Caffeine!

BY DAVID SCHARDT

More than 80 percent of American adults consume caffeine regularly. That's no surprise, what with a coffee shop seemingly on every corner and in every supermarket, and tiny $3 bottles of 5-hour Energy popping up like mushrooms wherever there's a checkout counter. Caffeinated energy drinks have become so mainstream that major players like V8 and Ocean Spray have introduced their own versions to stay competitive.

Here's a rundown of what scientists are learning about the world's most popular drug.

WHEN CAFFEINE MAY HELP

Sleep Deprivation

"Caffeine is definitely beneficial for keeping individuals who are sleep deprived more alert," says Timothy Roehrs of the Sleep Disorders and Research Center at Henry Ford Hospital in Detroit.

And that's potentially a lot of people. In a national survey, about 30 percent of the participants reported averaging six hours or less of sleep a night.[1] And in Roehrs' study of 259 working adults, about 15 percent were so sleepy during the day that they fell asleep within six minutes when they had the opportunity in a sleep lab.[2]

Why does caffeine help people who are sleep deprived?

Caffeine works mainly by temporarily binding to adenosine receptors in the brain. That prevents adenosine, which is a natural sedative produced by the brain, from occupying those receptors and making us feel drowsy. (See illustration.) Adenosine levels build up during waking hours and then drop as we sleep.

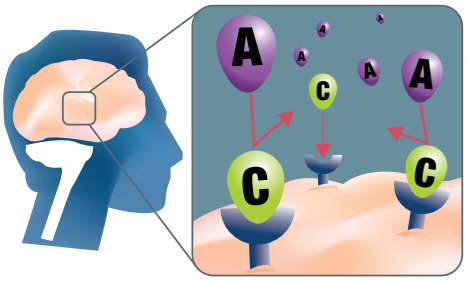
"But if you stay up late to watch the World Series and don't get a full night's sleep, you'll wake up with more adenosine in your brain than you normally would," Roehrs explains. A hit of caffeine will, in effect, neutralize the extra adenosine and help you feel less sleepy.

If you're a regular caffeine user, though, you may need an extra boost to counter your late night. That's because regular users build up a tolerance to caffeine.

"As tolerance develops, the brain makes more receptors for adenosine to occupy," says Roehrs. "So you need more caffeine to block the new added receptors."

Mental Stimulation

People who don't use caffeine regularly and who haven't developed a dependence on it "usually become significantly more alert and better able to perform cognitive and motor tasks—such as paying attention during boring tasks or typing—if they're given the right dose of caffeine," says Laura Juliano, a professor of psychology at American University in Washington, D.C.



Why caffeine keeps you up. Caffeine (C) binds to adenosine receptors in the brain. That prevents adenosine (A), which is a natural sedative, from attaching itself and making you feel drowsy.

If they use caffeine regularly, however, it offers few, if any, benefits. For example, in 2005, researchers gave 96 regular caffeine users a battery of tests after two weeks on and two weeks off caffeine. The participants did no better when they were consuming caffeine than when they weren't.[3]

"What feels good and stimulating about caffeine to habitual caffeine users is mostly due to the alleviation of withdrawal symptoms," explains Juliano. In other words, their brains have become dependent on caffeine, so when they haven't had some for a day or two, they experience unpleasant withdrawal symptoms, like headache, drowsiness, and difficulty concentrating.

If they have a cup of coffee or an energy drink, the symptoms disappear and they feel much better again. "But they're probably not feeling or performing any better than if they didn't have a caffeine habit," notes Juliano.

Physical Performance

"Caffeine can improve physical performance in endurance exercise like running, but the effect is less for short bursts of movement such as lifting weights or sprinting," says Matthew Ganio, a professor of kinesiology at the University of Arkansas.[4]

That's true of people who consume caffeine as well as those who don't, but the benefit may be smaller in regular users.

Caffeine helps people last longer during exercise because it prompts the body to burn more of its ample stores of fat instead of the limited stores of carbohydrate that are in our muscles. When the muscles run out of carbohydrate, we get tired.

"Caffeine also reduces the perception of muscle pain and the perception of how hard we are working, which makes us feel better when exercising and may help us exercise longer," adds Ganio.

Headaches

When you have a headache, the blood vessels in your brain often dilate, or widen. Caffeine constricts blood vessels. That's one reason why caffeine is added

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Photo: Jorge Bach/CSPI. Illustration: Jorge Bach/CSPI.

to Excedrin, Anacin, and some other headache remedies. Another reason: caffeine is a mild pain reliever.

