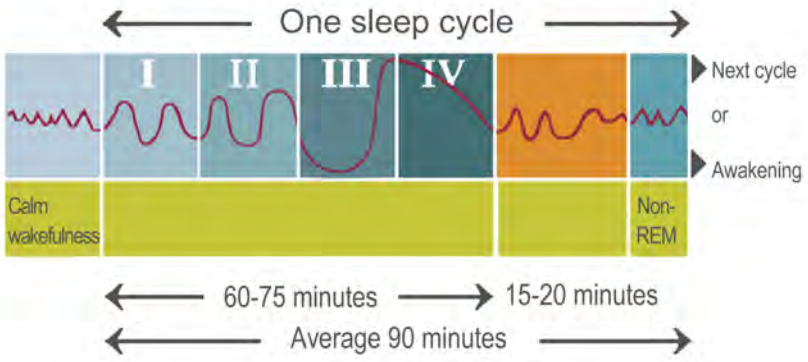
1 The NAPP team is mandated to develop expertise on the issue of weight to support and assist the health care system's efforts in this field. The NAPP team is part of the Habitudes de vie et lutte au tabagisme unit (Lifestyles and antismoking), in the Direction du développement des individus et des communautés (Personal and community development branch) of the INSPQ.

SLEEP AND WEIGHT PROBLEMS: A New Avenue for Intervention?

The prevalence of obesity has been growing steadily for a number of years. Obesity is usually associated with two major factors: increased calorie intake and reduced level of physical activity among the population. However, other variables may contribute to weight problems, including a lack of sleep.[(1)] This issue of *Topo* will examine recent research results on the relationship between sleep and weight status, and potential links between the environment, sleep, and obesity. Sleep is a lifestyle habit that has been increasingly studied in recent years and has also been more closely associated with major problems of health and well-being (chronic diseases, mental health, child development, etc.), hence the importance of focusing on it.

A few basic concepts relating to sleep

The stages of sleep have different characteristics and functions. Some of these stages appear to be more closely associated with the phenomenon of excess weight due to their role in hormonal regulation. Below is a brief description of the stages of a sleep cycle, accompanied by a diagram illustrating their sequence.



I: Falling asleep

II: Light sleep

III and IV: Deep and very deep sleep

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In which stage does one truly rest?

Deep sleep, which is composed of stages 3 and 4 of slow-wave sleep as shown in the sleep cycle diagram, is essential for physical recovery. It combines muscle relaxation, slowed metabolism, cell division, and hormonal regulation. This is when hormones like leptin and ghrelin are regulated. They are two hormones that affect an individual's degree of satiety. Leptin creates a feeling of satiety whereas ghrelin creates a feeling of hunger. Deep sleep is also a time for mental relaxation in which the brain rests. A lack of deep sleep can lead to psychological complications, such as the emergence of aggressive behaviour and mood disorders. In children, lack of deep sleep is characterized by an inability to concentrate and a decline in school performance.

Sleep needs vary between individuals. Some people feel refreshed after only three sleep cycles while others require up to six. Cycles also vary in duration from one person to another; two individuals sleeping 10 hours a night may not complete the same number of cycles (e.g. 5 cycles of 120 minutes vs. 6 cycles of 100 minutes). Generally speaking, sleep needs change with age, which explains the sleep quantity recommended by experts in the field (see Table 1).

Sleep duration

Table 1: Sleep duration recommendations

Category	Age	Average no. of hours of sleep required per 24-hour period	Average no. of naps required per 24-hour period
Newborn	0-2 months	16-20 hours	3 to 10
Infant	2-12 months	9-12 hours at night; 2-4½ hours during naps	1 to 4
Toddler	1-3 years	12-13 hours	1 to 2
Preschool-aged child	3-5 years	11-12 hours	0 to 1
School-aged child	6-12 years	10-11 hours	0*
Adolescent	12-18 years	9-9½ hours	0*
Adult	18 years +	7½ -8½ hours	0*

* There are cultural variations in daily naps among older children and adults; naps are common in some tropical regions.

