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## Effect of Caffeine on Health

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### Abstract

Coffee, tea, energy drinks and other naturally generated stimulants like caffeine are common consumer goods because of their positive effects on mood and cognitive function. This overview looks at the complex relationship between caffeine and human wellness, including both positive and negative impacts. Frequent consumption of caffeine was positively linked to higher concentration, enhanced memory and possible prevention of certain sickness, including insulin resistance and dementia. Furthermore, new research indicates that caffeine may improve cardiac wellness by lowering the risk of haemorrhage and cardiac disease. However, taking excessive amounts of the drug may cause detrimental impact like stress, insomnia, raised blood pressure, upset stomach and possibly a higher risk of developing a dependent. Concerns are also raised about how caffeinated beverages affects conception, bone wellness and the possible cancer risk of several of the chemicals found in coffee. To attempt to equilibrium the expected positive effects of caffeine with individual variability and health problems, this review emphasizes the need for additional study in order to understand the ideal levels of being eaten.

**Keywords** - caffeine, human body, effect on health

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### INTRODUCTION

The most popular beverage is tea, that made through the naturally occurring shrub's leaves. The Chinese were the ones who initially prepared it and employed it as medicine. Rich in organic materials, well-drained sandy loam soil is ideal for growing tea. For cultivation, acidic soil with a pH of 4.5–5 is utilized. In the tropical region, it is often planted between 700 and 2400 meters above sea level on the hillsides and level plateaus. Better harvests are produced by irrigation in the dry months .<sup>[1]</sup>

#### Classification

##### White tea

Dehydrated and unfermented.

##### Yellow Tea

Permitted to turn yellow, but not withered or oxidized.

##### Green tea

Not oxidized or withered.

##### Oolong

Partial oxidation and wilting.

##### Black tea

Completely oxidized, wilted and occasionally crushed.

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Green tea that has been given time to ferment is known as post-fermented tea.<sup>[2]</sup> Herbal components like mint, ginger and others can also be added to make herbal drinks. Additionally, flavoured teas are made with a variety of flavouring ingredients, such as vanilla, jasmine, etc. Tea leaves are oxidized by enzymes to generate tea. The tea leaves are first shattered and divided into tiny fragments. Enzymatic oxidation, which happens as a result of the action of enzymes released as a result of the breakdown of cell walls, comes next. To stop too much oxidation, a firing procedure is carried out.<sup>[3]</sup>



*Figure 1: Tea leaves*

### **Caffeine**

Among most strongly popular and widely drank beverages around the universe is caffeine. While coffee its main source, it can also be found in leaf tea, its seeds, cherries and cacao seeds, among other crops. It's crucial to remember that caffeine can also be found in medicinal products, energy-containing flavored beverages and gums.<sup>[4,5]</sup> Research indicates that excessive caffeine use is further of a routine as opposed to an addictive.<sup>[6]</sup> Caffeine has in recent time drawn attention from scientists due to evidence that it is a bioactive chemical with positive health effects (it can prevent oxidative stress in Alzheimer's disease (AD)).<sup>[7]</sup> On the other hand, caffeine use may have detrimental effects that are more likely to affect children, adolescents, the elderly and those with hypertension.<sup>[8]</sup> Because caffeine is so widely consumed, we discuss its effects both good and bad on the human being while considering the needs of each particular system. The gastrointestinal (GI) tract absorbs caffeine quickly and it passes through layers of cells as effectively since when it circulates through tissue. Cocaine is converted by the hepatocyte to produce byproducts such as theophylline, theobromine, and paraxanthine by the activity of an enzyme.<sup>[9,10]</sup> The elevated concentration of coffee peaks through the circulation 60 minutes after ingestion, occurring in the first 15 to 45 minutes after consumption. Like lipid-soluble compounds, it freely passes the blood-brain barrier and affects how our neurons work, with an energy balance-related effect. A cup of coffee provides a natural burst of energy due to its caffeine content.



*Figure 2: Caffeine seed*

## Effect Of Caffeine On Health

Its impact on human health can be either beneficial or detrimental.