Parkinson's Disease

Several large studies have "uniformly concluded that higher caffeine intake seems to be closely associated with a reduced chance of developing Parkinson's disease," says Michael Okun, medical director of the National Parkinson Foundation.

For example, in a study of more than 600,000 U.S. men and women, those who consumed the most caffeine (at least 600 milligrams a day) were about 20 percent less likely to be diagnosed with Parkinson's over the next 10 years than those who consumed the least caffeine (less than 20 mg a day).[5] The risk was no lower in people who got less than 600 mg of caffeine a day, however.

What's the connection? Parkinson's patients gradually lose the nerve cells that produce the neurotransmitter dopamine. But when caffeine blocks adenosine receptors, that stimulates brain cells that control muscle movements to release dopamine.

Caffeine may even help people who have the disease. Researchers at McGill University in Montreal recently gave 100 to 200 milligrams of caffeine or a placebo twice a day to 61 Parkinson's patients to see if it would make them less sleepy. The caffeine didn't help, but it did improve their tremors or other motor symptoms.[6]

"However, patients should be aware that in most studies, participants develop tolerance to the effects of caffeine, and this could negate any long-term benefits," cautions Okun.

Gallstones

Women in the Nurses' Health Study who drank two to three cups of regular coffee a day were about 20 percent less likely to be diagnosed with gallstones over a 20-year period than women who drank no regular coffee.[7] And men in the Health Professionals Follow-Up Study who drank two to three cups of regular coffee a day were 40 percent less likely to be diagnosed with gallstones.[8] In both studies, decaf drinkers had no lower risk.

One possible explanation: caffeine may stimulate the gallbladder to contract and expel cholesterol and bile pigments that can form gallstones.

Dementia

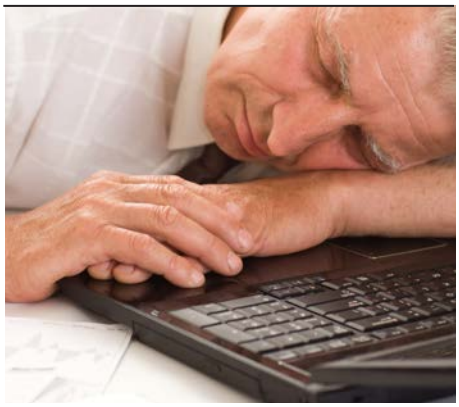
"Evidence is building that caffeine might be the first dietary component able to protect against Alzheimer's disease," says Gary Arendash of Arizona State University.

"In mice bred to develop the disease, caffeine not only protects against inevitable memory impairment," he explains, "but it also substantially decreases the amount of beta-amyloid, the bad protein in the brain that many researchers believe is the root cause of the disease."[9]

The few human studies have been inconsistent.

For example, in a Hawaiian study that tracked nearly 3,500 middle-aged men for 25 years, those who had reported consuming at least 400 mg of caffeine a day were 55 percent less likely than those who said they consumed less than 140 mg a day to have the brain lesions characteristic of dementia at their death. However, they were no less likely to be diagnosed with dementia during their lifetime.[10]

That kind of research can't prove whether or not caffeine wards off Alzheimer's in people. "To determine that, we need a clinical trial," notes Arendash.



Sleep deprived? Caffeine could help. But if you're a regular user, you may need an extra boost.

WHEN CAFFEINE MAY HURT

Pregnancy

The March of Dimes recommends that women who are pregnant or trying to become pregnant consume no more than 200 mg of caffeine a day because the harmful effects of more than that on fertility, miscarriage, and fetal growth "cannot be ruled out."

The Food and Drug Administration's advice: "Pregnant women should avoid caffeine-containing foods and drugs, if possible, or consume them only sparingly."

Disrupted Sleep

"People who routinely rely on caffeine to overcome too little sleep can end up in a vicious cycle," cautions Henry Ford Hospital's Timothy Roehrs. "Disturbed sleep leads to sleepiness and then to increased caffeine consumption, which can lead to more disturbed sleep."

"People don't realize how much caffeine affects their sleep," says American University's Laura Juliano. "For those who are slow metabolizers of caffeine, there's still enough in their system to disrupt sleep at night even if they stop consuming it much earlier in the day."

People who go off caffeine typically report sleeping longer and sounder, both Roehrs and Juliano report.

WHEN CAFFEINE DOESN'T MATTER

■ **Heart.** This fall, the parents of a 14-year-old Maryland girl sued the manufacturer of Monster Energy drink after their daughter drank two large (24 oz.) cans containing a total of 480 mg of caffeine within 24 hours and suffered cardiac arrest. The autopsy report cited "cardiac arrhythmia due to caffeine toxicity" that exacerbated an underlying heart condition.

