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A REVIEW OF RECENT HUMAN RESEARCH ON COFFEE AND HEALTH

Dr. Piyush Khajuria*

*Assistant Professor,
Department of General Medicine, Faculty of Medicine,
Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, INDIA
Email id: khajuriapiyush@gmail.com

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ABSTRACT

Coffee is a complicated chemical combination that contains high levels of chlorogenic acid and caffeine. Unfiltered coffee has a lot of cafestol and kahweol, two diterpenes that have been linked to coffee's cholesterol-raising effects. Coffee intake may help avoid many chronic illnesses, including type 2 diabetes, Parkinson's disease, and liver disease, according to epidemiological studies (cirrhosis and hepatocellular carcinoma). Coffee intake has not been linked to an elevated risk of cardiovascular disease in the majority of prospective cohort studies. Coffee intake, on the other hand, has been linked to an increase in many cardiovascular disease risk variables, such as blood pressure and plasma homocysteine. There is currently minimal evidence that coffee drinking raises cancer risk. There is minimal evidence of health hazards and some evidence of health benefits for people who drink moderate quantities of coffee (3–4 cups per day, giving 300–400 mg of caffeine). People with hypertension, children, teenagers, and the elderly, for example, may be more susceptible to the negative effects of caffeine. Furthermore, recent research indicates that pregnant women should restrict their coffee intake to three cups per day, with no more than 300 mg of caffeine per day, to avoid any increased risk of spontaneous abortion or fetal development.

KEYWORDS: *Caffeine, Type 2 Diabetes, Parkinson's disease, Liver Disease, Cardiovascular Disease, Pregnancy.*

1. INTRODUCTION

Coffee is a beverage made from ground, roasted coffee beans that is said to be one of the most commonly consumed drinks on the planet. Coffee's popularity is largely due to its caffeine concentration, which is praised for its fragrance and taste. Coffee, in reality, is a complex chemical combination containing over a thousand distinct components, including carbohydrates, lipids, nitrogenous substances, vitamins, minerals, alkaloids, and phenolic compounds, according to reports. The bulk of human research on the health consequences of coffee intake are observational in nature. Concerns regarding the health hazards of coffee and caffeine use highlighted by epidemiological studies in the past were likely amplified by links between excessive coffee consumption and harmful habits like cigarette smoking and inactivity. Coffee intake has lately been linked to a lower risk of developing a number of chronic illnesses[1], [2].Conflicting results and methodological problems have made it difficult for health experts and the general public to understand the existing data on coffee intake and health in many instances.

The goal of this article is to examine and understand current studies on the advantages and disadvantages of coffee intake in humans.

1.1. Compounds in Coffee that May Affect Human Health:

1.1.1. Caffeine:

Caffeine (1,3,7-trimethylxanthine), a purine alkaloid found in coffee beans, is a purine alkaloid. Caffeine seems to exert the majority of its biological effects at levels associated with coffee consumption via antagonizing the A1 and A2A subtypes of the adenosine receptor. Adenosine is an endogenous neuromodulator with mostly inhibitory effects, while caffeine's antagonism of adenosine produces stimulatory effects. Central nervous system stimulation, abrupt rise in blood pressure, higher metabolic rate, and diuresis are some of the physiological consequences of caffeine consumption. Caffeine is quickly and almost fully absorbed in the stomach and small intestine and transported throughout the body, including the brain. Caffeine metabolism takes place mainly in the liver, where the cyto chrome P450 is form CYP1A2 is responsible for almost 95% of the primary metabolism of caffeine. The 3-demethylation of caffeine mediated by CYP1A2 leads in the production of 1,7-dimethylxanthine (paraxanthine). CYP1A2 may demethylate paraxanthine to produce 1-methylxanthine, which can then be oxidized to 1-methyluric acid by xanthine oxidase. Alternatively, paraxanthine may be hydroxylated by CYP2A6 to produce 1,7-dimethyluric acid, or acetylated by N-acetyltransferase 2 (NAT2) to form 5-acetylamino-6-formylamino-3-methyluracil, an unstable molecule that can be deform lated non enzymatically to form 5-acetylamino-6-amino-3-methylura[3], [4].Caffeine levels in coffee drinks may vary significantly. Caffeine content in 8 oz. (240 ml) of brewed coffee varied between 72–130 mg, according to a recent study of 14 distinct specialty coffees bought from coffee shops in the United States. Caffeine content in espresso coffees varied from 58 to 76 mg per shot. On six different days, the caffeine level of the same kind of coffee bought from the same shop ranged from 130 to 282 mg per 8-oz cup.

