Expanding investigations on the relation between sleep restriction and energy balance

Dear Sir:

Klingenberg et al (1) recently presented an innovative study from the University of Copenhagen entitled “Sleep restriction is not associated with a positive energy balance in adolescent boys” investigating the relation between sleep restriction and energy balance in male adolescents. The authors make a marked effort in their protocol design to encompass all aspects of energy balance, measuring both energy expenditure (EE) and energy intake (EI) through a variety of tests and analyses to assess changes in physical activity, appetite, and hormones. Because previous studies have observed conflicting results with regard to the effect of sleep deprivation on EE, showing either an increase or no effect on EE (2, 3), findings from this study, although interesting, do not completely ascertain the actuality of this relation.

The authors observed an increase in 24-h EE after shortened sleep, contradicting their original hypothesis that EE would be unaffected. In addition, they observed a decrease in motivation to eat and a decrease in appetite and food consumption, which was contrary to their original hypothesis that EE would be unaffected. In this study, they also observed a decrease in motivation to eat and appetite, and food consumption, which was contrary to their original hypothesis that EE would be unaffected. In addition, they observed a decrease in motivation to eat and appetite, and food consumption, which was contrary to their original hypothesis that EE would be unaffected. In this study, they also observed a decrease in motivation to eat and appetite, and food consumption, which was contrary to their original hypothesis that EE would be unaffected.

Further topics that should be discussed in future studies include the criteria for the exclusion of the volunteers. Volunteers were excluded if they showed signs of metabolic disease, eating disorders, self-reported sleeping problems, etc. However, they were not submitted to a polysomnography, a gold-standard method in sleep research, before being included in the study, which could greatly alter the results. If the subjects had any previous sleep problems (of which they were unaware), such as obstructive sleep apnea, it could alter their sleep quality and lead to differences in EI and EE. Of note, in a large population sample one study observed a high prevalence (32.9%) of obstructive sleep apnea syndrome, including in subjects aged from 20 to 80 y (5).

Another point of concern is that during the first 2 days of the study, the subjects slept in the laboratory, with the rest of the day designated as “free-living.” The boys were asked to abstain from heavy exercise and were sent text messages to eat on time, with food provided by the researchers. Although the food provided was not chosen by the adolescents, as a means to standardize the ad libitum EI, it was not representative of their everyday diet, leaving the question of whether different food would cause alternate effects on energy balance.

The study also measured appetite with the visual analog scale, but this test was only performed periodically at around breakfast in the morning and at around the ad libitum lunch (to measure ad libitum EI). The visual analog scale would have also needed to be tested on the subjects at around dinner, especially because it is known that adolescents have a tendency to eat later at night (which may lead to obesity) (6). Also, the ad libitum lunch was a large portion of spaghetti Bolognese, with a serving size greater than what was expected that the adolescents would consume. Although serving a larger portion allows subjects to eat more if they desire, thus measuring their ad libitum EI, if it is not a food they are particularly fond of, their appetite and consequently their EI would appear misleadingly low.

In today’s modern society, adolescents are constantly and excessively exposed to the unhealthy temptations of food advertisements and spend exorbitant amounts of time on the Internet. In this sense, high-calorie diets and loss of sleep that result from these events have become increasingly frequent in the lives of young adults. Klingenberg et al’s study is greatly welcomed for addressing the impact that this shortened sleep can have on the energy balance of adolescent boys and for subsequently encouraging further investigations to broaden our knowledge of this highly relevant topic.

The authors had no conflicts of interest.

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Reply to L Bennedsen et al

Dear Sir:

We thank Bennedsen et al for their letter regarding our study (1), which explains possible mechanisms behind the association between short sleep duration and obesity in male teenagers. We agree that our results of increased energy expenditure (EE) and decreased drive to eat combined with decreased spontaneous energy intake are not supportive of the current evidence in the field, especially in younger populations (2). Bennedsen et al in their letter raise some important methodologic considerations in this regard.

We found that the difference in EE between sleep conditions (ie, 4 h compared with 8 h of sleep/night) was fully explained by the prolonged wakefulness in the short sleep condition. We agree that there are conflicting results regarding the impact of sleep restriction on EE, but a total sleep-deprivation protocol was applied in the study by Jung et al (3) as well as in the study by Benedict et al (4). This crucial methodologic difference prevents any direct comparison with our study. Also, the study by Benedict et al (4) did not measure 24-h EE. In the study by Bosy-Westphal et al (5), individual regression lines of VO$_2$ compared with heart rate were used to calculate total EE. This method to determine 24-h EE under mainly sedentary conditions is suitable for the purpose of the study and can answer critical questions whether changes in food choice or timing of food intake (eg, late-night snacking) after sleep restriction would cause alternate effects in energy balance and thus help explain the gap between experimental studies and the unequivocal epidemiologic evidence.

Although we agree with Bennedsen et al that further experimental studies are needed to draw any definitive conclusions on the behavioral aspects potentially underpinning the sleep-obesity relation, we do believe that our study has provided important findings that may even help to develop future studies such as those outlined by Bennedsen et al. In our opinion, a primary target of future studies should be the nonhomeostatic, reward-driven regulation of eating behavior that could be affected by sleep restriction. A better characterization of short sleepers will also be needed, because it appears that only some of these individuals are likely to overeat in response to sleep restriction.

The authors declared no conflicts of interest.

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