Adapted from Iglowstein et al., 2003.[2]

The numbers presented in Table 1 are not absolute fact. They are benchmarks based on population averages. Thus significant variations may be observed among individuals, due to certain personal and environmental factors. For example, pregnancy, aging, earlier sleep loss, or a decline in sleep quality (e.g.: being woken up frequently) can cause substantial variations in sleep requirements.

According to data from an article based on a Statistics Canada general social survey,[3] the average Canadian sleeps about 8 hours a night, with slight variations by age group and gender. At first glance, the situation is ideal, but digging a little deeper reveals that 17% of men and 13% of women sleep fewer than 6.5 hours a night, which is definitely insufficient. This data was gathered from time use diaries completed by each survey participant. Participants were required to record how they spent their time for 24 hours and include naps and nighttime sleep hours.

Unfortunately, there is no data enabling us to determine the proportion of individuals who lack sleep at a specific time in their lives, but statistics indicate that the proportion of people sleeping fewer than 6.5 hours a night is higher among parents. It is thus highly likely that a significant part of the population lacks sleep at a specific time in their lives and that the consequences of this lack of sleep endure even if the situation has returned to normal.

Before continuing, it is important to note that experts from the Institut national du sommeil et de la vigilance (INSV), a French organization devoted to the study of sleep, estimate that the typical night of sleep has been cut by 90 minutes per 24-hour period over the past 50 years.

Sleep and obesity

The relationship between sleep and obesity is complex and far from being completely understood by scientists. However, some aspects of the issue seem to be well-established and we will review them.

Lifestyle factors – eating component

First, it seems that sleep can have a significant impact on lifestyle factors, especially eating. The studies consulted tend to associate a lack of sleep with the consumption of foods that have a higher energy density (number of calories per gram of food consumed). In fact, a number of studies have shown that lack of sleep is associated with higher fat consumption.[4,5] Conversely, a study conducted among children links an ideal sleep duration to higher consumption of fruits and vegetables.[6] Eating habits are traditionally associated with the weight problems that are affecting our society, which adds to the credibility of the relationship between sleep and obesity.

However, current knowledge does not enable us to exclude beyond any doubt that the associations observed are due to the fact that people with better eating habits also have better sleep habits.

Lifestyle factors – physical activity component

Engaging in physical activity is also related to sleep. Sleeping more and being more rested provide sufficient energy to engage in physical activity and sports. It is thus possible that the beneficial effects of sleep on weight status are caused in part by greater participation in spontaneous physical activity and sports.

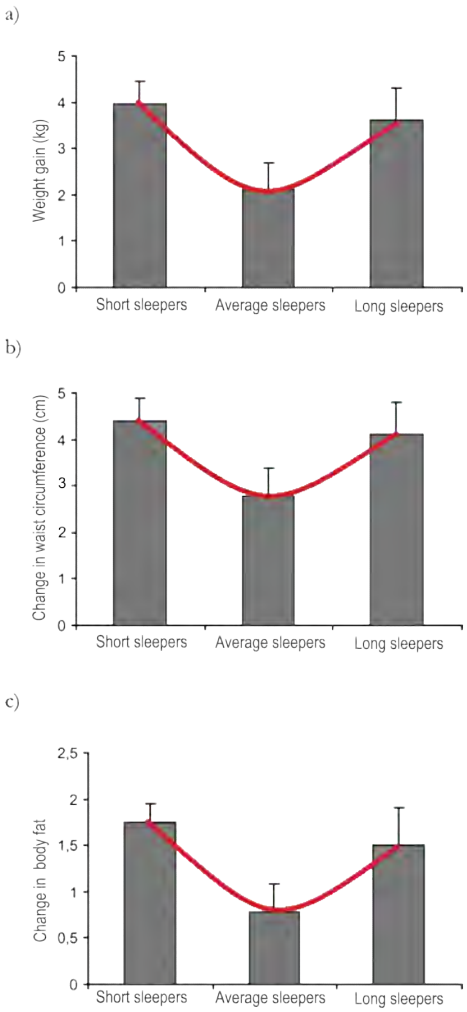
Sleeping better after physical activity: fact or fiction?

