











# Association Between Black Tea and Coffee Consumption, Socioeconomic Status, and Digestive Disorders: A Case-Control Study

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## ABSTRACT

This study aimed to explore the relationship between black tea and coffee consumption and the prevalence of digestive system disorders in the Azeri population of East Azerbaijan, Iran, while considering the influence of underlying social and economic conditions. A case-control study involved 186 patients diagnosed with digestive system disorders and 185 healthy controls. Data were collected via questionnaires that assessed demographic factors, black tea and coffee consumption habits, water intake, and socioeconomic status. We used a rapid urease test to detect *Helicobacter pylori* infection in the patients. Statistical analyses were performed using the chi-square test, with a p-value less than 0.05 as statistically significant. Black tea and coffee consumption was significantly higher in the patients than in the healthy controls ( $p < 0.05$ ). Patients also had lower levels of education and financial status. Daily water intake was significantly lower in patients, while consumption of liquids with meals was higher ( $p < 0.05$ ). Additionally, patients who consumed black tea and coffee after meals had a higher prevalence of digestive disorders. High consumption of black tea and coffee is associated with an increased risk of digestive system disorders, especially among individuals with lower socioeconomic status. These findings suggest that dietary habits, along with underlying social and economic conditions, should be considered when managing digestive health, especially in populations with high black tea and coffee consumption.

**Key words:** Coffee; digestive system disorders; socioeconomic factors; tea; dietary habits.

## 1 INTRODUCTION

Digestive system disorders are a significant global health concern, affecting millions of individuals and encompassing a wide range of conditions affecting the gastrointestinal (GI) tract. In recent years, these disorders have exhibited a significant increase in both developed and developing countries, resulting in substantial healthcare costs and a diminished quality of life for affected individuals. Globally, the incidence of these disorders has surged by 74.44% over the past three decades, reaching 443.53 million cases, indicating a remarkable rate of increase in these cases (Wang et al., 2023). These gastrointestinal disorders can be divided into functional and structural categories. Functional disorders, such as gallbladder dysfunction, functional dyspepsia, irritable bowel syndrome (IBS), and functional constipation, are characterized by symptoms like abdominal pain and altered bowel habits without any visible structural abnormalities. In contrast, structural disorders involve physical changes or damage to the GI tract, including gastroesophageal reflux disease (GERD), gastric ulcers, duodenal ulcers, gastric cancer, Crohn's disease,

and ulcerative colitis (Drossman; Hasler, 2016; Bharucha; Chakraborty; Sletten, 2016). The clinical symptoms and causes of these disorders vary depending on the type of disease. The clinical symptoms of these disorders can range from abdominal pain, diarrhea, and fatigue in IBS to more severe symptoms such as severe and persistent indigestion and unintentional weight loss in gastric cancer (Moshiree; Heidelbaugh; Sayuk, 2022; Smyth et al., 2020). The etiology of these gastrointestinal disorders is multifactorial and varies from one disease to another, involving genetic predispositions, immune system malfunctions, and environmental influences (Sepanlou et al., 2015). For instance, gastric ulcers are often caused by *Helicobacter pylori* infections or prolonged use of nonsteroidal anti-inflammatory drugs (NSAIDs) (Kamada et al., 2021). At the same time, IBS is believed to result from a combination of abnormal GI tract movements, increased sensitivity to pain, and stress (Mayer et al., 2023). Moreover, esophagitis can be caused by acid reflux, infections, certain medications, or allergies (Hoversten et al., 2018).

Despite the diverse etiologies of these disorders, environmental factors, particularly dietary habits such as black

tea and coffee consumption, play a significant and pivotal role (Corsello et al., 2020). The direct relationship between diet and the digestive system is evident as dietary components are metabolized by gut microbes, producing metabolites that influence gut barrier function, immune responses, and overall digestive health (Hills et al., 2019).

