

# Caffeine Consumption and Anxiety: The Role of Individual Differences

Leah Torres-Springer  
ltorresspringer@gmail.com

## ABSTRACT

Caffeine is consumed by over 80% of U.S. adults (McLellan et al., 2016). This paper examines the effects on anxiety that remain individualized and highly complex. This review examines the relationship between caffeine and anxiety symptoms, specifically on dose-dependent impacts and biological factors. Caffeine blocks adenosine receptors, activating stress pathways and elevating cortisol levels. Although low doses of caffeine can increase alertness and cognitive benefits, higher doses could increase anxiety-like symptoms. Individuals with pre-existing anxiety disorders and certain individuals who are genetically susceptible experience a stronger stress response to caffeine consumption. Caffeine's effects are often generalized among populations and should alternatively be understood through a lens of individualized vulnerability and dose-dependent response. Clinically, the generalization of caffeine intake undermines the significance of personal caffeine consumption and the consideration of caffeine as a substantial factor in anxiety-like behavior.

## INTRODUCTION

Caffeine is a naturally occurring stimulant. It is one of the most commonly consumed psychoactive substances in the world and is naturally found in the seeds, beans, and leaves of more than 60 plant species, including coffee beans, tea leaves, etc. These species are primarily grown in Africa, South America, and Asia (Volk et al., 2013). Today, caffeine is consumed through coffee, energy drinks, and sodas, although it is also present in tea, chocolate, and some medications. Caffeine is regularly consumed by people of all ages in order to increase alertness and reduce fatigue.

Caffeine stimulates the central nervous system by blocking adenosine receptors, which leads to improved focus and increased alertness. These effects are viewed as beneficial, however, caffeine can also produce negative side effects, especially when consumed by individuals who are more sensitive or have different reactions to its effects (Reddy et al., 2024). Anxiety is one of the effects, it is a psychological and physiological response that includes feelings of nervousness, increased heart rate, and increased arousal. For some individuals, caffeine can intensify these symptoms by overstimulating the nervous system and increasing stress responses. The purpose of this research review is to examine how caffeine consumption

April 2026  
Vol 6, No 1.

can increase anxiety in some individuals more than others. By using these databases to explore individual differences such as sensitivity, dosage, frequency of consumption, and demographic factors as well, the goal is to better understand why caffeine-induced anxiety varies across populations and individuals and to call attention to potential risks associated with excessive or sensitive caffeine consumption. Especially given widespread caffeine consumption today, understanding these variations is crucial for safer and more personalized consumption habits as well as clinical recommendations.

## **METHODS**

The research method I am using is a literature review. Academic databases such as ScienceDirect, Google Scholar, and PubMed will be used to locate journal articles relevant to the research focus. The selected data will be chosen based on its contribution to my topic and its credibility.

## **BACKGROUND INFORMATION: THE RELATIONSHIP BETWEEN CAFFEINE AND ANXIETY**

Caffeine is a naturally occurring, commonly consumed stimulant that affects the central nervous system. Caffeine enhances alertness and physiological arousal by activating neural activity and blocking the adenosine receptors in the brain that typically promote relaxation. Caffeine acts as an adenosine receptor antagonist, increasing neuron firing and releasing the stimulating neurotransmitters. Caffeine has been purported to have anxiogenic and panicogenic properties, specifically salient in patients with panic disorder (PD) (Klevebrant & Frick, 2022). This indicates caffeine's stimulatory effects are believed to trigger anxiety and panic attacks. Caffeine's impact on brain chemistry and physiological arousal interacts with the nervous system in complex ways in people diagnosed with anxiety disorders. Particularly at higher doses, caffeine consumers experience physical responses that reflect its stimulant effects. These may include nervousness, accelerated heartbeat, restlessness, jitteriness, gastrointestinal discomfort (Klevebrant & Frick, 2022), sleep difficulties, and impaired memory retention as part of the body's increased arousal reaction to caffeine. Sensitivity to caffeine varies among individuals and can be influenced by genetic factors and tolerance levels. Anxiety symptoms can range from mild to severe. Additionally, some individuals can withstand moderate to high intake of caffeine with minimal effects, while others can experience caffeine symptoms at lower doses. Typical anxiety symptoms can include restlessness, difficulty focusing, muscle tension, and increased heart rate, indicating the activation of the body's stress response mechanisms (Bandelow et al., 2021). These physical sensations represent the body's natural "fight or flight" response.