Scientific literature on this topic is somewhat contradictory. This inconsistency arises from the fact that engaging in physical activity in the evening can have a stimulating effect and impair sleep. On the other hand, in a Finnish study based on self-evaluations, participants generally regarded physical activity as one factor among others conducive to sleep and sleep quality.[7] Furthermore, individuals in better physical condition generally seem to benefit from better sleep quality.[8] According to the authors, the link between these elements is psychological, potentially similar to the placebo effect.

The reverse is also true, evidence increasingly tends to show than someone who is well-rested is more apt to put a lot of effort into physical activity. Moreover, sports performance is improved by adequate sleep. Conversely, an insufficient amount of sleep is associated with a reduction in the amount of physical activity and interferes with sports performance.[9,10]

Hormones and metabolism

A non-negligible hormonal link is targeted by researchers' efforts to explain the association between sleep and obesity. Basically, sleep is the principal regulator of leptin and ghrelin activity. Therefore, too little or too much sleep can disrupt the activity of these hormones and thus affect weight. Scientific literature is unanimous on this point: there is a length of sleep that enables optimal regulation of these hormones. To describe this phenomenon, researchers in the field often refer to a "U" curve.[11] In reality, a "U" curve indicates that sleeping too much or too little is linked to certain health issues like significant weight gain, too large a waist circumference, or a high proportion of body fat. The figure presented below illustrates these different situations.



Adapted from Chaput et al., 2008.[11]

Quantified examples will make the above explanations more concrete. For example, for a 10-year-old child, 1 hour less of sleep, i.e. 10 hours instead of 11, can mean the difference between a normal and an altered weight status. In fact, one study on the subject shows that this child will be 1.5 times more likely to be overweight and twice as likely to be obese.[12] Once again, the blame must not be definitively placed on lack of sleep because the cause and effect relationship has not yet been shown scientifically, but this data indicates that a lack of sleep in the child is associated with greater probabilities of being overweight. Furthermore, some researchers have associated lack of sleep in childhood to weight problems in adulthood.[13] These researchers claim that lack of sleep in childhood is more strongly linked to being overweight a number of years later whereas lack of sleep in adolescence seems to have immediate consequences. This same group has also demonstrated that taking a nap does not adequately replace nighttime sleep.

The scientific community's level of knowledge is constantly evolving thanks in part to the emergence of longitudinal studies on the subject. The most recent longitudinal study shows the impact of normal nights on weight gain among adults.[14] "Short" sleepers (6 hours a night) were separated into two groups, one that kept the same sleep habits and the other having begun to sleep between 7 and 8 hours a night. At the end of six years, sleepers whose sleep became "normal" experienced a fat mass gain that was half of that of "short" sleepers. The observations from this study only reinforce the importance of getting sufficient sleep.

Appearances can be deceiving

One might think that sleep, by its very nature a sedentary activity, is thus conducive to weight gain. But the opposite is true.[15] Sleep helps regulate hormonal cycles, particularly those of leptin and ghrelin, which directly affect appetite. In fact, when hours of sleep are sufficient, the levels of hormones regulating appetite are adequate and reduce the probability of an overconsumption of food. Furthermore, even though sleep is a time of physical inactivity, it enables the body to rebuild its reserves so that it can be active the rest of the day. Some studies show that even during a weight loss program, an adequate amount of sleep is essential to obtaining the results sought and helps maintain fat-free body mass (mainly muscle mass), which determines basic metabolism.[16]

Escaping noisy environments is almost impossible in our modern era, but there are potential solutions aimed at improving sleep quality. Typical advice for people wanting to improve their sleep quality can be found on the Web site of the Institut national du sommeil et de la vigilance (INSV) (in French only).[17] The list below has been adapted from that of the INSV.