### Advantages of Caffeine on Health

Lower dosages of caffeine have the subsequent benefits for the human system. Individuals have a lot of energy and have excellent concentration. This helps individuals stay focused and perform well at work. According to a recent study patients with a common cold were also able to focus well and complete the work at hand effectively after taking coffee.<sup>[11]</sup> Adenosine, which inhibits neurotransmitters, is inhibited by caffeine. Dopamine and other neurotransmitters become more active as a result. Both headache and tension are relieved by it. The likelihood of developing depression also decreases. By quickening perception, it claims that there is also a beneficial impact on cognitive behavior. Because it contains several types of polyphenols, it functions as an antioxidant.<sup>[12]</sup> This aids in the in vivo prevention of oxidative stress. It also makes leucocytes more active.

### Harmful Effects of Caffeine on Health

Caffeine has health risks when ingested in excess. A person who consumes too much coffee finds it harder to fall asleep. According to this phenomena is the reason why persons who experience sleeplessness drink very little coffee. According to earlier investigations in 1995 adenosine produces vasodilation.<sup>[13]</sup> The adrenal glands release more norepinephrine when caffeine is present, which induces vasoconstriction, which raises blood pressure and heart rate. Addiction to caffeine is brought on by excessive doses (>1000 mg). The primary symptom of caffeine addiction is anxiety; other side effects include an increased risk of bladder problems; worsening glaucoma in patients; and an increased risk of osteoporosis due to a rise in calcium secretion in urine and dropped calcium absorption by bones. An excess of caffeine also increases the risk of diabetes by causing premenstrual symptoms in women and raising insulin release by the pancreatic  $\beta$  cells.<sup>[14]</sup>

### Toxicity of caffeine

In most cases, hazardous effects are not linked to just one intake of drinking caffeine of two hundred milligrams or slightly by healthy individuals without comorbidities or pharmacokinetic problems.<sup>[15]</sup> However, a single intake above 300 mg might lead to caffeine drunkenness, symptom among them are primarily attributable toward a stimulus properties of the drug. Among particularly common are: irritation, tachycardia, anxiousness, insomnia, increased urine, gastrointestinal issues. Caffeine use has negative effects however the intensity of such effects varies with dose.<sup>[16,17]</sup>

### Sources of Caffeine

Part of a class of molecules referred to as methylxanthines, caffeine is an organic compound. Among the majority of widely recognized natural caffeine's origins include leaves of tea and caffeine seed.<sup>[18]</sup> Food goods' caffeine content differs according to the item's type, portion size and processing technique. The plant species has an impact on the caffeine level of both teas as well as coffees. Over-the-counter painkillers are an additional resource of caffeine. Being an adjuvant, caffeine quickens the body's absorption of the drug. Additionally, several stimulant medication and cold treatments contain it. The products may contain 16–200 mg of caffeine.<sup>[19]</sup>

### Caffeine Daily Consumption Intake

Every individual use of caffeine daily 1.73 mg per kilogram of total body weight per day on average. Compared to older people, kids eat significantly fewer Caffeine. the typical amount of caffeine that kids of all ages consume each day from each drink that contains caffeine. Fruit juices and brews are the primary routes of stimulant for youngsters and youths, but caffeine is the primary

form for people 25 years of age and over. Energy beverages, on the other hand, are becoming more and more popular among a variety of age groups, this is a category whose consumption should be watched in the years to come.<sup>[20]</sup>



*Figure 3: Coffee plant*

Research on intake of caffeine, including summaries of the literature and individual research, widely indicates that a daily consumption of roughly 3 times of caffeine, is harmless is safe, even for the more sensitive groups, such small kids & expectant mothers.<sup>[21]</sup>

### **Functions of Caffeine**

After absorption, caffeine enters the central nervous system fast. It doesn't accumulate in the circulation or remain stored within the body. Caffeine enhances the nerve system and brain. Coffee won't lessen the effects of alcohol, even though the widespread misunderstanding think drinking coffee will assist one "sober up." Coffee beans can be used to momentarily alleviate fatigue or drowsiness. Caffeine is a booster of the neurological system that works mainly by preventing adenosine receptors. Adenosine is a neurotransmitter which encourages sleep and calmness; by blocking its action, caffeine increases alertness and decreases weakness. It additionally boosts the release regarding brain chemicals like dopamine along with norepinephrine, which further boosts mental health.

