



Research Article

The Relationship between Coffee and Tea Consumption with the Incidence of Gastroesophageal Reflux Disease (GERD) among Students at Muhammadiyah University

Muhammad Fathan Nuralam¹ | Noor Alis Setiyadi²

¹Department of Public Health, Faculty of Health, Universitas Muhammadiyah Surakarta, Indonesia

²Department of Public Health, Faculty of Health, Universitas Muhammadiyah Surakarta, Indonesia

*Corresponding Author:

Noor Alis Setiyadi, Department of Public Health, Faculty of Health, Universitas Muhammadiyah Surakarta, Indonesia.
Email: nas260@ums.ac.id

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ABSTRACT

Gastroesophageal Reflux Disease (GERD) is a condition where stomach acid rises back into the esophagus, which can negatively impact the quality of life, particularly among students who have coffee and tea consumption habits. This study aimed to analyze whether there is a relationship between coffee and tea consumption habits and the incidence of GERD among students at Muhammadiyah University. The study employed a case-control design involving 100 respondents (20 cases and 80 controls). Data were collected using the GERD-Q questionnaire and a validated and reliable questionnaire on coffee and tea consumption habits, which were then, analyzed using the Chi-Square test. The results showed that coffee consumption habits and coffee consumption duration of ≥ 4 years were significantly associated with the incidence of GERD among students. In contrast, tea consumption habits and tea consumption duration of ≥ 4 years were not significantly associated with GERD, although students who regularly consumed tea had a higher risk of developing GERD compared to those who did not regularly consume tea. Students are advised to regulate their coffee and tea consumption habits to reduce the risk of GERD.

Keywords: Caffeine, coffee consumption, GERD, students, tea consumption

INTRODUCTION

Gastroesophageal reflux disease (GERD) is a serious condition characterized by the backflow of stomach acid into the esophagus, leading to a variety of debilitating symptoms. These symptoms include heartburn, pain or discomfort in the epigastric region, dysphagia, fluid regurgitation, chest pain, hoarseness, coughing caused by aspiration, and asthma (Patria, 2023). Research by Saraswati et al. (2021) indicates that GERD results from progressive damage to the lower esophageal sphincter (LES), leading to LES dysfunction and acid reflux.

The prevalence of GERD is estimated to affect 20% of the global population annually (Patria, 2023). In Indonesia, 9.35% of the population is affected by GERD (Saraswati et al., 2021). Among students, the prevalence of GERD ranges from 8.8% to 25.9% at the Faculty of Medicine, Syiah Kuala University (Ajjah et al., 2020). A more recent study at the same institution reported a



prevalence of 17.9% (Ardhan et al., 2022). At another institution, the Faculty of Medicine, UPN Veteran Jakarta, the prevalence of GERD among students was reported to be 25.18% (Syah, 2023). Based on a preliminary study conducted among students at the Muhammadiyah University of Surakarta (UMS) using an online survey, 30.19% of respondents (53 students) reported experiencing GERD. This indicates that GERD is a significant health issue that may adversely affect the quality of life of students.

GERD can be fatal if not treated promptly. Persistent symptoms, such as chest pain, a burning sensation in the chest, and sleep disturbances, can disrupt concentration and academic performance. Students experiencing sleep disturbances due to GERD may suffer from fatigue, lack of focus, and reduced memory, all of which hinder their ability to learn and process information. Furthermore, untreated GERD can result in additional health complications, such as unintended weight loss due to difficulty eating, chronic indigestion, and, in severe cases, esophageal issues such as Barrett's esophagus or an increased risk of esophageal cancer (Barnhart et al., 2022). Research conducted by Kumalaseta et al. (2023) also highlights that GERD can cause dental erosion. Among 42 samples studied, 30 cases of dental erosion were identified in GERD patients. The most commonly affected teeth were anterior teeth, with the labial surfaces being the most frequently eroded areas.

There are several factors known to be associated with the occurrence of GERD, such as stress levels, diet, alcohol consumption, coffee, and tea. Research by Syadiyah et al. (2022) shows a significant relationship between stress levels and the incidence of GERD. A similar thing was found by Ardhan et al. (2022), who stated that diet also has a significant relationship with GERD. In addition, the study of Pan et al. (2019) revealed that alcohol consumption contributes to the incidence of GERD, while the study of Patria (2023) identified a similar relationship with coffee consumption. Data from Atepela (2023) complements these findings by showing that tea consumption also has a significant association with GERD.