### **How Caffeine Can Increase Feelings of Stress or Nervousness**

Caffeine acts as a central nervous system stimulant. "Restlessness, fatigue, irritability, difficulty concentrating, muscle tension, sleep disturbance, or autonomic arousal (increased heart rate)" Bekker & van Mens-Verhulst, 2007) are all physical effects that mimic anxiety symptoms. Symptoms of stress-like

April 2026  
Vol 6, No 1.

behavior occur because caffeine acts as an adenosine receptor antagonist; it binds reversibly to both receptors with strong affinity (Klevebrant & Frick, 2022).

### **Connection Between High Caffeine Intake and Anxiety Symptoms and Differences Between Small and Large Amounts of Caffeine**

Caffeine increases arousal in a dose-dependent manner; low doses can improve hedonic tone and may reduce anxiety, while high doses increase tension and symptoms of anxiety, nervousness, and jitteriness. However, how caffeine affects performance depends in part on the arousal level of the individuals under investigation, especially the extent to which subjects are sleep-deprived or fatigued versus well-rested (McLellan et al., 2016). In terms of performance, including mental alertness, there is an empirical relationship between arousal and performance, such that low arousal is associated with poor performance, whereas increased physiological or mental arousal is associated with improved performance, but only up to a point. When arousal level becomes too high, performance decreases.

In terms of dose specificity in high caffeine intake in relation to anxiety symptoms, in healthy individuals, moderate doses of caffeine (100–300 mg) have positive effects on mood, vigilance and learning, whereas higher doses (>400 mg) may induce anxiety (Klevebrant & Frick, 2022).

## **RESULTS**

### **The Most Susceptible Population to Caffeine and Anxiety**

#### **People With Existing Anxiety**

Individuals with existing anxiety disorders, more specifically panic disorders, have been proven to experience more intense and severe anxiety symptoms as a result of caffeine administration. PD or panic disorder is diagnosed by the appearance of attacks unexpectedly on a regular basis, resulting in anticipatory fear of further episodes, and alternatively, a significant change in behavior. Besides the vulnerability to experience spontaneous panic attacks, patients with PD show an increased sensitivity to several external triggers, including anxiety-provoking situations in which earlier panic attacks may have occurred (Klevebrant & Frick, 2022). Based on these findings, caffeine is a trigger of anxiety in this population, rather than a cause. Caffeine acts as an amplifier for stress-response in individuals with an existing anxiety disorder, which demonstrates how even moderate caffeine intake has clinical relevance.

#### **Teens and Young Adults**

Often for teens and young adults, caffeine is used for social and experimental reasons. Children and adolescents consume caffeine in soft drinks (such as energy drinks) and chocolate, and less frequently in tea and coffee drinks. These adolescents were expected to experience both withdrawal symptoms and increased performance. However, habitual caffeine use in young consumers has been associated with headaches, anxiety, impaired sleep, daytime sleepiness, and juvenile depression (Costa et al., 2014).

There is a relationship between anxiety and caffeine consumption occurring during early life. Adolescent caffeine consumption is an environmental factor that may increase the risk of developing neuropsychiatric conditions such as anxiety. Multiple studies support this notion, such as a recent study reporting that higher levels of caffeine intake in children in the United Kingdom were associated with an increased risk of anxiety. Similarly, rats administered acute caffeine also display increased anxiety while consuming caffeine during adolescence (O'Neill et al., 2016). Therefore, there is sufficient evidence suggesting that caffeine consumption can influence anxiety in both adolescents and adults, although there are still implications suggesting the need for studies analyzing and confirming the long-term effects of chronic adolescent caffeine consumption on anxiety-related behaviors. Understanding that early-life caffeine consumption could also play a part in long-term vulnerability to anxiety-related disorders indicates how adolescence may be a significant developmental period for caffeine exposure. Additionally, behavioral aspects of caffeine consumption such as experimental use and social consumption factors can further increase risk, emphasizing the importance of closely monitoring caffeine intake during early development stages of life.