1) Adopt a regular sleep schedule.
2) Wake up at your own pace.
3) Engage in physical activity during the day.
4) Take a short nap (if possible) early in the afternoon. It is important to note that taking too long a nap can interfere with nighttime sleep.
5) Avoid stimulants (colas, coffee, energy drinks, etc.).
6) Avoid sleeping pills.
7) Eat a light supper of slow carbohydrates (starch found in grains, potatoes, some fruits, etc.) at least two hours before bedtime.
8) Make your environment conducive to sleep (dark and between 18 and 22 degrees).
9) Engage in calm, relaxing activities 30 minutes before going to bed.
10) Go to bed at the first signs of sleepiness (yawning, heavy eyelids, itchy eyes).
11) Allow time to get to sleep; if after 15 minutes, you are not asleep, engage in a calm activity and wait for another sign of drowsiness.

A few tips that help you to sleep in a noisy setting:

1) **Turn on any device that will provide monotonous background noise that does not hinder sleep.**
2) **Put in earplugs, if they don't inconvenience you.**
3) **Improve the bedroom's soundproofing.**

Sleep and the environment

The environment evolved extensively during the 20th century. Industrialization, the development of urban centres, the proliferation of roads, automobiles, and flight corridors are all factors that can be associated with sleep disturbance. Who hasn't been awakened by a road accident, an emergency vehicle, or an exploding transformer? This reality was much less common 100 years ago.

A study conducted in 2007 on the impact of ambient noise on sleep disturbance revealed that nighttime transportation is likely the most significant aspect influencing sleep quality.[18] The authors propose a public health approach seeking to improve noise conditions during the night. People living in major urban centres are not necessarily the most affected by this reality because they are exposed to background noise on a daily basis and may become impervious to its effects. On the other hand, areas exposed to significant volumes of focused noise like a flight corridor or snowmobile trail are more likely to alter the sleep quality of people living nearby.

The food environment has also changed a great deal, offering a broad range of products containing caffeine that can hamper sleep (colas, iced coffees, energy drinks, etc.). The growth of urban centres beyond the capacity of transportation infrastructure is another sleep loss factor to consider. Individuals working in downtown areas have seen the commute time required to get to their workplaces increase constantly over the past 50 years. The sleep of these individuals has consequently experienced a proportional decline.

Other factors associated with contemporary life may be involved in the decrease in sleep hours. Experts at the Institut national du sommeil et de la vigilance mention specifically the pervasiveness of the media in our daily lives, which pushes us towards overconsumption and information overload, at times to the detriment of hours of sleep. Long business hours extending into the evening and even into the night encourage consumers to engage in lots of activities other than sleep. For some, an atypical work schedule coupled with the higher proportion of parents in the labour market delays some household tasks until a period traditionally reserved for sleep. Higher performance standards are also a factor that can lead to loss of sleep. In short, sleeping seems to have become secondary in our society.

Knowledge to develop

It would be useful to better comprehend the relationships between:

1) **Sleep and a number of health issues, including obesity**
2) **Sources of nighttime noise and sleep**
3) **Sleep and the increasing popularity of drinks containing caffeine**
4) **Urban settings, commute time, and sleep**
5) **An atypical work schedule, sleep, and weight**
6) **Overexposure to the media and sleep**
7) **Extended business hours and sleep**

Conclusion

Although the relationship between sleep and obesity appears to be targeted in obesity control, the limitations associated with this emerging problem must be taken into consideration. For example, sleep is reported anecdotally in the majority of studies but is rarely measured. The same is sometimes true of the body composition data (weight and waist size) used in some studies on sleep. Furthermore, individual sleep needs can vary considerably from one individual to another, making it difficult to establish an ideal amount. However, all studies consulted that address the topic in one way or another seem to point in the same direction by associating a significantly higher weight and waist circumference with a lack of sleep or excess sleep. This relationship must continue to be studied.

Finally, sleep is not a traditional public health theme. However, more and more research is showing the significance of sufficient sleep in maintaining healthy weight. The concepts of health practices and healthy lifestyle are increasingly at the core of discussions among experts in the field of obesity. In light of the literature available on the subject, sleep should be among these considerations. To ensure sustainable results, perhaps we should rethink our environments, which are not always designed to be conducive to quality sleep.

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SLEEP AND WEIGHT PROBLEMS: A NEW AVENUE FOR INTERVENTION?

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