1.1.2. Cafestol and Kahweol:

In certain observational studies, coffee intake has been linked to increased blood total and LDL cholesterol values, but not in others. The finding that the positive relationship between coffee consumption and serum cholesterol was more consistent in Scandinavia, where boiled coffee was more popular at the time, than in other European countries and the United States, where filtered coffee was more popular, led to the hypothesis that the brewing method was critical to coffee's cholesterol-raising effect. 12 A meta-analysis of 14 randomized controlled trials looking at the effect of coffee consumption on serum cholesterol concentrations found that drinking boiled coffee increased serum total and LDL cholesterol concentrations in a dose-dependent manner, while drinking filtered coffee had very little effect. 13 The diterpenes, cafestol, and kahweol, which were initially identified in coffee oil, were subsequently shown to be the cholesterol-raising agents. These diterpenes are extracted from ground coffee during brewing, but paper filters remove the majority of them. Cafestol and kahweol levels are very high in Scandinavian boiling coffee, Turkish coffee, and French press (cafetiere) coffee (6–12 mg/cup), whereas they are relatively low in filtered coffee, percolated coffee, and instant coffee (0.2–0.6 mg/cup). Although espresso coffee has significant diterpene concentrations, the modest serving size makes it a good source of cafestol and kahweol (4 mg/cup). According to studies in ileostomy patients, approximately 70% of the cafestol and kahweol in unfiltered coffee is absorbed via the intestine.

Although the mechanisms underlying these diterpenes' effects on lipoprotein metabolism are unknown, consumption of cafestol and kahweol in French press coffee has been found to cause persistent increases in cholesterol ester transfer protein (CETP) activity in humans, which may contribute to LDL cholesterol increases. CETP transports cholesteryl esters from HDL to LDL and VLDL, which are apolipoprotein B-containing lipoproteins[5], [6].

1.1.3. Chlorogenic Acid:

Chlorogenic acids are a type of dietary phenols made composed of esters produced by the reaction of quinic and trans-cinnamic acids. 5-O-caffeoylquinic acid, which is still referred to as chlorogenic acid, is the most frequent individual chlorogenic acid. Coffee is the greatest dietary source of chlorogenic acids and cinnamic acids for people who consume it (caffeic acid). The amount of chlorogenic acid in a 200 mL (7 oz) cup of coffee has been estimated to be between 70 and 350 mg, corresponding to 35–175 mg of caffeic acid. According to studies in colostomy patients, approximately 33% of consumed chlorogenic acid and 95% of ingested caffeic acid is absorbed via the intestine.

As a result, approximately two–thirds of the chlorogenic acid consumed enters the colon, where it may be digested by the colonic microbiota. Chlorogenic acid is likely converted to caffeic acid and quinic acid in the colon. The presence of chlorogenic acid bacterial metabolites in the urine indicates that they are absorbed in the colon. Although chlorogenic acid and caffeic acid exhibit antioxidant action in vitro, the amount of antioxidant activity they provide in vivo is unknown since they are extensively degraded, and the metabolites typically have lesser antioxidant activity than the parent molecules[7], [8].

1.1.4. Micronutrients:

Several micronutrients present in coffee, such as magnesium, potassium, niacin, and vitamin E, may play a role in the health benefits associated with coffee intake. According to the USDA Nutrient database, 8 oz (240 ml) of brewed coffee has 7 mg of magnesium, whereas 1 oz (30 ml) of espresso contains mg. In adult males, one cup of coffee may provide 1–5% of the recommended dietary intake (RDA) for magnesium (420 mg/d). An 8-ounce cup of brewed coffee has 116 milligrams of potassium, whereas a 1-ounce shot of espresso contains 34 milligrams, implying that one cup of coffee provides just 1–2% of the adequate intake (AI) for potassium (4700 milligrams per day) in adults. During the roasting process, trigenolline in coffee beans is demethylated to produce nicotinic acid. Coffee is said to contain 1–3 mg of nicotinic acid per cup. In adult males, one cup of coffee may provide 6–18 percent of the RDA for niacin (16 mg/d). One cup of coffee contains approximately 0.2 mg of -tocopherol and 0.2 mg of -tocopherol, or about 0.1 percent of the adult RDA for vitamin E (15 mg/d of RRR-tocopherol)[9], [10].