### **People Who Rarely Consume Caffeine**

Non-habitual (low-caffeine-intake) individuals can respond and behave differently than habitual consumers at regular or higher doses. Non-habitual consumers might have a stronger psychological and physical response to a fixed dose of caffeine, as they lack the tolerance that regular consumers have.

The highest dose of caffeine produces the greatest increase in cortisol, a hormone associated with stress. However, greater cortisol release at the highest dose is highest with non-habitual consumers given moderate or high doses of caffeine compared to habitual consumers (Mahoney et al., 2011). Therefore, non-habitual consumers experience greater increases in heart rate and alertness, as well as tension and nervousness, when cortisol levels rise. Individuals with lower tolerance are more vulnerable and can interpret these sensations more intensely compared to habitual consumers of caffeine. Habitual exposure to caffeine plays a significant part in moderating caffeine's impact on anxiety. A high tolerance to caffeine acts as a protective mechanism that weakens caffeine's effects on anxiety over time. Monitoring consumption patterns plays a crucial role in especially infrequent caffeine consumers who may be more vulnerable to anxiety symptoms even at moderate to low doses of caffeine.

### **Biological and Behavioral Factors that Influence Sensitivity to Caffeine-Induced Anxiety**

#### **Genetics (How Fast the Body Breaks Down Caffeine)**

Caffeine sensitivity varies with genetic differences, particularly those in genes involved in caffeine metabolism and brain receptor responses. The liver enzyme that is responsible for breaking down around 95% of caffeine in the body is CYP1A2. The CYP1A2 gene variations are concluded based on if an individual is a slow or fast metabolizer (Cornelis et al., 2007). A slower metabolizer breaks down caffeine more slowly, leading to caffeine staying in the system longer and longer-lasting effects such as sleep difficulty and anxiety. Additionally, variations in the gene ADORA2A, codes for the adenosine receptors in the brain. The gene influences an individual's sensitivity in terms of the stimulating impacts of caffeine in the body (Gajewska et al., 2013). Individuals with the ADORA2A variant are more likely to present

April 2026  
Vol 6, No 1.

anxiety-like behavioral responses post-caffeine consumption, which suggests that an identical caffeine dose could lead to different outcomes among individuals. Genetic variability plays a key role in identifying the individual differences in caffeine's impact. Caffeine sensitivity is not solely determined by factors such as dosage, but by biological differences. As a result of how caffeine intake can produce different outcomes because of variations in genes responsible for caffeine metabolism and receptor activity, a personalized approach to understanding individual differences in caffeine-related anxiety is reinforced.