Coffee and tea consumption habits are one of the interesting factors to be studied further, because this habit is common and closest to students, including UMS students. Based on observations in the field, the tight lecture schedule, the number of lecture assignments and academic load are suspected to be factors that cause UMS students tend to stay up late to do their homework so that they have the habit of consuming coffee or tea.. Around the campus area there are also many coffee shops and iced tea sellers that are often visited by students because of their relatively affordable prices. In the city of Solo there are 113 coffee shops spread across each sub-district, including Laweyan District, there are 46 coffee shops, while in Serengan District there are 8 coffee shops. Pasar Kliwon District has three coffee shops, Jebres District has 22 coffee shops, and Banjarsari District has 24 coffee shops (Wibowo, G. A., Duhri, 2023). In addition, there is also quite a lot of iced tea outlets which is recently known as jumbo iced tea, spread around the UMS area. An iced tea seller named Annisa explained that she is able to sell around 100 to 150 cups of iced tea every day at a price of Rp. 3000 per cup (Wibowo, G. A., Yuniati, 2023).

Coffee and tea can cause GERD due to their caffeine. The caffeine content in pure coffee ranges from 70mg to 160mg per cup, and the caffeine content in instant coffee ranges from 13.04 mg to 50.02 mg per package (Patria, 2023). Based on the study's results, tea also has caffeine. The results of caffeine extraction and isolation from various types of tea leaves with triple reflection showed that the caffeine levels of green tea were 110 mg (0.55%), 130 mg (0.65%), 120 mg (0.60%), black tea 150 mg (0.75%), 140 mg (0.70%), 160 mg (0.80%), and oolong tea at 220 mg (0.110%), 230 mg (0.115%), 240 mg (0.120%) (Ramdan et al., 2023). The caffeine in coffee and tea can

weaken the tone of the lower esophageal sphincter (LES) and cause acid reflux which causes GERD. This mechanism occurs because caffeine, as a bitter alkaloid, can induce binding to bitter receptors in the oral cavity and stomach, which stimulates the production of more stomach acid (Hartoyo et al., 2022).

The results of previous research show that there is still a debate about the relationship between coffee and tea consumption and the incidence of GERD. The results of a study conducted by Patria (2023) stated that there is a relationship between coffee and the incidence of GERD. However, there were conflicting results in other studies, such as those conducted by Saraswati et al. (2021) and Wei et al. (2019) found that there was no significant association between coffee consumption and GERD. Likewise, the results of research on tea consumption, based on data from Atepela's (2023) research, a study at the Central Sulawesi Beteleme Health Center, stated that there was a significant relationship between tea consumption and the incidence of GERD. However, according to a study conducted by Wei et al. (2019), there is no significant relationship between tea consumption and the incidence of GERD. Given these inconsistencies, this study aims to analyze the relationship between coffee and tea consumption and the incidence of GERD among students at Muhammadiyah University.

MATERIAL AND METHODS

This research is a type of quantitative research using a case-control design. Case-control research is an analytical study that analyzes the cause-and-effect relationship using an inverse logic approach, namely determining the disease (outcome) first and then identifying the cause (risk factors) (Izza et al., 2023). This research was conducted at the Muhammadiyah University of Surakarta (UMS) in March 2024 and has been approved by the Health Research Ethics Committee (KEPK) of the Faculty of Medicine, Muhammadiyah University of Surakarta (FK-UMS) which is contained in Ethical Clearance number: 5231/B.1/KEPK-FKUMS/V2024.

