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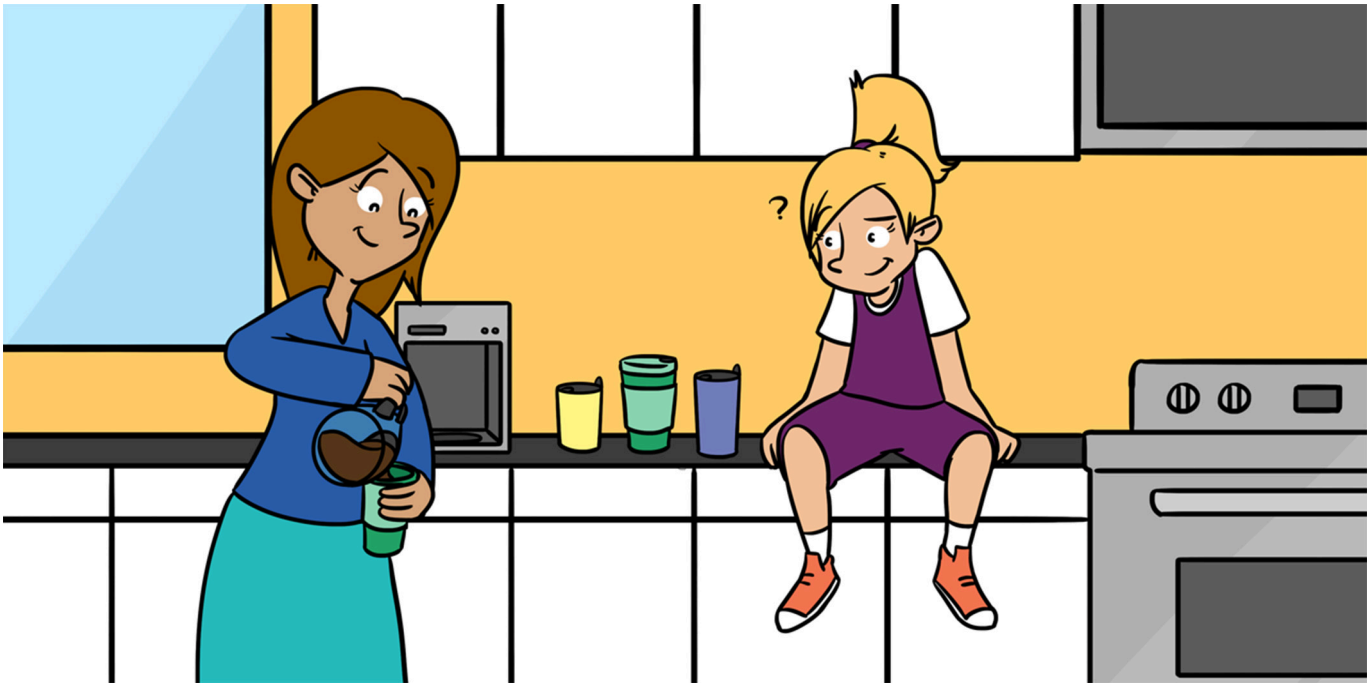

COFFEE: IS IT A FRIEND OR A FOE?

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Coffee is not only one of the most consumed drinks in the world, it is also one of the most addicting. Coffee is complex—it is made up of many substances. One of coffee's components is of special interest to the scientific community: caffeine. Caffeine has several important effects on the body, and these effects differ whether caffeine is taken once in a while or regularly. Also, it has been shown in both animal studies and in humans that, if caffeine is consumed regularly, it might affect several diseases, including diseases of the heart and metabolism.

COFFEE AND ITS COMPOUNDS

Everyone knows how to prepare coffee: pour boiling water onto roasted, ground up coffee beans and brew them. Although it has a bitter taste, coffee is one of the most consumed drinks in the world and an adult favorite. If it is bitter, why do people love it so much? The answer is simple: coffee is a natural stimulant, which means it gives people an energy boost to get them through the day.