2. METHODOLOGICAL ISSUES IN EPIDEMIOLOGICAL RESEARCH ON COFFEE

Much of the existing knowledge on the health effects of coffee comes from epidemiological studies. The study of coffee consumption in human populations, on the other hand, presents numerous problems regarding exposure categorization and possible confounders that should be taken into account when interpreting the findings of coffee consumption epidemiological research.

2.1. Exposure Misclassification:

Food frequency surveys, which gather data on the number of cups of coffee drank daily or weekly, are often used to evaluate coffee exposure. Cup size, on the other hand, may vary significantly depending on the population. According to one research in the United States, pregnant women's cup sizes varied from 2–32 oz, with 7-8-oz cups accounting for just 30% of cup sizes utilized. One cup of coffee is often considered to contain 85–100 mg of caffeine in epidemiological research. However, since the caffeine level of various coffees varies so much (see above), it's conceivable that individuals who drink a lot of coffee drink weaker coffee than those who only drink 1–2 cups per day. Until recently, only a few epidemiological studies have gathered data on the coffee brewing procedure. When it was found that paper filters substantially eliminated cholesterol-raising chemicals in coffee, this knowledge became critical. Finally, individual differences in the metabolism of coffee components may enhance or reduce a person's exposure to a bioactive ingredient in coffee. The enzyme NAT2 is involved in the metabolism of caffeine, for example. Individual exposure to caffeine metabolites is believed to be affected by a genetic variation in the NAT2 gene, which results in “fast acetylators” and “slow acetylators” (see Considerations for Future Research below). Furthermore, through increasing CYP1A2 activity, cigarette smoking improves caffeine clearance, and smokers have been shown to have lower caffeine plasma levels than nonsmokers at the same amount of intake. Individual exposure to additional bioactive chemicals in coffee is unknown due to genetic and lifestyle variables.

2.2. Confounders:

Inadequate correction for confounding variables that may affect the connection between coffee intake and health outcomes is a common critique of epidemiological studies on coffee. Because excessive coffee consumption is often linked with cigarette smoking, cigarette smoking is regularly mentioned as a possible confounder. The majority of studies are modified to account for the impact of cigarette smoking. Underreporting of a socially undesirable activity, such as smoking, while correctly reporting a socially neutral behavior, such as coffee drinking, may result in insufficient adjustment for the impact of smoking and overestimation of the effect of coffee consumption on a health outcome. This issue may be especially important in research with pregnant women. Coffee intake and health consequences may be muddled by other lifestyle variables as well. People who drink coffee, for example, are younger, have greater incomes, and are usually healthier than those who drink tea in Scotland. It's possible that this isn't the situation in other nations. In order to establish if a health impact is linked to caffeine or other chemicals in coffee, health outcomes in regular coffee drinkers are occasionally compared to those in decaffeinated coffee drinkers. However, a research of the characteristics of decaffeinated coffee drinkers in the United States found that for some individuals, decaffeinated coffee consumption was linked to a history of disease, while for others, it was linked to a healthy lifestyle. Most epidemiological studies do not differentiate between former caffeinated coffee users who may have converted to decaffeinated coffee due to a health issue and never users who may be avoiding caffeine as part of a healthy lifestyle when assessing health outcomes in decaffeinated coffee users.

3. POTENTIAL HEALTH BENEFITS OF COFFEE CONSUMPTION

3.1 Epidemiological Research:

Six out of nine prospective cohort studies have shown a substantial negative relationship between coffee consumption and the incidence of type 2 diabetic mellitus (DM). A prospective study of over 17,000 Dutch men and women showed that those who drank at least 7 cups of coffee daily had a 50% reduced chance of acquiring type 2 diabetes than those who drank 2 cups or less. In Finland, where coffee consumption is among the highest in the world, a 12-year study found that men who drank at least 10 cups of coffee daily had a 55 percent lower risk of developing type 2 diabetes than men who drank 2 cups or less, and women who drank at least 10 cups daily had a 79 percent lower risk of developing type 2 diabetes. Those who drank at least 7 cups of coffee per day had a 35 percent reduced risk of type 2 diabetes than those who drank 2 cups or less, according to a study of more than 10,000 Finnish twins. In a smaller cohort of Swedish women tracked for 18 years, those who drank at least 3 cups of coffee per day had a 50% reduced risk of type 2 diabetes than those who drank less than 2 cups per day. The Health Professionals Follow-up Study (41,934 men) and the Nurses' Health Study (84,276 women) in the United States were the two biggest prospective cohort studies to investigate the association between coffee intake and type 2 diabetes. Men who drank at least 6 cups of coffee per day had a 54 percent reduced risk of getting type 2 diabetes than men who did not, and women who drank at least 6 cups of coffee per day had a 29 percent lower risk of developing type 2 diabetes than women who did not. Caffeine use was also linked to substantial risk reductions in both groups. In both men and women, a relatively moderate negative relationship between decaffeinated coffee intake and the incidence of type 2 diabetes was seen, indicating that chemicals other than caffeine may have preventive benefits. Tea intake, on the other hand, was not linked to the incidence of type 2 diabetes in either the Dutch or American cohorts.