### **Body Size and Age**

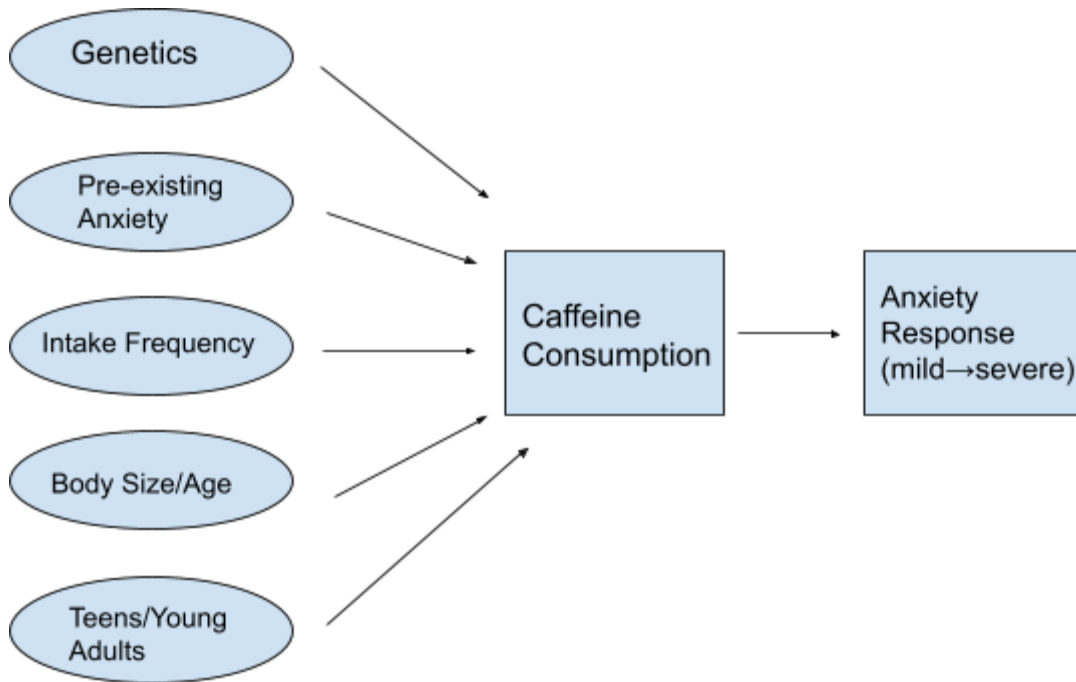
The physiological effects of caffeine on individuals depend on and are expressed relative to body mass (mg/kg). Individuals with a lower body mass present a higher systemic exposure when consuming the same dose as individuals with less body mass. Individuals with a higher body mass might experience more intense central nervous system stimulation and cardiovascular effects (Ehlers et al., 2019).

Age-dependent differences in caffeine sensitivity arise from metabolic and developmental shifts

The caffeine half-life, in which half the consumed amount of caffeine remains in the system after a certain time, differs across lifespan. Older adults, adolescents, and children demonstrate differences in pharmacokinetics in comparison to healthy young adults. For example, adolescents may exhibit different neurobiological sensitivities as they navigate emotional regulation and responses to stress. On the other hand, older adults display a slower caffeine clearance, sleep disturbances or difficulty, physiological arousal in the form of nervousness, tachycardia, etc, and a longer systemic exposure (Wikoff et al., 2017). The differences in caffeine's impacts on individuals based on age related variations explain the heterogeneity in the anxiety response and stress reactivity. These findings indicate that, as opposed to a fixed amount, caffeine intake should be tailored to individual physiological characteristics.

### **How Often Caffeine is Consumed**

The habitual consumption of caffeine can alter sensitivity through neuroadaptive mechanisms. Repeated exposure to caffeine develops pharmacodynamic tolerance by increasing adenosine receptor signaling and altering neurotransmitter pathways. In a 2011 study, non-habitual consumers of caffeine presented a reduced cerebral blood flow when exposed to a 75 mg dose of caffeine, whereas the habitual consumers exhibited a weaker response. This tolerance suggests that habitual users demonstrate less cerebral blood flow and fewer jitters than infrequent users, as the body adapts to maintain baseline alertness despite the chronic adenosine blockade (Kennedy & Haskell, 2011). The physiological response in non-habitual consumers reveals greater acute sensitivity when tolerance is absent. Individuals who do not consume caffeine on a daily basis lack the adaptive mechanisms and have a reduced subjective and vascular responsiveness. Frequency of caffeine consumption is a crucial factor in determining the intensity of caffeine-induced anxiety, while also reinforcing how caffeine's contrasting impacts are shaped both by biological and behavioral factors.