Coffee contains a variety of substances such as fats, proteins, and sugars. This makes it a rich substance with many different effects on our bodies. One of coffee's best-known ingredients is caffeine, which is responsible for the energy boost we get from drinking this beverage [1]. But caffeine is not present in just coffee—it is contained in other things we eat and drink as well.

HOW AND WHERE DO WE CONSUME CAFFEINE?

Chocolate, sodas, and green and black tea are examples of foods or drinks that contain caffeine (Figure 1). What about the many different types of coffees—are they all the same? Coffee that is brewed in a coffee pot like you might have in your home has about 57 mg of caffeine per 1.8 g of grounded beans. Espresso, made by specific machines and often sold in coffee shops, has between 40 and 75 mg of caffeine in 30 ml of coffee. Decaf coffee has the least caffeine, with about 3 mg per 150 ml. To make decaf coffee, the beans undergo treatments to remove the caffeine [2]. Since it has low amounts of caffeine, decaf is often thought to be the best for human health. But, as you will soon learn, this might not be the case.

Figure 1

Amounts of caffeine in various food products. One coffee bean represents 6 mg of caffeine. A cup of coffee has about 90 mg of caffeine, while a cup of tea has about 45 mg. A 44 g piece of milk chocolate has ~10 mg of caffeine. A typical soda contains 35 mg of caffeine.

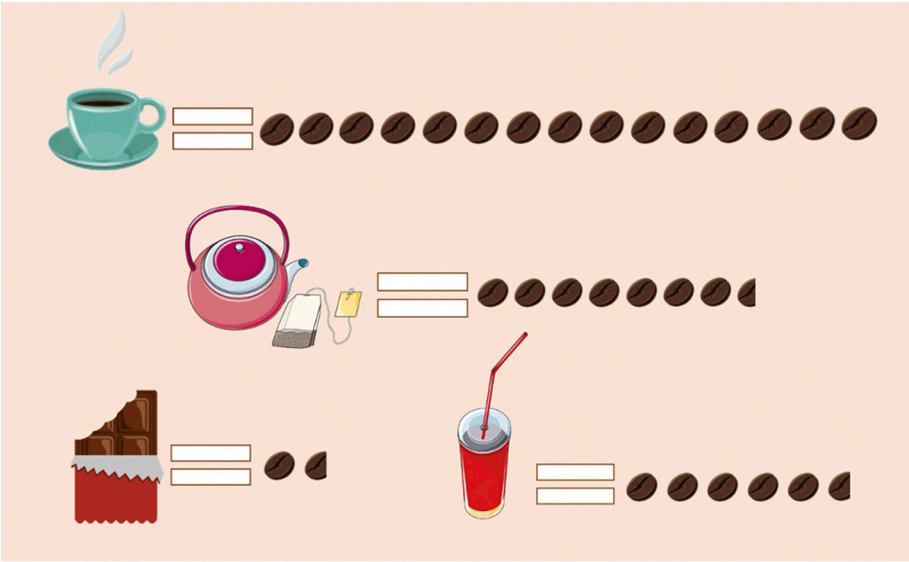

Figure 1

COFFEE IN CARDIOMETABOLIC DISEASES

CARDIOMETABOLIC DISEASES

Diseases that affect the reactions within our cells that use the nutrients from the food to produce energy and make all our organs function.

Have you ever heard of **cardiometabolic diseases**? These are diseases that affect the reactions within our cells that use the nutrients from the food to produce energy and make all our organs functioning. Diabetes, high blood pressure, and obesity are well-known examples of cardiometabolic diseases. Type 2 diabetes results in increased levels of sugar (glucose) in the blood. Normally, a hormone called insulin

keeps blood sugar low because it helps glucose to enter into the body's cells, but in type 2 diabetes, the cells do not respond to insulin, resulting in a state called **insulin resistance**. High blood pressure happens when the force exerted by the blood on the walls of the arteries is high. Obesity is the presence of an excessive amount of fat in the body. These three diseases are the result of changes in the body's **metabolism**, meaning changes in the reactions using nutrients from food. Later in life, these diseases can lead to other negative health effects, like strokes and heart attacks.