3.2. Glucose Tolerance and Insulin Sensitivity:

Acute caffeine treatment has been shown in a number of controlled clinical studies to impair glucose tolerance and reduce insulin sensitivity. The effects of coffee intake for 2–4 weeks on blood glucose and insulin levels have been studied in many randomized controlled studies. When healthy participants who normally received 560 mg of caffeine per day from coffee or tea were given just decaffeinated coffee for 14 days, their average fasting blood glucose levels fell substantially. In contrast to decaffeinated coffee, replacing caffeinated coffee at 850 mg/d for 20 days did not substantially raise fasting blood glucose. The effects of coffee intake on blood glucose and insulin levels have recently been investigated in two trials that were initially intended to evaluate the impact of coffee consumption on plasma homocysteine concentrations. Participants who usually drank 5–8 cups of coffee per day were randomly allocated to a 4-week phase in which they had one liter of filtered coffee daily, giving 1100 mg/d of caffeine, or a 4-week period in which they did not drink any coffee. Despite the fact that fasting glucose levels did not vary between the two treatment periods, serum insulin levels rose during the coffee phase, indicating a reduction in insulin sensitivity. In a second crossover study, individuals who usually drank more than 6 cups of coffee per day were given 870 mg/d of caffeine, 900 ml/d of coffee with 870 mg/d of caffeine, or a placebo for two weeks, in that sequence. During the coffee phase, serum insulin levels were non-significantly higher than during the placebo period, but fasting glucose levels did not vary across the three groups.

4. DISCUSSION

In order to assess the health hazards and benefits of coffee and caffeine intake, accurate data on caffeine and other chemicals in coffee must be available. The discovery of biomarkers that correctly reflect the intake of bioactive components in coffee is a crucial tool for researchers looking into the link between coffee consumption and health outcomes. Caffeine metabolite measurements in the blood or urine may be used to determine dietary caffeine intake. The measurement of serum paraxanthine was shown to be helpful for differentiating between different caffeine consumption in a study of pregnant women. Pearson correlation values (0.50–0.53) between self-reported caffeine consumption and blood paraxanthine concentrations were similar to published correlations between cigarette smoking and serum cotinine concentrations in that research. Urinary caffeine metabolites such 1-methylxanthine and 1,7-dimethyluric acid may be used to determine dietary caffeine consumption. 8 Because chlorogenic acid or its metabolites may also play a role in coffee's health benefits, a reliable biomarker for coffee-derived polyphenol consumption would be beneficial. Isoferulic acid, a particular metabolite of dietary caffeic acid derivatives like chlorogenic acid, has been discovered. However, urine isoferulic acid excretion explained less than 7% of the variation in coffee consumption in a recent research, suggesting that it has limited use as a biomarker for coffee-derived polyphenol exposure.

5. CONCLUSION

Coffee is a complicated chemical combination that contains high levels of chlorogenic acid and caffeine. Unfiltered coffee has a lot of cafestol and kahweol, two diterpenes that have been linked to coffee's cholesterol-raising properties. Coffee intake may help avoid many chronic illnesses, including type 2 diabetes, Parkinson's disease, and liver disease, according to epidemiological studies. Coffee intake has been linked to substantial dose-dependent decreases in the risk of acquiring type 2 diabetes in large prospective cohort studies in the Netherlands, the United States, Finland, and Sweden, but the mechanisms remain unknown. Caffeine intake from coffee and other drinks is negatively related with the risk of Parkinson's disease among men and women who have never taken postmenopausal estrogen, according to many large prospective cohort studies. Caffeine's capacity to inhibit adenosine A2A-receptors in the brain may play a role in this protective effect, according to animal research. Coffee intake has also been linked to a lower incidence of liver damage, cirrhosis, and hepatocellular cancer in epidemiological studies, but the causes remain unknown. Inverse correlations between coffee intake and the incidence of colorectal cancer have not been consistently established in prospective cohort studies.

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