The population in this study consisted of 21,795 students from the Muhammadiyah University of Surakarta, including 7,764 students from the class of 2021, 7,170 students from the class of 2022, and 6,861 students from the class of 2023. The sample of cases in this study is Muhammadiyah University of Surakarta students who are indicated by GERD based on the GERD Questioner (GERD-Q), and the control sample is General Students of the Muhammadiyah University of Surakarta. The sampling technique used in this study is purposive sampling for the case group, which is sampling based on specific considerations/criteria made by the researcher himself, and random sampling for the control group, which is a sampling technique with each member of the population having the same chance of being selected as a sample/respondent. The sampling technique used in this study is purposive sampling for the case group, which involves selecting samples based on specific considerations or criteria determined by the researcher. For the control group, random sampling is used, a technique where each member of the population has an equal chance of being selected as a sample or respondent. For the inclusion criteria of the case group, namely students of the Muhammadiyah University of Surakarta class of 2021, 2022, and 2023 who are indicated by GERD based on the GERD Questioner (GERD-Q) and are willing to participate in the research.

The sample size in this study was calculated using the Schlesselman 1982 approach by considering the odds ratio (OR) value. Previous research showed an OR value of 2.764 and a prevalence of GERD with a poor diet of 11.9% (Ardhan et al., 2022). In this approach, the prevalence of exposure in the control population (P) is used as the basis for calculation, which is

0.119 (11.9%). The proportion of exposure in the case group (P1) was calculated by considering the OR value using the proportion estimation formula so that $P1 = 0.281$ (28.1%) was obtained. The proportion of exposure to the control (P2) is assumed to be equal to the P value of 0.119. The sample size calculation was performed considering a 95% confidence level (Z-score: 1.96), a prevalence of exposure in the control population of 0.119, a proportion of exposure in the case group of 0.281, and a difference in the proportion of exposure ($P1 - P2$) of 0.162. In addition, the ratio of controls to cases was set at 1:4. The calculation results indicated that the minimum required sample size for the case group was 15 individuals. However, during the data collection process, 20 individuals with GERD were identified; thus the case group consisted of 20 samples. Based on the 1:4 control-to-case ratio, the control group comprised 80 samples.

Data was collected through questionnaires filled out by subjects. The coffee and tea consumption habits questionnaire is a modified questionnaire from previous research conducted by (Patria, 2023) Patria (2023) and has been tested for validity and reliability at Slamet Riyadi University. The results of the validity test stated that all items were valid and the results of the reliability test showed that the coffee and tea consumption questionnaire was reliable with Cronbach's Alpha value of 0.723 for the coffee consumption questionnaire, and 0.724 for the tea consumption questionnaire. Meanwhile, GERD is measured using the GERD-Q questionnaire which is a tool designed to help diagnose GERD. The questionnaire is based on high-quality clinical data and qualitative interviews with patients, and draws on leading clinical studies. The development also considers the aspect of ease of filling by respondents. This questionnaire is a combination of several instruments that have been validated and are often used in research (Rafsanjani et al., 2021). The GERD-Q questionnaire consists of 6 questions including the frequency of burning sensation behind the sternum (heartburn), the frequency of gastric contents rising to the throat or mouth (regurgitation), the frequency of pain in the heartburn (epigastric pain), the frequency of nausea, sleep disturbances due to GERD symptoms, and the use of additional medications for GERD symptoms other than those prescribed by the doctor with a total score of 18, if the score is < 8 then it is declared not GERD and if the score is ≥ 8 then GERD is declared GERD. Meanwhile, the coffee and tea consumption questionnaire, each consisting of 7 questions, includes the habit of drinking coffee and tea, the type of coffee and tea consumed, the habit of mixing coffee and tea with other ingredients such as milk, creamer, and sugar, and how long have you been consuming coffee and tea. Each question is given a score starting from 0-1 and is categorized.

Data analysis was performed using statistical software and included both univariate and bivariate analyses. Univariate analysis was used to describe the characteristics of respondents, including age, gender, academic semester, coffee consumption habits, tea consumption habits, and GERD status, in terms of frequency (n) and percentage (%). Bivariate analysis was conducted using the Chi-square test to determine whether there is a relationship and the risk level of coffee and tea consumption habits on the incidence of GERD among students.

RESULTS AND DISCUSSION

This study was conducted at the Muhammadiyah University of Surakarta (UMS), a reputable institution known for its rigorous academic standards and diverse student population, involving 100 subjects with details of 20 case groups and 80 control groups that met the inclusion criteria. In full, the frequency distribution of research respondent characteristics and research variables can be seen in table 1.

