

COMMENTARY

## Buzzed before bedtime: hidden harms of late day caffeine consumption

Commentary on Drake C, Roehrs T, Shambroom J, Roth T. Caffeine effects on sleep taken 0, 3, or 6 hours before going to bed. *J Clin Sleep Med*. 2013;9(11):1195–1200. doi:10.5664/jcsm.3170

Tracy Jill Doty, PhD<sup>1</sup>; Jacob F. Collen, MD<sup>2,3</sup>

<sup>1</sup>Sleep Research Center, Behavioral Biology Branch, Walter Reed Army Institute of Research, Silver Spring, Maryland; <sup>2</sup>Department of Medicine, Uniformed Services University of the Health Sciences, Bethesda, Maryland; <sup>3</sup>Pulmonary, Critical Care and Sleep Medicine, Walter Reed National Military Medical Center, Bethesda, Maryland

Caffeine is the most widely used stimulant substance in the world.<sup>1</sup> It is often consumed to maintain alertness but it is also consumed habitually and socially in many cultures.<sup>2</sup> In the United States, 85% of adults aged 18–24 years consume at least 1 caffeinated beverage a day, and the amount of caffeine consumed daily increases with age.<sup>3</sup> These rates may even be higher in certain occupations that require sustained performance (commercial truck drivers, physicians, military).

“Caffeine Effects on Sleep Taken 0, 3, or 6 Hours before Going to Bed”<sup>4</sup> by Drake and colleagues investigated how a large dose (ie, 400 mg) of caffeine taken at varying times before bed impacted subsequent sleep. Two major strengths of the study were its crossover design and its blinding procedure. All participants were involved in each of the 4 caffeine conditions (0, 3, or 6 hours before bed or placebo) and took three pills during each condition (where only one pill contained caffeine and the rest were placebo, with the exception of the placebo condition where all pills were placebo). Even when caffeine was taken 6 hours before bed, it still reduced total sleep times by almost an hour. This finding was the first blinded, crossover intervention study to discover that caffeine so far in advance of bedtime could negatively impact sleep. This result has since been replicated in a variety of studies, including caffeine impacting daytime sleep when given 5 hours prior.<sup>5</sup>

There are some minor limitations, none of which detract from the message. The number of subjects was low, caffeine consumption was self-reported, and sleep times were based on actigraphy, which may not accurately reflect sleep times compared to in-lab polysomnography. The authors cite patterns of societal caffeine consumption from an Italian study, which may not be reflective of use elsewhere.<sup>6</sup> It is also worth noting that the delivery mechanism of caffeine is an important research consideration. Caffeine pills are less precise for drug administration than caffeine gum (which starts being absorbed via oral mucosa almost immediately). Presently however, Drake and colleagues’ findings have stood the test of time and given us empiric data for an enduring topic.

Worldwide we continue to fall short in getting enough sleep each night. Among regular caffeine users, daily sleep duration is lower and correlates to increased medical comorbidity and reductions in physical activity.<sup>7</sup> The negative health consequences may be easier to ignore than the economic costs in lost gross

domestic product and lower work productivity.<sup>8</sup> Up to \$680 billion is lost each year in the United States, Canada, Germany, Japan, and the United Kingdom due to insufficient sleep, the bulk of this in the United States alone.<sup>8</sup> As we continue to struggle with the negative impact of sleep loss, the use of such caffeinated beverages as energy drinks is steadily increasing across all age groups, particularly in young adults.<sup>9</sup> Ubiquitous late day consumption in the workplace and at social gatherings may warrant a fine-tuning of the message. A policy of afternoon abstinence may be unrealistic, and narrowing the recommendation to a later time, or to after the subject has left the workplace, could improve acceptability and adherence.

### CITATION

Doty TJ, Collen JF. Buzzed before bedtime: hidden harms of late day caffeine consumption. *J Clin Sleep Med*. 2020; 16(suppl\_1):23S–24S.

### REFERENCES

1. Franke AG, Bagusat C, Rust S, Engel A, Lieb K. Substances used and prevalence rates of pharmacological cognitive enhancement among healthy subjects. *Eur Arch Psychiatry Clin Neurosci*. 2014;264, S1, Suppl 1:83–90.
2. Huntley ED, Juliano LM. Caffeine Expectancy Questionnaire (CaffEQ): construction, psychometric properties, and associations with caffeine use, caffeine dependence, and other related variables. *Psychol Assess*. 2012;24(3):592–607.
3. Mitchell DC, Knight CA, Hockenberry J, Teplansky R, Hartman TJ. Beverage caffeine intakes in the U.S. *Food Chem Toxicol*. 2014;63:136–142.
4. Drake C, Roehrs T, Shambroom J, Roth T. Caffeine effects on sleep taken 0, 3, or 6 hours before going to bed. *J Clin Sleep Med*. 2013;9(11):1195–1200.
5. McHill AW, Smith BJ, Wright KP, Jr. Effects of caffeine on skin and core temperatures, alertness, and recovery sleep during circadian misalignment. *J Biol Rhythms*. 2014;29(2):131–143.
6. Penolazzi B, Natale V, Leone L, Russo PM. Individual differences affecting caffeine intake. Analysis of consumption behaviours for different times of day and caffeine sources. *Appetite*. 2012;58(3):971–977.
7. Zhu G, Catt M, Cassidy S, et al. Objective sleep assessment in >80,000 UK mid-life adults: Associations with sociodemographic characteristics, physical activity and caffeine. *PLoS One*. 2019;14(12):e0226220.

8. Hafner M, Stepanek M, Taylor J, Troxel WM, van Stolk C. *Why Sleep Matters—the Economic Costs of Insufficient Sleep: A Cross-Country Comparative Analysis*. Santa Monica, CA: RAND Corporation; 2016. [https://www.rand.org/pubs/research\\_reports/RR1791.html](https://www.rand.org/pubs/research_reports/RR1791.html). Accessed October 7, 2020.
9. Vercammen KA, Koma JW, Bleich SN. Trends in energy drink consumption among U.S. adolescents and adults, 2003-2016. *Am J Prev Med*. 2019;56(6):827–833.

## SUBMISSION & CORRESPONDENCE INFORMATION

Submitted for publication October 8, 2020

Submitted in final revised form October 8, 2020

Accepted for publication October 9, 2020

Address correspondence to: Jacob F. Collen, MD, Uniformed Services University of the Health Sciences, Department of Internal Medicine, 4301 Jones Bridge Road, Bethesda, MD 20814; Tel: (703) 966-1598; Email: [jacob.collen@usuhs.edu](mailto:jacob.collen@usuhs.edu)

## DISCLOSURE STATEMENT

All authors have read and approved the final manuscript. Work for this study was performed at the Walter Reed National Medical Center. The authors report no conflicts of interest. The views in this commentary reflect those of the authors, and do not constitute official policy of the United States Army or Department of Defense.