Among the dietary habits across different countries, tea and coffee are widely accepted as traditional beverages with high global consumption rates. Historically, tea has been deeply embedded in the cultural practices of countries like China, Japan, Iran, and the United Kingdom (UK). Similarly, coffee holds rich cultural significance in regions such as the Middle East, Europe, and Latin America, where coffeehouses serve as social hubs. Both beverages are a daily choice for millions of people, making them the most widely consumed drinks globally, second only to water. This widespread consumption underscores their importance in both modern diets and traditional customs (Grigg, 2002). These beverages have complex effects on the digestive system. Both drinks contain caffeine, which can stimulate the production of stomach acid, which can lead to conditions such as acid reflux or heartburn (Liszt et al., 2017). However, they also possess beneficial properties. For instance, coffee promotes bowel movements and may reduce the risk of constipation (Nehlig, 2022). Given the high consumption of these two beverages and the inconclusive and limited results regarding their effects on digestive system disorders, it is essential to investigate their impact further.

Socioeconomic factors such as education level and financial situation can also influence individuals' dietary habits (Affret et al., 2017). Including these factors in the study will provide a more comprehensive understanding of the contributing elements to the risk of digestive system disorders. This study investigates the association between black tea and coffee consumption and digestive system disorders within the Azeri population of East Azerbaijan province, Iran, considering socioeconomic and health factors to provide a comprehensive understanding of the contributing elements.

## 2 MATERIAL AND METHODS

This study involved 186 patients who had been diagnosed with digestive system disorders and were referred for endoscopy at Imam Reza Hospital in Tabriz, as well as 185 healthy individuals who served as controls. The study received approval from the Ethics Committee of Tabriz University of Medical Sciences (IR.TBZMED.REC.1394.505). A demographic questionnaire, which included questions about age, gender, height, weight, place of residence, age of disease onset, level of education, financial status, daily consumption of black tea and coffee and consumption of them after meals, daily water intake, and consumption of liquids with meals, was completed by both patients and healthy controls. The control group consisted of

individuals without digestive system disorders, and they did not undergo endoscopy. Although the rapid urease test has the potential for false-negative results, we performed it to diagnose *Helicobacter pylori*. A biopsy sample obtained during endoscopy was shaken and placed in a transparent vial containing the reagent (from Bahar Afshan Company, Iran). After one hour, the color change was observed. In samples positive for *Helicobacter pylori*, the reagent color changed from yellow to red and then to purple. In biopsy samples without *Helicobacter pylori*, the reagent color remained unchanged and yellow.

## 2.1 Statistical analysis

Statistical analyses were conducted using the SPSS software. Data were analyzed using the chi-square test, with a p-value of less than 0.05 indicating statistical significance. Confidence intervals (CIs) for proportions and differences in proportions were calculated using the Wilson score method with a 95% confidence level.

## 3 RESULTS

Of the 186 biopsy samples obtained via endoscopy, 51 (27.4%) tested positive for *Helicobacter pylori* using the rapid urease test. Additionally, 41 patients (22%) reported a family history of digestive disorders. A notable proportion of patients experienced their initial digestive discomfort between the ages of 30 and 40 (Table 1). Regarding educational attainment, a significant percentage of patients, 116 individuals (62.4%), had less than a high school diploma or were illiterate. In contrast, the control group predominantly comprised individuals with

**Table1:** Characteristics of Patients

Characteristic	Patients (%)
<b>Age (years)</b>	
<15	5 (2.7%)
15-20	16 (8.6%)
21-25	18 (9.7%)
26-30	18 (9.7%)
31-40	49 (26.3%)
41-50	45 (24.2%)
>50	35 (18.8%)
<b>Rapid urease test</b>	
Positive	51 (27.4%)
Negative	135 (72.6%)
<b>Family history of gastrointestinal disease</b>	
Positive	41 (22%)
Negative	145 (78%)

**Note:** This table summarizes the age distribution, rapid urease test results, and family history of gastrointestinal disease among the patient cohort.

a high school diploma or higher, totaling 177 individuals (95.7%). Financially, a considerable number of patients were of moderate to poor status, whereas a significant number of healthy individuals had good financial status. The consumption of liquids with meals ( $p < 0.05$ ) and black tea after meals ( $p < 0.05$ ) was higher among patients compared to the control group. As illustrated in Table 2, patients consumed more black tea and coffee daily than the control group, whereas their daily water consumption without meals was generally lower.