### **Side Effect of Caffeine**

Depression, Anxiety

Inability to sleep Feeling

Queasy Anxiety Shivers

An elevated heart rate

More frequent urination

Throwing up abruptly quitting coffee can result in withdrawal symptoms like

Headaches

Irritability

Drowsiness

Nausea

Vomiting

Lower coffee intake gradually to avoid any withdrawal symptoms. Caffeine's impact on health has been extensively researched. Coffee may contribute to or exacerbate lumpy, discomfort breasts caused by fibrocystic illness. If caffeinated beverages take the place of nutritious drinks like milk,



Coffee could have been a detrimental impact on the diet of a youngster. A toddler who beverages coffee can also consume less because the stimulant lowers food intake.<sup>[22]</sup>

### **Caffeine's Function in The Human Body's Various Systems**

#### **The nervous system of the body**

The substance known as neurotransmitter acetylcholinesterase (AChE) is one more potential mechanism by which caffeine affects the neurological system.<sup>[23]</sup> With numerous studies on the impact of caffeine in which its mechanisms impact is yet unknown but which have been practically proven, this could be a significant finding. The brain and spinal cord are stimulated by coffee at decreased blood concentrations. However, at elevated levels it can cause a shaking sensation, nervousness, anxiousness, headaches, and sleeplessness.<sup>[24]</sup> who found that a 500 mg caffeine dosage had a greater negative impact (tension, feeling uneasy,) than beneficial impacts (elation, calmness, happiness).<sup>[25]</sup>

#### **Effects of Coffee on Kids and Teens**

The effects of caffeine use extend beyond adults to children as well investigated 309 kids according to data collected parent's interviews regarding daily.<sup>[26]</sup>

This investigation demonstrated a positive connection of greater coffee use and increasing ages, increased adolescence scores and increased apathy in mornings. Conversely, however, improved internalization and a reduction in overall behavior issues were linked to lower overall caffeine usage. Additionally, a poorer sleep schedule, morning fatigue and restless sleep were linked to higher coffee intake. After controlling for extra nutritional, sociological, lifestyle and sexual information data analysis revealed a possible link between a coffee use and Stress, fear, and depressive disorder among kids at secondary school. Men and women experienced different impacts; women experienced the most severe effects related to stress.

#### **Coffee and Pain Perception**

Due to its vasoconstricting and anti-inflammatory properties, which can complement analgesics and sometimes boost their efficacy by up to 40% even medicinal and without a prescription pain relievers frequently contain caffeine. Caffeine intake was linked to increased warm pain tolerance, stress pain limits and pain tolerance.<sup>[27]</sup>

#### **The Connection Together Caffeine and Mental Disorders**

The frequency of problems including anxiety, suicidal thoughts, is rising. In kids as well as adults, this leads to a closer look not just at the causes of these illnesses but also at potential novel treatments. Numerous studies have examined caffeine, the years as a possible hazards factor or safeguarding element for mental illnesses.<sup>[28]</sup> Caffeine use has already been linked to signs of depression in studies. Research revealed that individuals who consumed over 2 caffeinated coffee cups daily Having a 24% decreased chance of becoming depressed compared to non-drinkers.<sup>[29]</sup> Discovered that the prevalence of anxiety declined with an increase in coffee consumption; however, they did not confirm any gender-specific variations. In a study conducted on 2307 children aged 11–17 examined the impact of caffeine on depression and found that while boys were not more likely to experience feeling depressed, girls were more likely to do so if they consumed fewer over a weekly dose of one thousand milligrams of caffeine.<sup>[30]</sup> Analysis of data from 4737 people supports this conclusion, showing that ladies who drank Increased caffeine intake had a decreased incidence of sadness.<sup>[31,32]</sup>