Table 1. Frequency Distribution of Respondent Characteristics and Research Variables

Characteristics Respondent	Case		Control		Total
	n	%	n	%	n (%)
Respondent's Age					
18	0	0,0	13	16,3	13 (13,0)
19	2	10,0	20	25,0	22 (22,0)
20	4	20,0	17	21,3	21 (21,0)
21	9	45,0	27	33,7	36 (36,0)
22	5	25,0	3	3,7	8 (8,0)
Gender					
Male	5	25,0	26	32,5	31 (31,0)
Female	15	75,0	54	67,5	69 (69,0)
Semester					
2	2	10,0	31	38,7	33 (33,0)
4	5	25,0	24	30,0	29 (29,0)
6	13	65,0	25	31,3	38 (38,0)
Coffee Consumption					
Routine	6	30,0	14	17,5	20 (20,0)
Not Routine	14	70,0	66	82,5	80 (80,0)
Tea Consumption					
Routine	17	85,0	50	62,5	67 (67,0)
Not Routine	3	15,0	30	37,5	33 (33,0)
GERD					
Yes	20	100,0	20	25,0	40 (40,0)
No	0	0,0	60	75,0	60 (60,0)
Total	20	100,0	80	100,0	100 (100,0)

It can be seen that the age of the most respondents is 21 years old, namely 36 people (36.0%), with a distribution of 9 people (45.0%) in the case group and 27 people (33.7%) in the control group. The age of 21 years is usually at 6 semesters where the academic load is quite high. In this semester, students are often faced with a busy schedule that includes completing assignments, practicum reports, and exam preparation. This activity often forces them to stay up late to complete academic work. This condition can increase the habit of gathering in cafes or other places to study together while consuming coffee or tea as a side drink. The habit is driven by the notion that caffeine can help improve concentration and reduce drowsiness. Research shows that coffee consumption can have a positive impact on students' concentration on learning. A study conducted on students of the Faculty of Engineering found that students who consumed coffee had a better level of concentration compared to students who did not consume coffee (Amini & Akbar, 2024). In addition, other studies have also shown that caffeine administration can increase alertness and energy, as well as speed up reaction time in tasks that require concentration (Boolani et al., 2020). Furthermore, research on medical students at Udayana University shows that caffeine consumption significantly increases concentration power (Widyadari et al., 2021). Therefore, it is not surprising that many students opt to consume caffeinated beverages when facing high academic pressure. However, excessive consumption of coffee or tea, particularly on an empty stomach or combined with irregular eating patterns, can increase the risk of digestive disorders, including GERD (Saraswati et al., 2021). In addition, the academic stress that is often experienced by 6 semester students can also be a supporting factor for the occurrence of GERD. Stress can lead to an increase in stomach acid and

weaken the lower esophageal sphincter, ultimately worsening GERD symptoms. Research shows that young adults, especially college students, have a higher risk of developing GERD. This is related to lifestyle, stress levels, and eating habits. An Indian study reported the prevalence of weekly GERD symptoms in 30% of medical students (Kuswono et al., 2021). Factors such as caffeinated beverage consumption, irregular diet, and lack of physical activity can worsen the GERD condition. Unhealthy lifestyle habits, such as alcohol consumption and smoking, also contribute to the increased prevalence of GERD (Ndraha et al., 2023). Smoking habits, both using e-cigarettes and conventional cigarettes, are commonly found in the age group of 15-25 years (Illaeni et al., 2023). In addition, academic stress is also one of the leading causes that affect the onset of GERD symptoms in this age group (Ardhan et al., 2022). Other research has also shown that low physical activity, stress, and obesity are significant risk factors for GERD in various age groups, including young adults (Hidayati et al., 2022).

