Energy drinks are especially popular with adolescents, but how do they affect their health?

Whether black or with milk, coffee is the most popular drink in Germany, even outperforming beer and water. Other beverages containing caffeine are also in demand. Alongside tea and cola, one of the in vogue beverages among young people are energy drinks. So when is the consumption of caffeine of health concern and who is particularly at risk?

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The first "study" on the health assessment of caffeine took a surprising turn. Legend has it that, in the 18th century, King Gustav of Sweden pardoned two twins who had been sentenced to death and ordered that they instead be imprisoned for life. He then had one of them drink three cups of tea a day, while the other drank the same amount of coffee. His theory? Both would die within a short period of time – first the coffee drinker, then the tea drinker – and thereby scientifically underline the royal decree on the "abuse and excess of tea and coffee". Fortunately for the prisoners, the dose was relatively moderate. It's said that both men outlived not only the king but also the doctors, and that the first prisoner to die was the tea drinker at the age of 83.

Scientific studies are performed differently today, but the early "toxicologists" weren't completely wrong. Coffee and black tea really can have undesirable effects on health – even if not of the kind that was assumed to be the case back then. Both beverages contain the same active substance, namely caffeine, in differing concentrations. This is why toxicologists are still interested today in the question of how much caffeine humans can tolerate.

High quantities can cause cardiovascular problems

It is undisputed in physiological terms that caffeine has a stimulating effect on the cardiovascular and central nervous system. The intake of caffeine causes people to temporarily be more alert and focused. However, high intake amounts can also cause nervousness, excitability, sleeplessness, outbreaks of sweating and heart palpitations. If caffeine consumption is excessive over long periods of time, this may under certain circumstances lead to cardiovascular problems like elevated blood pressure and can also inhibit the growth of the foetus in pregnant women.

For healthy adults, the European Food Safety Authority (EFSA) has derived a guidance value of 3 milligrams (mg) caffeine per kilogram (kg) bodyweight which can still be considered safe as a single dose. This means that a healthy adult weighing between roughly 60 and 70 kg can consume a caffeine dose of up to around 200 mg caffeine without any expected health impairments. This is approximately equivalent to two mugs of coffee (see graphic page 25). In the case of habitual consump-

tion spread over the course of the day, an amount of up to roughly 400 mg caffeine per day is considered safe for healthy adults.

Children and pregnant women should be particularly cautious

It's important to note that these are maximum amounts that are considered safe and not intake recommendations. "Sensitivity to caffeine can vary widely between individuals", explains Dr. Karen Ildico Hirsch-Ernst, Head of the Nutritional Risks, Allergies and Novel Foods Unit at the BfR. "People who are sensitive to caffeine tolerate less caffeine than others. And children, pregnant women and breastfeeding mothers should exercise particular restraint when it comes to caffeine or should ideally refrain from consuming products with high caffeine content."

Nevertheless, caffeine is popular all over the world – as a stimulant, a pick-me-up and a break beverage. And it's not only coffee that makes the heart beat faster. One thing most people are unaware of is that children mainly consume caffeine through the chocolate they eat. One bar (100 g) of dark chocolate contains roughly the same amount of caffeine as one mug of black tea. Alongside cola and tea, a further source of caffeine has become popular with adolescents in recent decades – namely energy drinks. The caffeinated soft drinks that generally contain not only caffeine but also taurine, glucuronolactone or inositol came into fashion in the 1990s and have been advertised as boosting the ability to concentrate and physical performance.

When does the consumption of energy drinks become a health risk?

One can of energy drink contains about as much caffeine as one mug of coffee. Moderate consumption is therefore unlikely to result in any health impairments in healthy adults. There is little or no data for children, but as children are a particularly sensitive group of people and are often not used to caffeine, they should refrain from consuming these kinds of drinks wherever possible. The same applies to pregnant and breastfeeding women. Health risks can arise particularly if energy drinks are consumed in large quantities, especially together with high amounts of alcohol or during intense physical activity. Some case reports describe serious health impairments such as cardiac arrythmia – that can even result in death in a worst-case scenario – following high-level consumption of energy drinks, often in combination with alcohol. However, causal relationships have not been investigated in this context.