#### 4 DISCUSSION

Tea and coffee are integral to many cultures and diets worldwide, serving not only as daily staples but also as central elements in social rituals and traditions. Despite their widespread consumption, the impact of these beverages on health—particularly on the digestive system—remains complex and not uniformly understood. Previous research has frequently focused on the direct effects of tea and coffee on gastrointestinal health, often in isolation from broader

contextual factors. Therefore, further and more extensive studies are needed, considering other influencing factors. Given the increased prevalence of digestive diseases in Iran, particularly in Northwestern Iran (Kalan et al., 2020; Dolatkah et al., 2015), the rising consumption of black tea and coffee, and differences in socioeconomic and health factors, this study was conducted. Our study examined the relationship between black tea and coffee consumption and digestive health, considering health and socioeconomic factors in 371 individuals, comprising 186 patients and 185 healthy controls.

This study found a significant relationship between the consumption of black tea, coffee, and water with digestive system disorders. Patients demonstrated a higher daily intake of black tea and coffee compared to healthy controls. Conversely, the overall daily water intake was lower in patients than healthy individuals. Similarly, a study by Notariza et al. (2021) on 64 individuals over 60 showed that frequent consumption of either tea or coffee was associated with GERD. In contrast, the study conducted by He et al. (2024), which investigated

**Table 2:** Demographic Characteristics of Patients with Upper Gastrointestinal Disorders and Healthy Controls in Northwest Iran

Characteristics		GI patients (%)	Healthy Controls (%)	P-Value	Differences (95% CI)
Level of education	Illiterate	27 (14.5)	1 (0.5)	0.0001	0.14 (0.09,0.19)
	Below diploma level	89 (47.9)	7 (3.8)	0.0001	0.44 (0.36,0.52)
	Diploma	37 (19.9)	86 (46.5)	0.0001	-0.27 (-0.36, -0.17)
	Above diploma	33 (17.7)	91 (49.2)	0.0001	-0.32 (-0.41, -0.22)
Financial status	Poor	41 (22.1)	15 (8.1)	0.0003	0.14 (0.07, 0.21)
	Moderate	91 (48.9)	81 (43.8)	0.37	0.05 (-0.05, 0.15)
	High	54 (29)	89 (48.1)	0.0002	-0.19 (-0.29, -0.09)
Daily black tea and coffee consumption	Low	25 (13.5)	53 (28.7)	0.0005	-0.15 (-0.23, -0.07)
	Moderate	38 (20.4)	63 (34.1)	0.004	-0.14 (-0.23, -0.05)
	High	123 (66.1)	69 (37.2)	0.0001	0.29 (0.19, 0.39)
Consumption of black tea and coffee after meals	Barely	50 (26.9)	94 (50.8)	0.0001	-0.24 (-0.34, -0.14)
	Usually	33 (17.7)	39 (21.1)	0.49	-0.03 (-0.11, 0.05)
	Always	103 (55.4)	52 (28.2)	0.0001	0.27 (0.18, 0.37)
daily water intake	1cup	26 (14)	16 (8.7)	0.15	0.05 (-0.01, 0.12)
	2 cups	60 (32.3)	35 (18.9)	0.004	0.13 (0.05, 0.22)
	4 cups	51 (27.4)	70 (37.8)	0.042	-0.10 (-0.20, -0.01)
	6 cups	30 (16.1)	44 (23.8)	0.086	-0.08 (-0.16, 0.00)
	8 cups	19 (10.2)	20 (10.8)	0.99	-0.01 (-0.07, 0.06)
consumption of liquids with meals	Low	71 (38.2)	108 (58.4)	0.0001	-0.20 (-0.30, -0.10)
	Moderate	65 (34.9)	51 (27.6)	0.16	0.07 (-0.02, 0.17)
	High	50 (26.9)	26 (14)	0.003	0.13 (0.05, 0.21)
Total		186	185	-	

**Note:** Differences in education level, financial status, beverage consumption habits, and water intake are compared. P-values were calculated using chi-square tests; the "Differences" column represents the absolute difference in proportions with 95% confidence intervals.

the relationship between nine dietary habits, including tea consumption, and the risk of colorectal cancer, found no significant association between tea consumption and the risk of this cancer. Similarly, another study by Shimamoto *et al.* (2013), which included 8013 participants (5451 coffee drinkers and 2562 non-coffee drinkers), examined the relationship between coffee consumption and four major acid-related diseases: gastric ulcer (GU), duodenal ulcer (DU), reflux esophagitis (RE), and non-erosive reflux disease (NERD) in the Japanese population. The findings indicated no significant association between coffee consumption and the risk of developing these diseases. The discrepancies observed between these studies and our research may be attributed to several factors, including variations in the racial and genetic composition of the study populations, differences in environmental factors influencing the populations, incomplete alignment of the gastrointestinal diseases examined, and disparities in the number of patients and healthy individuals assessed in each study.

