Restless Sleep is Associated with Weight Gain: A Within-Subject Analysis

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Background and Introduction

• The rising popularity of digital health trackers presents the opportunity to measure physiological quantities and health outcomes frequently, over time.
• We focus on weight gain as an outcome and examine its relationship to sleep patterns.
• We use longitudinal weight data combined with minute-level sleep data from over 6,000 users of digital health trackers across the United States.

Data

• Inclusion/Exclusion criteria: Included users had at least two months of data, with at least 5 nights of sleep and 5 weight measurements recorded in each month. 1,087 male and 5,207 female users met the inclusion criteria.
• Data: Minute-level sleep and daily weight measurements collected from fitness trackers for 11,552 users of a proprietary platform that incentivize healthier lifestyles (achievemint.com) between 1 April 2015 and 1 April 2016.
• We created a panel dataset consisting of weight change and sleep statistics aggregated monthly for each user.

Methods

• Analysis: We used fixed-effects panel regression to control for heterogeneity between users, with separate regressions for each gender.
• Outcome variable: User’s monthly percent weight change.
• Explanatory variables (aggregated monthly):
  • Mean nightly sleep start time,
  • Mean sleep duration,
  • Mean number of naps during the day,
  • Mean time in bed until sleeping,
  • Mean number of nightly restless episodes,
  • Standard deviation of sleep duration during the month
• Control variables:
  • Month of year (control for seasonal variation),
  • Tracking device used for weight and sleep tracking,
  • Frequency of weight and sleep measurements, since more frequent weight tracking has been shown to be associated with weight loss

Results

• The regression surfaced a highly-significant association between restless episodes and weight gain in both genders.
• Each additional restless episode per night was associated with a 0.058 and 0.052 percentage point monthly increase in weight for females and males respectively.
• For females, fewer naps, later bed times, and more variable sleep duration were also associated with weight gain.
• For males, shorter sleep duration was associated with weight gain.