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Abstract:
The proposed study will be the first intervention study to test whether late sleep and meal timing leads to positive energy balance and insulin resistance. Individuals who sleep and eat late into the day are at increased risk of obesity and metabolic disorders. Studies, including our own, have shown that sleep restriction enhances food intake but there is also increasing evidence that sleeping during the daytime hours, without sleep curtailment, may induce overeating and increase insulin resistance (IR). However, studies of late sleep timing are limited to observational studies and confounded by differences in sleep duration. Neuropeptides that stimulate appetite such as neuropeptide Y (NPY) and hypocretin-1 also entrain the sleep-wake cycle and activate brain reward areas. We have previously shown that reducing sleep duration activates brain reward areas, such as the insula and orbitofrontal cortex. Since eating is a strong external time keeper, altering the alignment of sleep and meal times is likely to cause changes in hormones that will also affect energy balance regulation. The goal of the proposed study is to determine whether sleeping and/or eating late in the day has negative consequences for weight management and IR. The proposed study will test the hypothesis that sleeping and eating late in the day will increase food intake, enhance the rewarding properties of food, produce a hormonal profile indicative of enhanced appetite and reduced satiety, as well as IR compared to eating and sleeping at earlier times. This will be assessed by measuring food intake at an ad libitum test meal and over a 24-h period, functional magnetic resonance imaging, measurements of appetite-regulating hormones, and insulin resistance. Thirty-eight overweight men and women will be recruited to participate in a 4-phase inpatient study. Phases will differ in the timing of sleep: normal (Ns; 0000-0800 h) or late (Ls; 0330-1130 h) and alignment of meals (Nm=meals at 1, 5, 11, and 12.5 h after awakening; Lm=meals at 4.5, 8.5, 14.5, and 16 h after awakening). All 4 combinations will be tested: Ns/Nm, Ns/Lm, Ls/Nm, and Ls/Lm. Measurements will be taken after 3 d of the sleep/meal protocol. Blood samples will also be assayed melatonin and cortisol as markers of circadian rhythm. This proposed study, which will manipulate sleep timing and meal timing, is important because it will provide information on the mechanism by which sleep and meal patterns affect obesity and diabetes risk, independent of sleep duration. It will also help explain the greater prevalence of obesity/diabetes in shift workers, those affected by jetlag/social jetlag, and breakfast skippers. As such, the proposed study will be a stepping stone in the establishment and assessment of lifestyle recommendations or therapies that affect hormone and metabolite rhythmicity to prevent the adverse health effects associated with sleeping and eating late during the day.