

Many people have difficulty sleeping, take medication to improve sleep, and would presumably prefer to solve the problem without the cost and common side effects of medication. Many of these same people enjoy drinking alcoholic beverages, often in the evening, and endeavor to avoid any unpleasant side effects. Sleep is critical to health, and insufficient or poor sleep can compromise alertness, thereby worsening performance and potentially leading to accidents that cause further harm.¹ Factors that can negatively affect nighttime sleep include stress, daytime napping, light exposure, and drugs such as caffeine and alcohol.² It has long been understood that failure to cease alcohol consumption within several hours of bedtime increases the risk of sleep disruption,³ in what is sometimes termed middle insomnia.⁴ However, guidance regarding such a cutoff varies from roughly three to six hours, and depends on multiple factors (e.g., the type and quantity of alcohol consumed).⁵ Given that bedtimes can vary from night to night, and unpredictably, it would be useful to know whether simply halting alcohol consumption at a specific hour each night would improve sleep. Or to frame this as a testable research question: Would abstaining from alcohol consumption after a certain hour in the evening improve the likelihood that adults will sleep through the night without an interruption lasting longer than 30 minutes?

Assuming a typical bedtime of 10-11 p.m., allowing a 3-4 hour buffer between alcohol consumption and sleep, and considering that alcohol is often consumed with dinner, a cutoff at 7pm seems a realistic and potentially effective treatment. As a placebo, a control group could be prescribed a presumably ineffective (and natural in the sense that no change in behavior is required) cutoff of 10 p.m., provided the instructions are clear that drinking at this hour is not encouraged. All subjects would be told to otherwise drink when/as they normally would, including possibly abstaining from alcohol consumption for all or part of the test duration. Although a shortage of sleep one night can lead to more sleep the next, the primary effect of alcohol is more immediate (i.e., same night), suggesting useful data could be gleaned from a relatively short-term experiment of perhaps one or two weeks in duration. If the fourteen students in W241.4 recruited seven subjects on average (potentially including themselves), the experiment would include nearly 100 observations, and additional help from the instructor could push the experiment over this threshold.

Potential test subjects include the W241.4 students and their instructor—plus their friends, family, co-workers, and other acquaintances. All participants must be at least 21 years old, and night-shift workers would be excluded because they are on a different sleep schedule. Combination of alcohol and sleep medication in the same night would be discouraged, for safety

¹ Stein, M., & Friedmann, P. (2005). [Disturbed Sleep and Its Relationship to Alcohol Use](#). Substance Abuse, 26(1): 1–13.

² Division of Sleep Medicine at Harvard Medical School (2007). [Twelve Simple Tips to Improve Your Sleep](#).

³ National Institute on Alcohol Abuse and Alcoholism (1998). [Alcohol Alert](#), No. 41, July 1998.

⁴ Heid, M. (2016). [You Asked: Why Do I Always Wake Up at 3 A.M.?](#) TIME, June 8, 2016.

⁵ Cuffey, A. (2017). [How Alcohol Messes With Your Sleep -- And What You Can Do About It](#). HuffPost, July 10, 2017.

reasons.⁶ To ensure non-interference, only one partner (chosen by coin toss) in a couple that sleeps together would be allowed to participate. The study can include subjects who do not drink alcohol and/or do not have trouble sleeping. Although this convenience sampling (e.g., subject enlistment and week of year) would not be random or necessarily representative of the general adult population, blocking can be used to improve precision if subjects respond to the following questionnaire prior to assignment, and bias within blocks would be eliminated via random allocation to treatment:

- Do you work a night shift? If so, there is no need to complete the rest of this questionnaire, as night-shift workers are not eligible for participation in this study.
- How old are you? Participants must be at least 21 years old, and would be anonymized in this study.
- In a typical week, would you have trouble sleeping at least one night or take medication to improve sleep?
- In a typical week, would you drink coffee or another highly-caffeinated beverage at least once after noon?
- In a typical week, would you consume at least one alcoholic beverage?⁷
- In a typical week, would you take at least one daytime nap?

Blocking would then be based on these covariates (sleep medication, caffeine, alcohol, naps, age).⁸ Subjects would be tasked with answering the following set of questions each morning for seven days (or maybe fourteen) after the first night of treatment, allowing a proportion of days to be calculated from each set of corresponding responses:

- When did you go to sleep last night?
- Did you have at least one period of sleep disruption last night whereby you awoke and could not fall back asleep within 30 minutes?
- Did you take any sleep medication last night?
- Did you drink coffee or another highly-caffeinated beverage yesterday after noon?
- How many alcoholic beverages did you consume yesterday?
- Did you take a daytime nap yesterday?

The primary outcome measure of interest is the frequency of nights with sleep interruptions exceeding 30 minutes in duration. Secondary outcome measures that would be collected include daily bedtime, sleep medication use, afternoon caffeine consumption, alcoholic drink count (more alcohol presumably merits a longer buffer), and daytime napping. These additional measures may shed light on study findings (e.g., medication usage may decline with improved sleep), while also informing any follow-up investigations.

⁶ Sleep medication labels often advise against drinking alcohol due to potential adverse interactions.

⁷ A standard drink is 12 ounces of beer, 5 ounces of wine, or 1.5 ounces of distilled spirits; each contains approximately 0.5 ounces of alcohol.

⁸ Among adults, sleep quality is understood to generally worsen with age.

As with any study involving human subjects in their natural environment, a number of complications may arise, potentially confounding analysis. First, this study would rely on accurate self-reporting; for example, some subjects feeling self-conscious may fail to comply with treatment and/or understate the number of alcoholic beverages consumed in a given evening. Subjects in treatment may drink less than usual—or not at all—simply because they stop early, thereby confounding causal analysis (i.e., improved sleep may be due to less alcohol rather than early cutoff). Subjects may also vary from their typical sleep medication use, afternoon caffeine consumption, or afternoon napping; however, as these behavioral changes would be attributable to awareness of their participation in the study, the comparison of treatment and control groups (constructed via random allocation) is expected to eliminate any corresponding biases. This also addresses potential bias due to light exposure and other unobserved covariates.

Alcohol is known to affect sleep, but its effects are not perfectly understood, and many people are only vaguely aware of the relationship. I've found through non-citable exploratory investigation that drinking in moderation—in my case a pint of a Double/Imperial IPA or fine sour beer with dinner—seems to cause no sleep disruption, as long as I wrap up by 7-8 p.m. A simple rule-of-thumb along these lines might help many people continue enjoying alcoholic beverages, while sleeping better, and without medication or related side effects. I believe the experiment proposed herein is feasible, and I hope that my fellow students will also find this topic both relatable and worthy of further exploration.