However, in a study that followed more than 130,000 Kaiser Permanente members in California for 30 years, drinking coffee (regular or decaf) didn't increase the risk of cardiac arrhythmias, even among those with existing heart conditions.[11]

■ **Weight.** Many companies add caffeine to their weight-loss supplements because it speeds up the metabolic rate, at least for a short period of time.[12] Yet "there's little evidence that consuming caffeine leads to significant weight loss or helps people keep weight off," says the University of Arkansas' Matthew Ganio.

■ **High blood pressure.** While caffeine users experience a modest increase in blood pressure, "researchers have detected no substantial link with the development of hypertension in long-term studies of caffeinated coffee intake," notes Rob van Dam of the National University of Singapore.[13]

1 *Morbid. Mortal. Wkly. Rep. 61*: 281, 2012.
2 *Sleep 26*: A194, 2003.
3 *Neuropsychobiology 52*: 1, 2005.
4 *Int. J. Sport Nutr. Exerc. Metab. 14*: 626, 2004.
5 *Am. J. Epidemiol. 175*: 1200, 2012.
6 *Neurology 79*: 651, 2012.
7 *Gastroenterology 123*: 1823, 2002.
8 *JAMA 281*: 2106, 1999.
9 *J. Alzheimers Dis. 20 (Suppl 1)*: S117, 2010.
10 *J. Alzheimers Dis. 23*: 607, 2011.
11 *Perm. J. 15*: 19, 2011.
12 *Obes. Rev. 12*: e573, 2011.
13 *Am. J. Clin. Nutr. 94*: 1113, 2011.

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Take 2 Diet Cokes and Don't Call Us in the Morning

If companies had to list caffeine on their labels or menuboards (get the hint, FDA?), here's some of what you would see.

Coffee

	Caffeine (mg)
Dunkin' Donuts Coffee with Turbo Shot *(large, 20 fl. oz.)*	436
Starbucks Coffee *(venti, 20 fl. oz.)*	415
Starbucks Coffee *(grande, 16 fl. oz.)*	330
Panera Frozen Mocha *(16.5 fl. oz.)*	267
Starbucks Coffee *(tall, 12 fl. oz.)*	260
Starbucks Caffè Americano *(grande, 16 fl. oz.)*	225
Panera Coffee *(regular, 16.8 fl. oz.)*	189
Starbucks Espresso Frappuccino *(venti, 24 fl. oz.)*	185
Dunkin' Donuts Coffee *(medium, 14 fl. oz.)*	178
Starbucks Caffè Mocha *(grande, 16 fl. oz.)*	175
Starbucks Iced Coffee *(grande, 16 fl. oz.)*	165
Maxwell House Ground Coffee—100% Colombian, Dark Roast, Master Blend, or Original Roast *(2 Tbs., makes 12 fl. oz.)*	100-160
Dunkin' Donuts Cappuccino *(large, 20 fl. oz.)*	151
Starbucks—Caffè Latte, Cappuccino, or Caramel Macchiato *(grande, 16 fl. oz.)*	150
Starbucks Espresso *(doppio, 2 fl. oz.)*	150
Keurig Coffee K-Cup, all varieties *(1 cup, makes 8 fl. oz.)*	75-150
Folgers Classic Roast Instant Coffee *(2 tsp., makes 12 fl. oz.)*	148
Starbucks Doubleshot Energy Coffee, can *(15 fl. oz.)*	146
Starbucks Mocha Frappuccino *(venti, 24 fl. oz.)*	140
Starbucks VIA House Blend Instant Coffee *(1 packet, makes 8 fl. oz.)*	135
McDonald's Coffee *(large, 16 fl. oz.)*	133
Maxwell House International Café, all flavors *(2⅔ Tbs., makes 12-16 fl. oz.)*	40-130
Seattle's Best Coffee—Iced Latte or Iced Mocha, can *(9.5 fl. oz.)*	90
Starbucks Frappuccino Coffee, bottle *(9.5 fl. oz.)*	90
International Delight Iced Coffee *(8 fl. oz.)*	76
Maxwell House Lite Ground Coffee *(2 Tbs., makes 12 fl. oz.)*	50-70
Dunkin' Donuts, Panera, or Starbucks Decaf Coffee *(16 fl. oz.)*	15-25
Maxwell House Decaf Ground Coffee *(2 Tbs., makes 12 fl. oz.)*	2-10