INSULIN RESISTANCE

State in which cells from insulin-sensitive tissues do not respond correctly to insulin.

METABOLISM

Reactions using nutrients from food.

For a long time, scientists have debated the effects of coffee in people who have cardiometabolic diseases. At first, coffee was believed to have negative consequences for these diseases, but recent studies show that this might be a myth.

WHAT DOES CAFFEINE DO IN THE BODY?

After ingestion, caffeine is absorbed by the digestive system, circulates in the blood, and ends its journey in the liver. It interacts with the body in many ways and in various tissues (Figure 2). Caffeine acts by inhibiting **adenosine receptors**, which are molecules on the surfaces of cells that bind to a substance called adenosine. What is **adenosine**? It is a molecule involved in cell-to-cell conversations and in the production of energy. Adenosine has several functions, including the regulation of blood sugar levels. Because caffeine is similar to adenosine, it also sticks to the adenosine receptor. This means that fewer adenosine receptors will be available to bind to adenosine. Think of it as a game of musical chairs—the receptor is the only chair and caffeine and adenosine are the players that want the coveted spot. When adenosine loses the "game," the activity of adenosine in the body decreases and the activity of caffeine increases. Caffeine intake activates the **sympathetic nervous system** (SNS), which is the part of the nervous system that controls some of our unconscious actions. One of these actions is the "fight-or-flight" response. By activating the SNS, caffeine increases the body's production of a hormone called **adrenaline**, which sends a message to the body to stay awake and alert and to feel less bored.

ADENOSINE RECEPTORS

Molecules on the surfaces of cells, to which adenosine binds to exert its function.

ADENOSINE

A molecule involved in cell-to-cell conversations and in the production of energy.

SYMPATHETIC NERVOUS SYSTEM

The part of the nervous system that controls some of our unconscious actions.

ADRENALINE

Hormone that sends messages to the body to stay awake and alert and to feel less bored.

The best way to define caffeine is as a double-edged sword. On one side, we have the effects of occasional consumption—consuming caffeine once in a while—and, on the other, the effects of regular consumption—consuming caffeine on a daily basis. When we drink a cup of coffee once in a while, caffeine has a negative impact on the body. The SNS becomes activated, which leads to an increase in insulin resistance. The sugar present in the blood will not be able to enter the cells, which increases blood sugar levels. Due to this fact, for many years scientists and medical doctors believed that caffeine was bad for patients with cardiometabolic diseases [3].

Figure 2

Caffeine operates on multiple systems in the body including (clockwise from top) the heart, muscles, fat, liver, and brain.