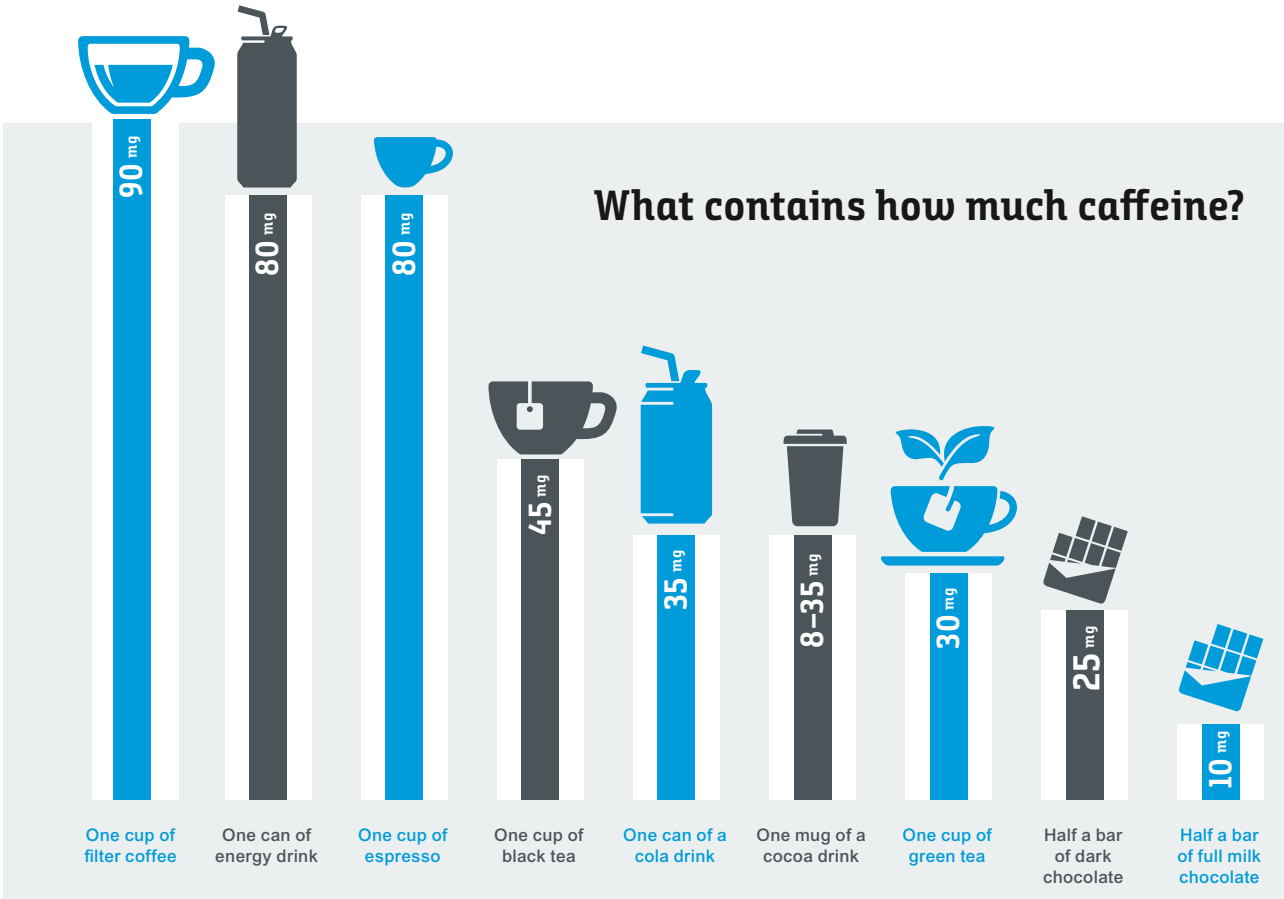
What is caffeine?