Caffeine, a primary component of black tea and coffee, has several adverse effects on the digestive system in addition to its benefits. One of the most notable impacts is the stimulation of gastric acid secretion. Increased gastric acid can lead to conditions such as GERD and peptic ulcers. It has also been shown that caffeine can exacerbate symptoms of GERD by relaxing the lower esophageal sphincter, allowing stomach acid to flow back into the esophagus, causing heartburn and discomfort (Boekema *et al.*, 1999). Additionally, caffeine can increase colonic motor activity, which may lead to diarrhea and abdominal cramping in some individuals. This laxative effect can disrupt regular bowel movements and contribute to conditions like IBS. Chronic consumption of caffeine has also been linked to the development of gastritis, an inflammation of the stomach lining, which can cause pain, nausea, and vomiting (Iriondo-DeHond *et al.*, 2021). Furthermore, while generally beneficial, antioxidants, particularly polyphenols found in black tea and coffee, can also negatively affect the digestive system. High concentrations of polyphenols can irritate the stomach lining and exacerbate symptoms of gastritis and ulcers. In some individuals, polyphenols can interfere with the absorption of certain nutrients, leading to deficiencies and digestive discomfort (Cardona *et al.*, 2013). It is also crucial to note that the gut microbiome, a complex community of microorganisms in the digestive tract, is significantly influenced by dietary components such as tea and coffee. While these beverages contain bioactive compounds that can promote the growth of beneficial bacteria, they can also disrupt the balance of the gut microbiota in some individuals. For instance, excessive consumption of caffeine and polyphenols can lead to dysbiosis, an imbalance in the gut microbiota associated with various digestive disorders. Furthermore, gut microbiome disruption can impair the gut barrier function, increasing intestinal permeability

and allowing harmful substances to enter the bloodstream, triggering systemic inflammation and exacerbating digestive disorders (Di Vincenzo *et al.*, 2024).

Unlike black tea and coffee, water consumption can enhance digestive health when not consumed during meals. Adequate hydration is essential for maintaining the mucosal lining of the intestines, which acts as a barrier against harmful pathogens and irritants. Water helps produce mucus, which protects the gastrointestinal lining and facilitates the smooth passage of food through the digestive tract (Popkin *et al.*, 2010). Water also plays a crucial role in the digestion and absorption of nutrients. It aids in the breakdown of food and the absorption of nutrients into the bloodstream. Proper hydration can prevent constipation by softening stools and promoting regular bowel movements. It has been shown that increased water intake can alleviate symptoms of constipation and improve overall gut health (Armstrong; Johnson, 2018). Moreover, water helps maintain the balance of the gut microbiome. Hydration supports the growth of beneficial bacteria and helps flush out toxins and waste products from the body. This can reduce the risk of developing digestive disorders and promote a healthy gut environment (Sato *et al.*, 2024).

This study found a significant association between the intake of liquids with meals and consuming black tea and coffee post-meal with digestive disorders. The intake of liquids during meals and the consumption of black tea and coffee post-meal were significantly higher among patients than healthy individuals (Table 2). The consumption of liquids with meals plays a crucial role in the digestive process, particularly regarding the dilution of gastric acid. Gastric acid is essential for the breakdown of food, activation of digestive enzymes, and protection against pathogens. However, excessive liquid intake during meals can dilute gastric acid, impairing digestive efficiency and potentially leading to gastrointestinal discomfort (Karamanolis *et al.*, 2008; El-Sharkawy; Sahota; Lobo, 2015). Also, research indicates that the dilution of gastric acid can slow gastric emptying and alter the pH of stomach contents, potentially resulting in inadequate digestion and nutrient absorption (Sutton *et al.*, 2017).