By gender, there were more female respondents than male respondents, with a total of 69 (69%), with a total of 15 (75%) in the case group and 54 (67.5) in the control group. This is in line with several literatures that state that women are more susceptible to GERD than men. One of the main factors is the hormonal changes that women experience, especially during menstruation, pregnancy, and menopause. For example, hormonal fluctuations can lead to increased sensitivity of the gastrointestinal tract, which can worsen the symptoms of GERD (Praveena & Nagashree, 2024). Research shows that menstruating and pregnant women often experience increased acid reflux due to hormonal changes that cause relaxation of the lower esophageal sphincter, allowing stomach acid to rise back into the esophagus more easily (Mile et al., 2020). The accumulation of body fat during menopause can increase the risk of GERD in women, as obesity is a significant risk factor for this condition (Tarigan & Pratomo, 2019). In addition, psychological factors such as stress have a more significant influence on women, contributing to the prevalence of gastritis and GERD. Research shows that women are more likely to experience stress-related gastrointestinal problems, which can lead to increased acid production and reflux symptoms (Sawitri & Yuziani, 2021). Lifestyle, including eating habits and irregular diets, are also more commonly reported in women, which may contribute to the development of GERD. For example, an irregular eating schedule can irritate the lining of the stomach and increase acid production, worsening GERD symptoms (Khan et al., 2024).

Based on the coffee and tea consumption habits of UMS students, it can be seen that the habit of consuming regular tea is higher than that of regular coffee. Respondents who had a habit of consuming regular tea were 67 (67%) people, with details of 17 (85%) people in the case group and 50 (62.5%) people in the control group. Meanwhile, respondents who had the habit of consuming coffee regularly were only 20 (20%) people, with details of 6 (30%) people in the case group and 14 (17.5) people in the control group. Coffee and tea consumption habits are suspected to cause GERD events due to the caffeine content in them. This is in line with research conducted by Patria (2023), which states that there is a relationship between coffee and the incidence of GERD. On the other hand, there are conflicting research results, such as those conducted by Saraswati et al. (2021) and Wei et al. (2019). Both studies found no significant relationship between coffee consumption and GERD. Likewise, the research results on tea consumption, based on Atepela (2023) research data, a study at the Beteleme Health Center of Central Sulawesi stated that there was a significant relationship between tea consumption and the incidence of GERD. However, according to a study conducted by Wei et al. (2019), there is no significant relationship between tea consumption and the incidence of GERD.

To determine whether there is a relationship between coffee and tea consumption habits and other factors with the incidence of GERD among UMS students, refer to Table 2 in this study.

Table 2. Results of Bivariate Analysis of Coffee and Tea Consumption Habits on the Incidence of GERD in UMS Students

Variable	GERD				p-value	OR	95 % CI	
	Case		Control				Lower	Upper
	n	%	n	%				
Coffee Consumption								
Routine	12	30,0	7	11,7	0,042**	3,245	1,070	9,167
Not Routine	28	70,0	53	88,3				
Tea Consumption								
Routine	17	85,0	50	62,5	0,06	2,667	1,051	6,766
Not Routine	3	15,0	30	37,5				
Types of Coffee								
Pure	2	10,0	19	23,75	0,562	NA*	NA*	NA*
Instant	17	85,0	57	71,25				
Decaffeination	1	5,0	4	5,0				
Types of Tea								
Oolong	1	5,0	8	10,0	0,960	NA*	NA*	NA*
Black	15	75,0	42	52,5				
Green	4	20,0	30	37,5				
Coffee Bend								
Yes	16	80,0	60	75,0	0,884	0,830	0,323	2,131
No	4	20,0	20	25,0				
Tea Blend								
Yes	14	80,0	60	75,0	0,884	0,830	0,323	2,131
No	4	20,0	20	25,0				
Duration of Coffee Consumption								
≥4 Years	17	85,0	60	75,0	0,023**	4,171	1,298	13,404
< 4 Years	3	15,0	20	25,0				
Duration of Tea Consumption								
≥ 4 Years	15	75,0	64	80,0	0,966	1,118	0,479	2,611
< 4 Years	5	25,0	16	20,0				
Total	20	100,0	80	100,0				
* NA (Not Aplicable)								
** Significant								