Caffeine is a natural alkaloid, a substance that plants form as protection against predators. In addition to being in coffee, caffeine is found in over 60 plants, such as tealeaves, cocoa beans, guarana seeds, mate leaves and cola nuts. After being consumed, caffeine is rapidly absorbed by the body and readily crosses the blood-brain barrier and the placenta.

The BfR conducted a study in order to establish how many energy drinks are consumed by some of the so-called "high consumers" and under what circumstances this occurs. The theory was that energy drinks are drunk in excessive quantities above all on certain occasions, such as parties and music and sporting events. The BfR therefore performed the surveys in places where it was assumed that the consumption of energy drinks is at its highest.

Up to five litres of energy drinks in individual cases

Accordingly, the interviews took place in discotheques, at festivals, at sporting events and at LAN parties, during which computer games are played on a common network. The participants were first asked if they had drunk more than half a litre of energy drinks during the past 24 hours. Those who answered in the affirmative were then



A healthy adult can tolerate up to roughly the following caffeine intake:

(No intake recommendation, but a maximum safe amount*)

* The figures do not apply to people who are highly sensitive to caffeine, to children or to pregnant or breastfeeding women.

Long waking phases, intensive dancing and high quantities of caffeine and alcohol: this combination can cause serious problems for the heart and the circulatory system.

asked to answer detailed questions on their consumption habits. It was found that high consumers drank an average of roughly one litre of energy drinks at the various events within 24 hours, equivalent to caffeine intake of around 320 mg; the participants who mixed the energy drinks with alcohol had an average intake of 1.5 litres. The behaviour of some extremely high consumers was particularly troubling. In individual cases, they drank up to five litres of energy drinks within 24 hours, often together with alcohol.

It is not only the quantity of energy drinks but also the behaviour of the participants in connection with this intake that can pose health risks. The gamers at LAN parties in particular stayed awake for up to two days and two nights. And at sports and music events, high consumers were often physically active, danced intensively or rode bikes for several hours at a time. The combination of extremely long waking phases or intense sporting activity and high amounts of caffeine can increase the risk of cardiovascular problems.

Risk warnings on drinks

A further finding of the study is that high consumers are hardly aware of the health risks. This means there is a need for more information. But what is the best way to communicate these risks? "The BfR already recommended back in 2008 that labels should be attached advising children, breastfeeding mothers and people who are sensitive to caffeine to refrain from consuming energy drinks", says Hirsch-Ernst.

In 2014, the new labelling regulation of the EU Commission came into force and also outlined labelling obligations for caffeinated foods. Ever since, beverages in the EU containing more than 150 mg caffeine per litre that are not coffee or tea beverages must bear the warning: "High caffeine content. Not recommended for children or pregnant or breastfeeding women".

Still little or no research regarding consequences for children and adolescents

Does this mean that toxicology can now close the chapter on caffeine? By no means. Data on the possible effects on the health of children and adolescents are still rare. What happens, for example, if adolescents regularly consume more than one litre of an energy drink per day over a longer period of time? The BfR convened an expert meeting on this issue in 2017. As no data is currently available in this regard, the question remains for the participants whether chronically high consumption of energy drinks might favour the occurrence of cardiovascular diseases.

The BfR believes that targeted information is important to reduce the risks, particularly in the case of adolescents. One thing the BfR recommends is to explain on the labels of energy drinks, too, that the consumption of large quantities particularly in connection with high-intensity sporting activities or alcohol consumption can have undesirable effects on health.

Competition for improved performance

All the while, more and more caffeinated trend products are coming onto the market. Gyms are a good example: "Certain food supplements for those engaging in sport contain caffeine as an ingredient designed to enhance performance", says Hirsch-Ernst. But especially the combination of excessive caffeine intake and intense exercise can increase the risk of cardiovascular problems.

Ice tea, mate, chai, matcha and guarana also promise to deliver a certain kick and have reached new target groups. Perhaps the hype over caffeine is partly due to the desire for improved performance, the pressure to keep up. A trend towards more calmness and a sense of proportion would certainly be helpful. Or, as people used to say: switch down a gear, take it easy. ◘

More information:
www.bfr.bund.de/en > A-Z-Index > Caffeine