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CLINICAL REVIEW

Napping: A public health issue. From epidemiological to laboratory studies

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SUMMARY

Sleep specialists have proposed measures to counteract the negative short- and long-term consequences of sleep debt, and some have suggested the nap as a potential and powerful “public health tool”. Here, we address this countermeasure aspect of napping viewed as an action against sleep deprivation rather than an action associated with poor health. We review the physiological functions that have been associated positively with napping in both public health and clinical settings (sleep-related accidents, work and school, and cardiovascular risk) and in laboratory-based studies with potential public health issues (cognitive performance, stress, immune function and pain sensitivity). We also discuss the circumstances in which napping—depending on several factors, including nap duration, frequency, and age—could be a potential public health tool and a countermeasure for sleep loss in terms of reducing accidents and cardiovascular events and improving sleep-restriction-sensitive working performance. However, the impact of napping and the nature of the sleep stage(s) involved still need to be evaluated, especially from the perspective of coping strategies in populations with chronic sleep debt, such as night and shift workers.

Introduction

Over the last few decades, epidemiological studies have progressively reported that sleep loss is a clear independent risk factor associated with obesity, type 2 diabetes, cardiovascular disease (CVD), and accidents [1–4]. In laboratory research, it has also been clearly shown that sleep restriction is associated with immune, endocrine, and vascular dysfunction [5–9]. It is now well established that, on average, 10–35% of adults suffer from sleep loss during weekdays, sleeping less than 6 h per 24 h [10–13]. One major determinant of sleep loss is work: in particular, 20% of the working population work at night or in shifts, and they sleep an average of one hour less than day workers [11,14]. Moreover, the time taken to travel from home to work and back has increased in most cities, directly impacting total sleep time (TST) [15]. Another determinant negatively impacting sleep is the use of mobile electronic devices (phones, computers) and the increasing amounts of leisure time spent on the internet. This activity affects many young adults, drastically reducing TST [16].

To counteract the negative short- and long-term consequences of sleep debt, napping has often been proposed as a potential and powerful “public health tool”. In his book “The promise of sleep”, William C Dement wrote, “My fellow sleep specialists and I are campaigning to rehabilitate napping and demonstrate that taking naps is an excellent and respectable strategy for sleep management. Naps can make you smarter, faster, and safer than you would be without them. They should be widely recognized as a powerful tool in battling fatigue, and the person who chooses to nap should be regarded as heroic” [17]. However, napping is not at all a homogeneous habit around the world, and this heterogeneity has to be taken into consideration from the public health point of view. It is indeed not the same to have a nap once a week on weekends and to nap on a daily basis due to shift work. While the short-term effects of napping on attention, concentration, and reaction time may take effect with a single nap, the mid- or long-term benefits of napping may only be considered in regular nappers (i.e., napping several times a week). Thus, different types of naps, depending on the length, the circadian position, and the sleep architecture, have

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Abbreviations

CAR	cortisol awakening response
CHD	coronary heart disease
CRP	C-reactive protein
CVD	cardiovascular disease
CVR	cardiovascular risk
EEG	electroencephalogram
HPA	hypothalamic-pituitary adrenal
IL	interleukin
NREM	non-rapid eye movement
OR	odds ratio
PSG	polysomnography
REM	rapid eye movement
RR	relative risk
SOREMP	sleep onset REM period
SPA	sympatho-adrenal system
SWS	slow-wave sleep
TNF	tumour necrosis factor
TST	total sleep time
WASO	wake time after sleep onset

to be defined [18]. Napping habits also change during an individual's lifespan, from a progressive decrease in nap length and nap episodes during early childhood to the midday napping habits practiced during adulthood [19]. Napping is also a culturally driven behaviour: afternoon/midday sleep or a siesta is a common habit in Mediterranean culture, mainly for climatic reasons, and in China, Taiwan, and Japan as a countermeasure to excessive working hours. In China, the right to nap at work has been written into the constitution since 1948 in order to ensure better working conditions and productivity. To embrace the diversity of napping while maintaining perspective on this rather universal and homogenous biological phenomenon, we will mostly consider, in this review, napping as a voluntary episode of sleep ranging from several minutes to nearly 90 min of sleep. Importantly, this review will not address naps that are taken as a result of sleep disorders, such as sleep apnoea.