The bivariate analysis results showed a significant relationship between coffee consumption and the incidence of GERD in UMS students. Students who regularly drink coffee have a 3.245 times greater chance of developing GERD than those who do not, with a confidence interval (OR 95% CI) between 1.070 and 9.167 and a p-value of 0.042. Also the length of coffee consumption for the incidence of GERD, but for the type of coffee and the habit of consuming coffee with a mixture of other ingredients, there was no significant relationship. These results are consistent with the literature showing that coffee consumption, which contains caffeine and other compounds, can stimulate the production of stomach acid, potentially causing GERD. Caffeine can cause relaxation of the lower esophageal sphincter, which increases the risk of acid reflux. This finding is in line with Patria's (2023) research. The analysis also showed that the length of coffee consumption was related to the incidence of GERD in UMS students. Students who consumed coffee for 4 years or more had a 4.171 times greater potential to develop GERD than students who consumed coffee for

less than 4 years, with confidence intervals (OR 95% CI) between 1.298 to 13.404 and a p-value of 0.023. These results are in line with the research of Ilham et al. (2019), which shows that symptoms in GERD patients worsen with an increase in the amount of coffee consumed, significantly when consumption exceeds 4 cups per day, GERD symptoms in patients increase in line with an increase in daily coffee consumption. However, for the types of coffee, including pure coffee, black coffee, or decaffeinated coffee, and the habit of mixing coffee with additives such as sugar, milk, or cream, the analysis showed no significant relationship with the incidence of GERD in UMS students; with a p-value of 0.562 for the type of coffee and 0.884 for the habit of mixing coffee. However, the results of the analysis showed that the type of coffee, both pure coffee, black coffee, and decaffeinated coffee, as well as the habit of adding ingredients such as sugar, milk, or cream to coffee, did not have a significant relationship with the incidence of GERD in UMS students. This is indicated by a p-value of 0.562 for the type of coffee and 0.884 for the habit of mixing coffee. This is because the influence of coffee on GERD is more influenced by the amount consumed than the type of coffee consumed (Zou et al., 2022). The addition of ingredients to coffee does not change the pH of the coffee or the content in the coffee because the acidity level of coffee is more influenced by the temperature when brewing (Kinasih et al., 2021).

On the other hand, the results of the bivariate analysis of tea consumption habits and the incidence of GERD in UMS students showed no significant relationship. Although there was no significant association, students who regularly consumed tea had a 2,667 times greater chance of developing GERD than students who did not regularly consume tea; with a confidence interval (OR 95% CI) between 1.051 to 6.766 and a p-value of 0.06. These results are in line with the research of Wei et al. (2019), which stated that there was no significant association between tea consumption and the incidence of GERD but noted a higher risk tendency in those who regularly consumed tea. The analysis results also showed that the length of tea consumption, the type of tea consumed such as oolong tea, black tea, or green tea, as well as the habit of adding ingredients such as sugar, milk, or cream to tea, did not have a significant relationship. This is evidenced by a p-value of 0.966 for the length of tea consumption, 0.960 for the type of tea, and 0.884 for the habit of mixing tea. This is because the consumption of tea, whether green, black, or oolong, has a protective effect on the gastrointestinal tract due to its antioxidant and anti-inflammatory properties, which can reduce the symptoms of GERD. However, it does not eliminate the risk (Cao et al., 2019).

CONCLUSION AND SUGGESTION

This study involved 100 students as respondents, consisting of 20 case groups and 80 control groups, with diverse genders, ages, and college semesters. The results of the bivariate analysis showed that there was a relationship between coffee consumption habits and coffee consumption ≥ 4 years with the incidence of GERD in UMS students, but the type of coffee consumed (pure coffee, black coffee, or decaffeinated coffee), and the habit of mixing coffee (sugar, milk, or creamer) was not significantly related to the incidence of GERD in UMS students. On the other hand, tea consumption habits, tea consumption duration ≥ 4 years, type of tea consumed (oolong tea, black tea, or green tea), and tea mixing habits (sugar, milk, or creamer) did not have a substantial relationship with the incidence of GERD in UMS students. Although tea consumption habits did not have a significant relationship with the incidence of GERD in UMS students, students who regularly consumed tea had a 2,667 times risk of GERD compared to students who did not regularly consume tea. Therefore, students who often drink coffee and tea are advised to pay attention to these

consumption patterns to minimize the risk of GERD. Further research with larger samples and more varied methods is expected to confirm these results and explore deeper mechanisms related to the relationship between these variables.

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CONFLICT OF INTEREST

The authors declare no conflict of interest

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