What's the buzz on caffeine?

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Credit: AI-generated image (disclaimer)

The most popular addictive drug available in Australia right now is 1, 3, 7-trimethylxanthine, or $C_8H_{10}N_4O_2$. Let's call it 137TX until we can come up with something catchier.

Most adults seem to feel a need to use it daily, and we hear people saying that they can't function until they've had their "fix". Wait, you may be saying, why haven't I heard of this common drug? Well, you probably

know it as caffeine, most commonly delivered in the form of coffee.

But why do we love caffeine so much? The list of its adverse effects should really put us off:

- it causes palpitations and headaches
- it impairs fertility and promotes reflux
- it increases levels of cortisol, the stress hormone, and increases the reaction to stress
- it increases calcium losses from our bones and may be a risk factor for low-impact fractures at high intakes
- it reduces sleep quality so profoundly that it has been used to simulate insomnia in experimental tests of sedative drugs

Just one cup of coffee at dinner time has a measurable effect on time to get to sleep and frequency of waking in the night. All this is news to nobody.

And now scientists at the Western Australian Institute for Medical Research have announced that coffee contains a substance associated with deadly accumulation of visceral fat.

So why would anyone want to risk experimenting with 137TX?

One possible answer is that we just can't get enough of its stimulant effect, which is mostly caused by adenosine inhibition. This measurably improves performance in sport and in situations where alertness may be reduced by fatigue.

Perhaps the wearying effects of modern life have made us even more dependent on the lift we get from our morning espresso?

Also, unlike other available stimulants, it's cheap, easy to obtain, and flavoursome. It's fast, too, peaking in the bloodstream within about an hour of consumption and wearing off about four hours after an average dose in most people.

Dose me up

An average dose – a standard coffee or a small can of Red Bull or V – has between 80 and 100 milligrams of caffeine. In comparison, a can of normal cola or a cup of hot or iced tea may have around 30 to 50mg. And a decaffeinated coffee, a hot chocolate or chocolate milk or a square of dark chocolate may have about five milligrams.

Studies of caffeine in sport performance use doses of around 200 to 250mg. Most studies of "high" doses use 300 to 500mg, or around five milligram per kilo body weight. This amounts to five or six cups of strong coffee.

The dose can also be affected by how you consume it. A lighter coffee roast is higher in caffeine and adding milk or sugar to a caffeine drink slows its emptying from the stomach so that it's absorbed more slowly.

Absorption and metabolism rates differ between individuals. This helps explain why one person can't function without four cups a day, while another may steer clear of everything except decaf, citing unwanted side effects.

While the mechanism of caffeine's effect is complex, we do know that it is metabolised in the liver to a variety of active substances. Some of these have opposing effects on the nervous system, blood pressure and molecules found in the blood. This may be another reason for the different effects of caffeine experienced by different people.

The bad bits

Overall, caffeine tends to increase urine production, and raises blood pressure by constricting the blood vessels, but only for a short while.

Chronic caffeine use does not seem to lead to chronic hypertension generally, although some individuals may be at higher risk. Similarly, reports of increased kidney stones seem to be limited to those who already have a higher-than-normal risk.

Caffeine does increase calcium losses, but this occurs at significant levels only when intake is more than two to four cups of coffee a day. And possibly only in people who already have a low calcium intake. Whether this effect is really important to bone health has been contested.

And the good points

In favour of caffeine are a number of studies suggesting that it has some interesting health benefits. It may, for instance, be associated with reduced risk of dementia.

Depression risk may be lower with increased caffeine intake too, according to a large cohort study of over 50,000 American women from the Nurses' Health Study. And similar results were seen in a study of over 2000 Finnish men. In that latter study, however, the relationship was with coffee intake, not dose of caffeine.

Some of the other other benefits of coffee seem to be independent of its caffeine content, too. Reduced risk of diabetes was seen with regular and decaf coffee alike in another large cohort study.

And a similar phenomenon was observed with some of the studies

indicating reduction in cancer risk. Coffee's antioxidant content may be part of the reason.

Another might be chlorogenic acid, a component of coffee that is increasingly attracting attention. This is the substance that was used in the West Australian study on visceral fat.

At low doses, chlorogenic acid seems to be involved in the positive effects of coffee, improving insulin sensitivity and blood pressure. But, in high doses, it had the opposite effect – promoting fat accumulation around the organs and raising blood glucose levels.

The high doses of chlorogenic acid used in the West Australian study were equivalent to a daily intake of five cups of coffee over an extended period. Still, we should probably apply caution to the applicability of this research to real life, given that the study was conducted in rats following a high-fat diet, rather than humans eating normally.

In any case, it seems that coffee drinkers who stick to consistently-consumed moderate doses can feel confident that their 137TX habit isn't harming their health.

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