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Proc Natl Acad Sci U S A. 2013 Apr 2;110(14):5695-700. doi: 10.1073/pnas.1216951110. Epub 2013 Mar 11.

Impact of insufficient sleep on total daily energy expenditure, food intake, and weight gain.

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Abstract

Insufficient sleep is associated with obesity, yet little is known about how repeated nights of insufficient sleep influence energy expenditure and balance. We studied 16 adults in a 14- to 15-d-long inpatient study and quantified effects of 5 d of insufficient sleep, equivalent to a work week, on energy expenditure and energy intake compared with adequate sleep. We found that insufficient sleep increased total daily energy expenditure by ~5%; however, energy intake--especially at night after dinner--was in excess of energy needed to maintain energy balance. Insufficient sleep led to 0.82 ± 0.47 kg (\pm SD) weight gain despite changes in hunger and satiety hormones ghrelin and leptin, and peptide YY, which signaled excess energy stores. Insufficient sleep delayed circadian melatonin phase and also led to an earlier circadian phase of wake time. Sex differences showed women, not men, maintained weight during adequate sleep, whereas insufficient sleep reduced dietary restraint and led to weight gain in women. Our findings suggest that increased food intake during insufficient sleep is a physiological adaptation to provide energy needed to sustain additional wakefulness; yet when food is easily accessible, intake surpasses that needed. We also found that transitioning from an insufficient to adequate/recovery sleep schedule decreased energy intake, especially of fats and carbohydrates, and led to -0.03 ± 0.50 kg weight loss. These findings provide evidence that sleep plays a key role in energy metabolism. Importantly, they demonstrate physiological and behavioral mechanisms by which insufficient sleep may contribute to overweight and obesity.

PMID: **23479616** [PubMed - in process] PMCID: PMC3619301 [Available on 2013/10/2]

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