Also, a significant relationship was found between socioeconomic factors and digestive disorders. The level of education and financial status of patients with gastrointestinal disorders were significantly lower than those of healthy individuals (Table 2). Similarly, a study by Wang *et al.* (2024) found a significant association between educational attainment and digestive disorders. The study demonstrates a causal and independent association between education and six common digestive disorders: GERD, Peptic ulcer, IBS, Diverticular disease, Cholelithiasis, and Acute pancreatitis. The relationship between socioeconomic status (SES), education and financial status, and digestive disorders is complex and multifactorial. Lower levels of education and economic status are often

associated with increased prevalence and severity of digestive disorders. One primary mechanism is health literacy, which is significantly influenced by educational attainment. Individuals with lower education levels may have a limited understanding of health information, leading to poor dietary choices and health behaviors that can exacerbate digestive issues. For instance, inadequate knowledge about the importance of fiber-rich diets, hydration, and the avoidance of irritants like caffeine and alcohol can contribute to conditions such as IBS and GERD (Wang et al., 2024). Financial status also plays a crucial role in digestive health. Individuals with lower economic resources may face barriers to accessing healthcare services, including preventive care and early treatment for digestive disorders. This can result in delayed diagnoses and more advanced disease states by the time medical intervention is sought. Additionally, financial constraints often limit access to healthy food options, leading to diets high in processed foods, sugars, and unhealthy fats, which are known to negatively impact gut health. A study by Nishinakagawa et al. (2023) found that lower SES was associated with higher consumption of fast food and lower intake of fruits and vegetables, contributing to a higher incidence of gastrointestinal disorders. Stress, which is more prevalent among individuals with lower SES, is another critical factor linking socioeconomic status to digestive health. Chronic stress can alter gut motility and increase intestinal permeability, leading to conditions such as IBS and inflammatory bowel disease (IBD) (Yan et al., 2023). Moreover, stress can influence the gut microbiome, reducing the diversity and abundance of beneficial bacteria, which are essential for maintaining gut health and preventing disorders (Cryan et al., 2019). Environmental factors associated with lower SES, such as living in areas with limited access to clean water and sanitation, can also contribute to digestive disorders. Poor living conditions can increase exposure to pathogens and toxins, leading to infections and chronic inflammation of the gastrointestinal tract. A study by Moayyedi et al. (2002) demonstrated that individuals from lower SES backgrounds had significantly higher rates of *Helicobacter pylori* infection, a bacterium implicated in peptic ulcers and gastric cancer development.

While this study provides valuable insights into the association between black tea and coffee consumption, socioeconomic status, and digestive disorders, several limitations should be acknowledged. The case-control design does not permit causal inferences, and the reliance on self-reported beverage consumption introduces the possibility of recall bias. Additionally, potential confounding factors—such as overall dietary patterns, physical activity, and other lifestyle variables—were not exhaustively controlled. Future research should focus on prospective cohort studies with larger and more diverse samples to better establish causality and explore the underlying biological mechanisms. Further investigations

into the role of the gut microbiome, genetic predispositions, and additional environmental factors will be critical to developing targeted interventions for the prevention and management of digestive disorders.

## 5 CONCLUSIONS

This study demonstrates that black tea, coffee, water intake, and socioeconomic factors (financial status, education) are significantly associated with digestive disorders. Adequate hydration, higher education, and improved economic status reduce risk, while excessive tea/coffee consumption and drinking liquids with meals increase prevalence. These findings highlight how environmental and socioeconomic conditions shape digestive health, urging interventions to promote dietary awareness, improve access to education, and address economic barriers to reduce disorder incidence and health inequities.

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## 7 AUTHORS' CONTRIBUTION

Conceptual Idea: Asgharzadeh, M.; Somi, M.H. Methodology design: Somi, M.H. Data collection: Asgharzadeh, V.; Mahdaviipoor, B.; Hosseini, M.R.; Ghazani, H.B.; Rashedi, J. Data analysis and interpretation: Kohkalani, M.; Rezaei, S.A.S. and Writing and editing: Ozma, M.A.; Kohkalani, M.; Rezaei, S.A.S.

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