**Figure 1:** Conceptual Model of Individual Differences in Caffeine-Induced Anxiety Responses

## DISCUSSION

Caffeine overall increases anxiety, however its impacts are individualized and dose-dependent. Research suggests that caffeine sensitivity varies based on physiological, behavioral, and genetic factors. The individual differences are crucial to understanding whether caffeine leads to mild alertness or anxiety-like symptoms. They determine the risk as well, from a clinical perspective. For example, even moderate doses of caffeine can lead to anxiety-like behavior or stress due to heightened sensitivity. Similarly, individuals who are not diagnosed with anxiety disorders can experience mild but present stimulation. Variability is critical for providing recommendations in the clinical setting. Individual differences are important to debunk the misconception that caffeine simply causes anxiety, for it in fact interacts with an individual's existing neurobiological factors.

### Real-World Implications

Individual differences can influence and direct people in terms of how caffeine consumption should be managed in public health. The practical strategies to support safe caffeine use include: Avoiding high doses in a short amount of time, in particular for non-habitual consumers, limiting caffeine intake later in the day to prevent sleep difficulty, monitoring daily intake from all caffeine sources such as energy drinks and tea, and improving (reducing) caffeine intake gradually to avoid increased tension and irritability. Identifying individuals' personal limits is important to recognize. Personal limits are created by

identifying tolerance thresholds, psychological vulnerabilities, metabolic factors, and more. More simply, self-awareness encourages individuals to overstimulate one's physiological tolerance.

### **Limitations**

An important limitation is that the literature used to identify caffeine's individual effects includes many adult populations, which may limit the generalizability of the findings. These findings might not be able to relate to adolescents, given that they are still experiencing ongoing neurodevelopment. Secondly, the reliance on self-reported caffeine intake is present in study participants, meaning they may not accurately record data of caffeine exposure effects. This subjective reporting could lead to inconsistent or inaccurate findings. Lastly, numerous studies examine the short-term effects of caffeine exposure, whereas the long-term effects of caffeine use are less well studied. Long-term research could be important for examining how tolerance interacts with stress over time, or how early exposure in adolescents translates into future neurobiological effects.

An additional challenge is studying caffeine intake in isolation. Most people, particularly adults, do not solely consume caffeine. Instead, they are exposed to other psychoactive substances like alcohol and nicotine as well. Both substances affect the central nervous system and anxiety regulation. Attributing anxiety symptoms specifically to caffeine is difficult when studying caffeine intake, therefore isolating caffeine's independent contribution is complex.

### **Future Directions**

Future research in the effects of caffeine consumption should aim to include more diverse populations. Groups of individuals with varying health backgrounds other than pre-existing anxiety could be incorporated to improve the applicability in additional settings. Objective measures of caffeine consumption, as opposed to self-reported data, would help enhance the reliability of the results.

Longitudinal studies, examining the long-term effects of caffeine intake during adolescence, would be particularly helpful in improving our understanding of how early life exposure to caffeine consumption could influence caffeine's impacts on individuals. Longitudinal studies involve the ability to separate long-term outcomes from acute effects of specifically chronic caffeine use caffeine, which can be helpful in analyzing the developmental influence on adolescents, tolerance and adaptation, and overall cognitive trajectories over time.

## **CONCLUSION**

Evidence proves that caffeine has the ability to heighten anxiety in individuals, more specifically at higher doses. The process in which caffeine increases arousal involves caffeine stimulating the central nervous system, blocking the adenosine receptors, activating the stress response system, and elevating cortisol levels. High doses of caffeine are likely to produce symptoms such as restlessness and nervousness. Additionally, caffeine has the potential to increase anxiety in susceptible individuals. Findings suggest that individuals with existing anxiety disorders such as panic disorder, are more vulnerable to caffeine.

April 2026

Vol 6. No 1.

The central point is that caffeine's responses are individualized. One difference is how caffeine affects the brain and body differently for individuals due to genetic differences, such as weight, age, and metabolism. The differences are helpful in identifying why caffeine findings can be mixed and why it should not be categorized as universally harmful.