## **System of digestion**

One of the factors contributing to patients reported abdominal pain and physicians noticed intestinal system issues is the drinking of caffeinated coffee.<sup>[33]</sup> Caffeine is the primary pharmacologically active ingredient in coffee. It can raise the production of stomach acid relax the muscle fibers by raising the amount of gastrin and the release of the acid hydrochloric which increases the risk of digestive and intestinal mucosal inflammation. However, caffeine is thought to have preventive and inflammation reducer effects <sup>[34,35]</sup>

## **Blood sugar levels and Caffeine**

Caffeine at high dosages improves glucose tolerance and reduces the response to insulin.<sup>[36]</sup> Coffee with decaf has been demonstrated to lower HbA1c levels when compared to caffeinated coffee; this implies that coffee may include additional components that enhance glucose metabolism and this deserves further investigation.<sup>[37]</sup>

## **Caffeine and kidney stone**

Research has been done on the connection regarding kidney stones and coffee and while conclusive findings have not been reached, certain findings provide useful information.<sup>[38]</sup>

## **Caffeine and Urine production**

Due to its moderate diuretic properties, caffeine increases urine production, which may help flush out minerals and avoid the development of kidney stones. It seems probable that they will not consistently be powerful sufficient to end the creation of stones entirely.<sup>[39]</sup>

## **Calcium Elimination**

The most frequent type of kidney stones is calcium-based and caffeine raises the excretion of calcium in urine, which may increase the chance of developing these stones.

## **Hydration**

Maintaining adequate hydration is essential to avoiding kidney stones. It's critical to make up for any a high level of caused by caffeine consumption by drinking enough water.

## **Osteopenia (health of the bones)**

Studies regarding Caffeine use and the state of the bones has received special attention because of the growing awareness of the prevalence of after menopause women's reduction in bone. It has been demonstrated that high caffeine use (more than 744 mg/day) increases elimination of calcium and magnesium in the urine.<sup>[40]</sup> However, a variety of other dietary components, including  $Ca^{++}$ ,  $K^+$ , anti-oxidant substances proteins, and saltwater can also have an impact on the complex process of removal of calcium.<sup>[41]</sup> Research on the metabolism of calcium and caffeine as well as bone degeneration indicate that milk consumption falls with increased drinking of caffeinated coffee. When dietary calcium intake is enough, bone degeneration is less evident and becomes more pronounced when it is insufficient. Caffeine's propensity to negatively impact calcium homeostasis and the breakdown of bones depends on lifelong intakes of both the substance and calcium; this is especially important for women.

## **Caffeine effect on cancer**

Because research on the topic has yielded conflicting findings, the association between caffeine and cancer is complicated and not fully understood.

## **Possible Preventive Measures**

Caffeine and other components in coffee may protect toward some forms of cancer, according to some research, among them are

### **Liver cancer**

Research indicates coffee consumers may have lower risk of the disease.

**Colon cancer**

According for investigation, coffee may lower the chance of colon cancer by influencing swelling and bowel motions.

**Mammary cancer**

Studies suggest that drinking coffee could reduce the risk of cancer in women, especially in women who have specific family histories. Caffeine's cellular Defense and immunomodulation qualities could be the cause of this.

**Potentially Harmful Impacts**

While some study indicates advantages other studies imply that consuming too much caffeine may raise your chances of developing specific cancers

**Urinary cancer**

While the evidence is inconclusive, some studies indicate potential connection between consumption of coffee and dangerous of developing prostate malignancy.

**Ureter cancer**

Although the evidence is conflicting, research has indicated that a high coffee consumption could be linked to a higher chance of severe prostate tumor.

**Caffeine's impact regarding diet****The impact of coffee on the absorption of vitamin and elements**

A minor stimulant, coffee can be found in many of our favorite foods and beverages, including tea, coffee, cola and sweets. Caffeine can interfere with our ability to absorb nutrients, so it's critical to monitor how much of it we eat. For most healthy persons, small amounts of caffeine consumption most likely pose no risks; but regular excessive doses may lead to reliance.