Tea

Starbucks Tazo Awake—Brewed Tea or Tea Latte *(grande, 16 fl. oz.)*	135
Starbucks Tazo Earl Grey—Brewed Tea or Tea Latte *(grande, 16 fl. oz.)*	115
Starbucks Tazo Chai Tea Latte *(grande, 16 fl. oz.)*	95
Starbucks Tazo Green Tea Latte—Iced or regular *(grande, 16 fl. oz.)*	80
Black tea, brewed for 3 minutes *(8 fl. oz.)*	30-80
Snapple Lemon Tea *(16 fl. oz.)*	62
Lipton Pure Leaf Iced Tea *(18.5 fl. oz.)*[1]	60
Green tea, brewed for 3 minutes *(8 fl. oz.)*	35-60
Lipton 100% Natural Lemon Iced Tea, bottle *(20 fl. oz.)*	35
Arizona Iced Tea, black, all varieties *(16 fl. oz.)*	30
Nestea Unsweetened Iced Tea Mix *(2 tsp., makes 8 fl. oz.)*	20-30
Arizona Iced Tea, Green, all varieties *(16 fl. oz.)*	15
Lipton Decaffeinated Tea—black or Green, brewed *(8 fl. oz.)*[1]	5
Herbal tea, brewed *(8 fl. oz.)*	0

Soft Drinks *(12 fl. oz.)*

	Caffeine (mg)
Pepsi MAX	69
Mountain Dew—Diet or regular	54
Diet Coke	47
Dr Pepper or Sunkist—Diet or regular	41
Pepsi	38
Coca-Cola, Coke Zero, or Diet Pepsi	35
Barq's Root Beer, regular	23
7-Up, Fanta, Fresca, ginger ale, or Sprite	0
Root beer, most brands, or Barq's Diet Root Beer	0

Energy Drinks *(16 fl. oz. unless noted)*

5-hour Energy *(1.9 fl. oz.)*	208*
Full Throttle	200
Monster Energy	160
Rockstar	160
AMP Energy Boost Original	142
Red Bull *(8.4 fl. oz.)*	80
V8 V-Fusion+Energy *(8 fl. oz.)*	80
Ocean Spray Cran-Energy *(8 fl. oz.)*	55
Glacéau Vitaminwater Energy *(20 fl. oz.)*	50
Starbucks Refreshers *(12 fl. oz.)*	50

Ice Cream & Yogurt *(4 oz. unless noted)*

Cold Stone Creamery Mocha Ice Cream *(Gotta Have It, 12 oz.)*	52
Starbucks Coffee Ice Cream	45
TCBY Coffee Frozen Yogurt *(large, 13.4 fl. oz.)*	42
Dannon All Natural Coffee Lowfat Yogurt *(6 oz.)*	30
Häagen-Dazs Coffee Ice Cream	29
Stonyfield Gotta Have Java Nonfat Frozen Yogurt	28
Starbucks Mocha Frappuccino Ice Cream	25
Baskin Robbins Jamoca Ice Cream	20
Dreyer's or Edy's Grand Ice Cream—Coffee or Espresso Chip	17
Breyers Coffee Ice Cream	11
Häagen-Dazs Coffee Almond Crunch Snack Size Bar *(1.8 oz.)*	10
Dreyer's, Edy's, or Häagen-Dazs Chocolate Ice Cream	less than 1

Chocolate Candy & Chocolate Drinks

Starbucks Hot Chocolate *(grande, 16 fl. oz.)*	25
Hershey's Special Dark *(1 bar, 1.5 oz.)*	20
Hershey's—Milk Chocolate *(1 bar, 1.6 oz.)* or Kisses *(9 pieces, 1.4 oz.)*	9
Hershey's Cocoa *(1 Tbs.)*	8
Dove Dark Chocolate Silky Smooth Promises *(5 pieces, 1.4 oz.)*	4
Silk Chocolate Soymilk *(8 fl. oz.)*	4
Hershey's Chocolate Lowfat Milk, bottle *(12 fl. oz.)*	2

Over-the-Counter Pills

Zantrex-3 weight-loss supplement *(2 capsules)*	300
NoDoz or Vivarin *(1 caplet)*	200
Excedrin Migraine *(2 tablets)*	130
Midol Complete *(2 caplets)*	120
Bayer Back & Body *(2 caplets)*	65
Anacin *(2 tablets)*	64

[1] Average. * Number from ConsumerLab.com analysis.
Sources: Company information, *J. Anal. Toxicol. 32*: 702, 2008.