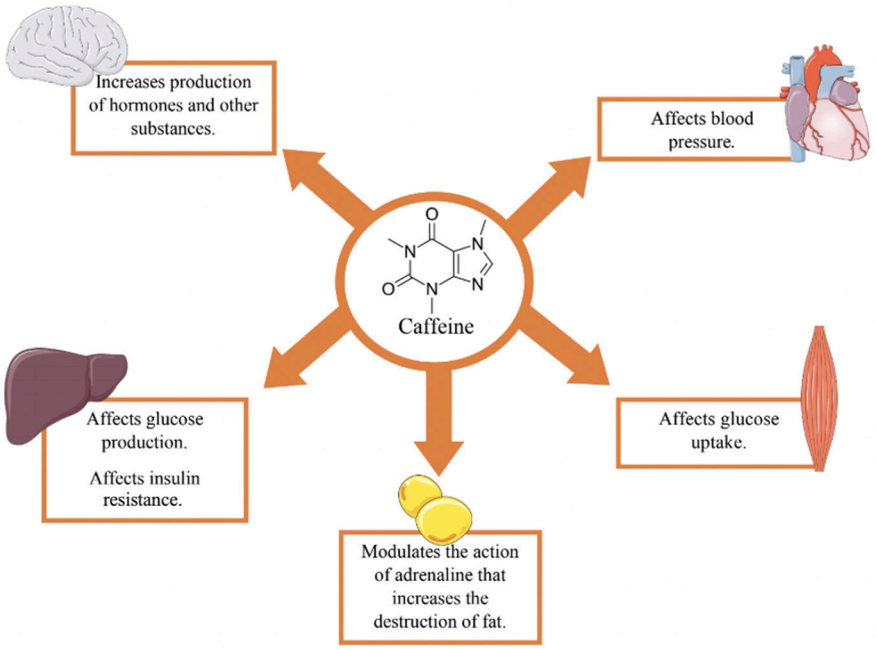

Figure 2

When we talk about regular caffeine consumption, we may see the opposite happening. When there is a regular intake of caffeine, the body gets used to it. Since caffeine and adenosine compete for the same receptors, the number of adenosine receptors in the body increases. In fact, coffee consumption may be beneficial for people with diabetes. Regular coffee consumption can decrease insulin resistance and lower blood sugar levels [2].

People with heart and blood circulation problems are commonly advised to limit caffeine intake. This advice is based on studies showing that caffeine can increase blood pressure. But several studies show the opposite effect, indicating that high coffee consumption, equivalent to around 4–5 coffees per day for at least 2 weeks, can lead to some protection against heart and circulation diseases [4].

Last, obesity is one of the major health problems of this century. Doctors strongly warn patients to limit how much and what kinds of foods they eat. Scientists do not understand why yet, but some studies show that caffeine intake reduces the amount of fat in the body [1].

DOES CAFFEINE BURN FAT?

How does caffeine burn body fat and decrease obesity and other cardiometabolic diseases? There are several theories. One theory says that caffeine increases adrenaline production, which increases

alertness and promotes weight loss. In the body, adrenaline increases the destruction of fat through a process called lipolysis [4]. Another theory involves the role of "good fat," called brown adipose tissue. This good fat helps to eliminate the "bad fat," called white adipose tissue. A study from the University of Nottingham showed that, after drinking coffee, metabolism accelerates due to activation of good fat, the brown fat, and the body releases more energy in the form of heat [5].

CAN CAFFEINE HELP CARDIOMETABOLIC DISEASES?

Studies have also shown that adenosine regulates insulin production and decreases insulin resistance, which helps glucose to enter the cells [3]. One lab studied the effects of caffeine in cardiometabolic diseases in rats. Rats ate a diet with high amounts of fat and sugar, until they developed insulin resistance and high blood pressure. Caffeine treatment reversed the insulin resistance [3].

VASODILATION

The widening of blood vessels.

Long-term caffeine intake can increase **vasodilatation**, which is the widening of blood vessels This means that caffeine might be useful as treatment to lower blood pressure [4, 6]. Vasodilation can also decrease insulin resistance because, when vasodilation increases, more insulin will reach the organs, which promotes the entry of glucose into cells. Also, in a study on old rats, caffeine did not increase the rats' blood pressure. Several studies were also carried out in humans, showing that high caffeine intake may *not* increase the risk of high blood pressure [4]. All of these studies show that long-term caffeine intake will benefit the treatment of cardiometabolic diseases.

CONCLUSION

So, is caffeine a friend or foe when it comes to cardiometabolic diseases? This is still an open question—caffeine can be an ally or an enemy, depending on a variety of factors that should be evaluated for each person, with the help of a doctor. Several studies are currently being done to learn more about what caffeine does to the body and the best way to consume it. Based on the most relevant studies, we can say that regular coffee consumption might have more good effects than bad effects, but exactly how caffeine circulates through the body and how it impacts metabolism are still not completely understood. One thing is for certain: understanding the effects of caffeine is a topic that still needs to be studied in more depth.

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I enjoy playing many sports, especially soccer. I like hanging out with my family/friends. The school subjects that I like the most are math, art, and social studies. I love watching "Full House." My favorite color is teal blue.

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