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Timo Partonen

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SPECIAL SELECTION: OBESITY

**Obesity = physical activity + dietary intake + sleep stages
+ light exposure**

Timo Partonen

National Institute for Health and Welfare, Department of Mental Health and Substance Abuse Services, Helsinki, Finland

Daily levels of physical activity and calories from dietary intake have been the focus of obesity prevention measures. Recent findings have made a twist in the line of thinking. The timing of physical exercise and that of dietary intake are also important to obesity prevention. Night-time sleep and exposure to light are therefore important targets of intervention.

Key words: Circadian, clock, diurnal, environmental, genetic, overweight, weight gain

Key messages

- A balance between physical exercise and dietary intake protects from obesity.
- Sufficient and normal stages of night sleep protect from obesity.
- Artificial light late in the evening or at night predisposes to obesity.

Obesity is a major health hazard globally. The view ahead does not look bright, as there are no national success stories of obesity prevention (1). To understand the development of obesity, the focus has been first on the level of physical activity, and then on the calories from dietary intake, and only recently on the balance between the two. In recent years more attention has been paid to not only the quantities, but also to the qualities of physical exercise and dietary intake.

Out of a clear blue sky a new avenue to prevention of obesity is starting to show after the cutting-edge findings that demonstrated the significance of two processes, sleep (2) on the one hand and circadian clocks (3) on the other hand, for weight-watching. The timing of physical exercise and dietary intake not only as such, but also in relation to each other can make a difference.

During the night-time sleep the sleep cycles follow each other, and the specific sleep stages slept give feedback on the master circadian clock (4) which generates and guides the sleep-wake cycle and circadian rhythms (5). Mistimed sleep, or circadian misalignment, reduces the rapid-eye-movement sleep during the second part of the night in specific (6). This change in sleep stage distribution leads to abnormal feedback to the master circadian clock.

In addition, mistimed sleep silences in particular those genes associated with the regulation of transcription and translation and enhances activity of genes associated with catabolic processes, the regulation of adenosine triphosphatase activity, and peroxiredoxin activity (7). These changes in the activity of genes feedback onto and reinforce processes that are at the core of the circadian clocks throughout from the brain to the periphery.

It is not known, whether the disruption of the sleep-wake cycle produces its negative health outcomes with this mechanism, but it is plausible.

Now, *Annals of Medicine* wants to provide new and refreshing perspectives to the topic that is, with no doubt, of high importance to the public health universally. The *Annals of Medicine* Special Section on Obesity includes one original article (8) and three review articles (9–11).

Danielsen et al. (8) report the results from intensive lifestyle intervention for 100 severely obese individuals in Norway. This intervention was a treatment program that included 90 minutes of physical exercise 5 days a week for 10 to 14 weeks, dietary consultation, and psychoeducation. Qi (9) reviews the obesity literature concerning foods, nutrients and eating habits, and put the focus of the review on the interaction between genetic factors and dietary factors.

Bayon et al. (10) review the links of sleep duration and its restriction, or sleep debt, to metabolic and endocrine alterations that may contribute to weight gain and obesity. Wyse et al. (11) review the roles of artificial light and pale light-dark transitions, or light pollution, in the development of obesity.

Together these four articles provide us a twist in our line of thinking, and hopefully it will bring about a change. We need a deep rather than a sudden inspiration to work out the problem, how to help those being troubled by weight gain.

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