At the beginning of the epidemiology section, we will present napping data during childhood as well as in the elderly, but we will focus mainly on young and middle-aged adults, as the need for efficient countermeasures to sleep-debt seems greatest in this latter population. Indeed, young people are more sensitive to sleep loss and are expected to have greater homeostatic pressure, so napping is a particularly effective countermeasure in younger adults [20]. We will also not forget napping issues related to professional life (night and shift work schedules).

The present review may be criticised for focusing predominantly on the beneficial effects of napping, but we also briefly describe how napping may have deleterious effects. One frequently claimed deleterious effect is sleep inertia, which is generally defined as a sensation of disorientation and a transient reduction in cognitive performance following long naps exceeding 30 min [21]. Usually, the longer the nap, the higher the percentage of slow-wave sleep (SWS) and the greater the occurrence of sleep inertia. These effects may be cancelled out by caffeine when taken right after the nap [22–24].

Another deleterious effect is associated with long naps during the afternoon or evening. These naps have been described to disturb sleep latency and both the quality and quantity of the subsequent night-time sleep. Accordingly, the usual recommendation is to restrict daytime napping for patients with insomnia (especially sleep onset insomnia) or delayed sleep phase syndrome. Studies in healthy subjects, in contrast, have led to contradictory conclusions. Objective recordings of sleep, such as at-home actigraphy, have shown that napping an average of 28.0 min/d between 12:00 h and 18:00 h in young subjects (mean age 23.8 ± 3.8 y old) does not influence nocturnal sleep [25]. In the elderly, however, napping from 30 min to 90 min during the afternoon and early evening seems more controversial in terms of its effects on night-time sleep. Yoon et al. reported in this same ecological study that "young elderly" nappers (mean age 66.2 ± 4.9 y old napping for an average of 30.4 min/d) had shorter time in bed and an earlier wake-up time but no significant differences in TST or sleep efficiency. In older nappers (mean age 78.6 y old, napping for 57 ± 18 min at the beginning of the afternoon), Monk et al. [26] measured lower sleep efficiency during night-time sleep using actigraphy and polysomnography (PSG) but found no change in SWS or wake time after sleep onset (WASO) and better objective evening vigilance performance. Finally, in the elderly, as discussed below, a long and potentially unplanned nap during daytime could be a contributing factor to increased cardiovascular risk (CVR).

Therefore, we will consider another important issue on how to objectively assess napping: not only the duration but also the quality of sleep in terms of non-REM (NREM) or rapid eye movement (REM) sleep. Several recommendations have been made, mostly by the American Academy of Sleep Medicine, regarding the use of PSG and actigraphy [27]. However, the lack of consensus on some methodological and theoretical points may impact the objective evaluation of naps: i) Do studies have to recruit habitual or non-habitual nappers? ii) Do scorers have to use specific classifications when scoring naps (sleep latency, first stage 1, SOREMs, awakenings)? iii) Do studies have to test naps at different times of the day or at midday? Interestingly, Kanady et al. tried to validate actigraphy versus PSG in the assessment of daytime naps and no-nap rest periods [28]. They tested the sensitivity levels (high, medium, low) of three actigraphy monitors (Actiwatch-64-Respironics) and compared sleep latency, TST, WASO, and sleep efficiency in 30 and 27 subjects in the nap and no-nap groups, respectively. They found that actigraphy was able to predict TST, sleep latency, and sleep efficiency during a nap, but with optimal levels depending on the variables of interest. A medium level of actigraphy monitor sensitivity showed significant correlations with TST and sleep efficiency, while high levels predicted sleep latency. Low-sensitivity levels were best for determining WASO. Actigraphy also accurately distinguished nap from rest in no-nap subjects, indicating that it is a reliable tool for the assessment of napping.

Finally, in the first section dealing with the epidemiology of napping, we will review the following: 1) napping across the lifespan; 2) sleep debt and napping habits; 3) napping in practical settings (sleep-related accidents, work and school); and 4) napping and cardiovascular risk. The second section will focus on the cognitive and physiological effects of napping, and we will review napping effects on 1) alertness; 2) memory; 3) stress and cardiovascular systems; 4) immune functions; and 5) pain sensitivity.

Epidemiology of napping

In the present section, we will fist describe napping across the lifespan and then discuss the circumstances in which napping could be a potential public health tool counteracting the consequences of sleep debt in real-life and clinical settings (Fig. 1).

Napping patterns during lifetime

Toddlers and children

Total sleep duration decreases rapidly during the first years of life, from an average of 16–17 h at birth to a mean of 13.9 h at one year of age and 9 h at 10 y of age [29].