**Calcium**

Calcium is expelled in the urine and feces as a result of caffeine. Five milligrams of calcium are lost for each 150 milligrams of caffeine consumed, or roughly the same quantity as a single cup to drink. This impact last for hours following caffeine ingestion. In comparison to women who used less coffee, postmenopausal women who consumed over 300 milligrams of the stimulant more bone was lost in their spines.

**Vitamin D**

Vitamin D receptors are inhibited by caffeine, which reduces the quantity that can be taken in. As far as vitamin D is necessary for the assimilation and utilization of calcium found in the formation of bone, deficiency in it may also lower density of bone minerals and raise the peril of bone cracks.

**Iron**

Caffeine prevents the body from absorbing iron, which is needed for the synthesis of red blood cells. When coffee is consumed along with an iron source, absorption might be decreased by up to 80%. Caffeine-containing food and drinks or medications containing iron should be kept apart for at least an hour.

**Vitamin B**

Due to its low diuretic impact, caffeine causes increased urination. The loss of fluid can cause the depletion of vitamins that dissolve in water, like the B-vitamins. Furthermore, it disrupts the breakdown of several B-vitamins, including thiamine (vitamin B1). It looks that vitamin B12 is the one limitation to this rule. The formation of stomach acid is stimulated by caffeine and this promotes the body absorb vitamin B12.

### **Effects of Caffeine on the Large as well as Small Intestines**

Although there is conflicting evidence, caffeine affects the duration of transit and net flow of fluid. Caffeine intakes ranging from 75 to 300 mg have been shown to boost net production in the intestines for at least 15 minutes and in the colon 35 minutes later.<sup>[42]</sup> Another study's findings demonstrated that coffee influences pharyngeal function by reducing the reduced intestinal sphincter's stress, which causes it to calm down.<sup>[43]</sup> Additionally, it has been shown that caffeine increases intestinal muscle activity and bladder stretching; nevertheless, there is no link between caffeine intake and indigestion. The impact of caffeine content on gastrointestinal transit time and the degree to which it is impacted by the use of caffeinated beverages and goods are still unknown.<sup>[44]</sup>

### **Anxiety from Oxidation and Caffeine**

The detrimental effects (the renal system) varieties that can upset the reactive-antioxidant equilibrium in the right conditions, lead to oxidative damage. Human beings constantly produce reactive oxygen species and reactive neutrons through immunological function, molecular energy metabolism and oxidative breakdown. Subsequently oxygen consumption growth and maintenance are also influenced by foods that cause inflammation. A variety of illnesses are largely caused by nutrient-mediated oxidative stress, which comes from a variety of origins.<sup>[45]</sup> Caffeine demonstrated influenced by concentration. Non-enzymatic antioxidant capacity in certain experiments by lowering superoxide dismutase and catalase activity as well as free radical production levels.<sup>[46]</sup> The function of caffeine in protecting the epidermis. Research revealed that dihydrochloride and UV light, which they employed to cause oxidative damage in both normal individuals cell types and altered skin cells, could be inhibited by a small amount of caffeine. In conclusion, it would have to be underlined which caffeine, as an anti-inflammatory, mitigates the harmful Antioxidant stress's effects & excesses between reactive and antioxidants. Cocaine has a beneficial impact on neurological disorders and shields nerve cells from cellular aging and degradation by reducing the production of free radicals. Furthermore, caffeine can prevent UV-induced damage to the skin & technically aid in the removal of reactive oxygen species shielding skin cells from oxidative strain brought on by the sun's rays.<sup>[47,48]</sup> Caffeine's demonstrated ability to shield the skin from UV rays and the free radicals they produce is an exciting subject for further investigation, including investigates that use recent developments in dermatology as well as pharmacotherapy

### **Caffeine contains pharmaceuticals**

Many drugs contain caffeine, particularly those intended to alleviate migraines, reduce pain, or increase concentration. It may also aid increase the efficacy of specific treatments and may amplify the effects of other active components, such as pain medications. The following are some typical prescription drugs that might contain caffeine

#### **Pain reliever**

##### **Analgesics**

The effectiveness of over-the-counter (OTC) pain relievers, especially those used to treat headaches and migraines is often increased by the addition of caffeine. It functions by narrowing blood vessels, which may lessen migraine discomfort.