Understanding how caffeine impacts the brain and body, and the individual differences, is crucial for making informed choices about caffeine consumption in day-to-day life. Recognizing individualized vulnerability in terms of mood and physiological state and monitoring dosages can reduce the intensity or likelihood of anxiety-like symptoms. Gaining awareness of appropriate caffeine intake can help consumers balance the cognitive benefits against the risks to mental stability and health.

## REFERENCES

- Bandelow, B., Michaelis, S., & Wedekind, D. (2021). Anxiety disorders. *The Lancet*, 397(10282), 914–927.
- Bekker, M. H. J., & van Mens-Verhulst, J. (2007). Anxiety disorders: Sex differences in prevalence, degree, and background, but gender-neutral treatment. *Gender Medicine*, 4(Suppl. 2), S178–S193.
- Cornelis, M. C., El-Sohemy, A., & Campos, H. (2007). Genetic polymorphism of the adenosine A2A receptor is associated with habitual caffeine consumption. *The American Journal of Clinical Nutrition*, 86(1), 240–244.
- Costa, B. M., Hayley, A., & Miller, P. (2014). Young adolescents' perceptions, patterns, and contexts of energy drink use: A focus group study. *Appetite*, 80, 183–189.
- Ehlers, A., Marakis, G., Lampen, A., & Hirsch-Ernst, K. I. (2019). Risk assessment of energy drinks with focus on cardiovascular parameters and energy drink consumption in Europe. *Food and Chemical Toxicology*, 130, 109–121.
- Gajewska, A., Blumenthal, T. D., Winter, B., Herrmann, M. J., Conzelmann, A., Mühlberger, A., & Domschke, K. (2013). Effects of ADORA2A gene variation and caffeine on prepulse inhibition: A multi-level risk model of anxiety. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, 40, 115–121.
- Kennedy, D. O., & Haskell, C. F. (2011). Cerebral blood flow and behavioural effects of caffeine in habitual and non-habitual consumers of caffeine: A near infrared spectroscopy study. *Biological Psychology*, 86(3), 298–306.
- Klevebrant, C., & Frick, A. (2022). Effects of caffeine on anxiety and panic attacks in patients with panic disorder: A systematic review and meta-analysis. *Journal of Affective Disorders*, 309, 414–420.
- Mahoney, C. R., Brunyé, T. T., Giles, G. E., Lieberman, H. R., & Taylor, H. A. (2011). Caffeine-induced physiological arousal accentuates global processing biases. *Pharmacology, Biochemistry and Behavior*, 99(1), 59–65.
- McLellan, T. M., Caldwell, J. A., & Lieberman, H. R. (2016). A review of caffeine's effects on cognitive, physical and occupational performance. *Neuroscience & Biobehavioral Reviews*, 71, 294–312. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0149763416300690>

April 2026

Vol 6. No 1.

- Meamar, M., Raise-Abdollahi, P., Rashidy-Pour, A., & Raeis-Abdollahi, E. (2024). Coffee and mental disorders: How caffeine affects anxiety and depression. In *Progress in Brain Research* (Vol. 288, pp. 115–132). Retrieved from <https://www.sciencedirect.com/science/article/pii/S0079612324001110>
- O'Neill, C. E., Newsom, R. J., Stafford, J., Scott, T., Archuleta, S., & Levenson, C. W. (2016). Adolescent caffeine consumption increases adulthood anxiety-related behavior and modifies neuroendocrine signaling. *Psychoneuroendocrinology*, 67, 40–50.
- Reddy, V. S., Shiva, S., Manikantan, S., & Ramakrishna, S. (2024). Pharmacology of caffeine and its effects on the human body. *European Journal of Medicinal Chemistry Reports*, 10, 100138. Retrieved from <https://www.sciencedirect.com/science/article/pii/S2772417424000104>
- Wikoff, D., Welsh, B. T., Henderson, R., Brorby, G. P., Britt, J., Myers, E., & Doepker, C. (2017). Systematic review of the potential adverse effects of caffeine consumption in healthy adults, pregnant women, adolescents, and children. *Food and Chemical Toxicology*, 109(Part 1), 585–648.