##### **Medication for Migraines**

Caffeine is used in several migraine medications to enhance absorption or efficacy. In combination with other medications, it might also help lessen the frequency of migraines.



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### **Medication for the Flu and Colds**

Caffeine is sometimes used in cold remedies to help with alertness by counteracting the sedative effects of other medicines, such as antidepressants. Caffeine has a modest energetic effect.

### **Tablets for Losing Weight and Appetite Suppressant**

Because caffeine has energetic qualities, which can speed up metabolism and reduce appetite, it is occasionally found in weight reduction products.

### **ADHD (attention deficit hyperactivity disorder) medications**

Caffeine has been used as a mild stimulant for ADHD, although it is not a popular treatment. Caffeine self-medication is not a primary therapy option, but it is used by certain individuals. Certain ADHD drugs, such as Adrenaline or Adderall, contain far more potent stimulants and are therefore more beneficial than coffee.

### **Drugs to Treat Weakness or Restlessness**

Caffeine is a stimulant that is included in several sleep aids for exhaustion or sleepiness (which are frequently caused by illnesses or extreme sleepiness).

### **Medicines for Asthma**

Because of its bronchodilator properties, caffeine used to occasionally be a part of asthma medicines. Although less often now, this can still occur with some combo treatments. Theophylline, a medication used to treat lung diseases and airways that is related to caffeine.<sup>[49]</sup>

### **Drugs for Allergies**

Although it is less frequent, some allergy treatments contain caffeine to combat the sleepiness caused by antidepressants.

### **Depression-fighting drugs**

Although it's uncommon, a few depressives particularly older brands, may have stimulant qualities or mix caffeine with other substances to help with energy and mood boosting

### **Caffeine contains beverages**

#### **Coffee:**

Coffee is a popular beverage that is appreciated to its full flavor & energetic properties because it contains caffeine.

#### **Advantages for Health**

##### **Enhanced Mental Function**

Caffeine has been shown to improve consciousness, attentiveness and general ability to think. According to some study, drinking coffee reduces the chance of developing diseases like Parkinson's, and some types of cancer. Oxidants, which are abundant in coffee, can help decrease swelling and prevent off serious illnesses. If caffeine is ingested too late in the day, it may impair the level of sleep. For a lot of people, 3 to 4 cups per day is typically regarded safe. Take care while using creamery items and sugar since they might increase calorie intake and lessen health advantages. Issues with digestion and Some people could feel uneasy in their stomachs.<sup>[50]</sup>

##### **Tea**

One of the world's most popular beverages tea is renowned for its variety of tastes and possible wellness benefits.

##### **Advantages for Health:**

Vitamins and minerals may lower the incidence of long-term illnesses and aid in the protection against reactive oxygen species. Heart conditions regular use is associated with reduced fat and enhanced heart wellness. Control of Weight specifically, green tea may aid in increasing digestive

processes and encouraging the breakdown of calories. In general, when savoured carefully, tea may be a pleasant and healthful addition to every day regimen.<sup>[51]</sup>



*Figure 4: Tea*

## CONCLUSION

Caffeine affects health in both positive and negative ways. Three to four cups of either coffee or tea each day is considered moderate use and is linked to a number regarding wellness benefits, such as better cognitive function, increased physical performance and a decreased risk for specific diseases. On the other hand, overindulging can have detrimental consequences like anxiety, insomnia and stomach problems. The sensitivity to caffeine and reaction might differ greatly, depending on a person's inheritance, overall wellness and other variables. People should therefore evaluate their own sensitivities and modify their coffee consumption accordingly. Overall, caffeine may be a secure and enjoyable component of a healthy lifestyle when taken carefully.

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