Association Between Coffee Consumption and Gastroesophageal Reflux Disease (GERD): A Cross-Sectional Analysis

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ABSTRACT

Background: *Gastroesophageal reflux disease (GERD) is a condition in which stomach contents flow back into the esophagus, leading to various symptoms and complications. In Indonesia, the prevalence of GERD has been reported at 57.6%. Coffee consumption is often suspected to be closely linked to the occurrence of GERD. This study aims to determine the association between coffee consumption and the incidence of GERD.*

Methods: *This study used a cross-sectional approach to conduct observational analytical research. The sample included individuals aged 18 to 65 years residing in Jakarta, selected using a consecutive sampling method. Data were collected using the Indonesian version of the Gastroesophageal Reflux Disease Questionnaire (GERD-Q). To assess the association between coffee consumption and GERD, the Chi-square test of independence was applied.*

Results: *Out of 105 respondents, 26 were identified as having GERD. Among those, 84.6% reported consuming coffee at moderate to high frequencies, while 15.3% consumed little to no coffee. The Chi-square test of independence revealed a statistically significant association between coffee consumption and GERD among Jakarta residents aged 18 to 65 years ($p = 0.006$).*

Conclusion: *There is a significant association between coffee consumption and the incidence of gastroesophageal reflux disease (GERD) among Jakarta residents aged 18 to 65 years.*

Keywords: *Coffee, consumption coffee, Gastroesophageal Reflux Disease (GERD)*

ABSTRAK

Latar belakang: *Gastroesophageal reflux disease atau biasa disingkat GERD merupakan suatu kondisi di mana naiknya isi dari lambung ke bagian esofagus sehingga menimbulkan gejala atau komplikasi. Indonesia sendiri merupakan negara dengan tingkat insidensi GERD yang tinggi yaitu terdapat 57,6% penduduk di seluruh Indonesia mengalami GERD. Konsumsi minuman kopi diduga memiliki hubungan yang erat dengan kejadian GERD. Penelitian ini bertujuan untuk mengetahui hubungan antara konsumsi minuman kopi terhadap kejadian gastroesophageal reflux disease (GERD) pada masyarakat Jakarta yang berusia 18 – 65 tahun.*

Metode: *Penelitian ini menggunakan pendekatan potong lintang dengan melakukan penelitian observasional analitik. Sampel penelitian ini adalah seluruh masyarakat Jakarta yang berusia 18 – 65 tahun dengan metode pengambilan sampel yang digunakan adalah teknik konsekutif sampling. Data penelitian diperoleh melalui kuesioner GERD-Questionnaire (GERD-Q) dalam Bahasa Indonesia. Uji statistik Chi-square digunakan untuk mengetahui hubungan antara konsumsi minuman kopi terhadap kejadian GERD.*

Hasil: *Dari total 105 responden, sebanyak 26 responden mengalami GERD. Sebanyak 84,6% responden yang mengalami GERD mengkonsumsi kopi dengan frekuensi sedang – banyak, dan sisanya sebanyak 15,3% responden yang mengalami GERD mengkonsumsi kopi dengan frekuensi tidak – sedikit. Hasil uji Chi-square menunjukan adanya hubungan signifikan antara konsumsi minuman kopi terhadap kejadian gastroesophageal reflux disease (GERD) pada masyarakat Jakarta yang berusia 18 – 65 tahun (p = 0,006).*

Kesimpulan: *Terdapat hubungan yang bermakna antara konsumsi minuman kopi terhadap kejadian gastroesophageal reflux disease (GERD) pada masyarakat yang berusia 18 – 65 tahun.*

Kata kunci: *Kopi, konsumsi minuman kopi, Gastroesophageal reflux disease (GERD)*

INTRODUCTION

Gastroesophageal reflux disease (GERD), commonly known as acid reflux, is a condition in which stomach contents flow back up into the esophagus, leading to symptoms and potential complications.[1] One study found that approximately 13% of people globally experienced symptoms of GERD at least once in a week.[2] In the United States, GERD is the most prevalent gastrointestinal disease, with an estimated 9 million cases.[3] In Indonesia, a study by Syam et al. reported a GERD prevalence of 57.6%, categorized into two groups: 21.9% without a decline in quality of life and 35.7% with a decline in quality of life.[4] Another study focusing on healthcare workers in Indonesia found that 27.4% had GERD, with 21% experiencing it without a decline in quality of life and 6.4% with a decline in quality of life.[5]

The rising incidence of GERD may be caused by several risk factors, including age, increased Body Mass Index (BMI), genetic or hereditary, lack of exercise or physical activity, smoking, and consumption of certain foods known to trigger GERD symptoms.[6] According to a study by Raaj S et al., beverages such as soda, tea, and coffee may increase the risk or incidence of GERD, while others, including water, milk, and juice, appear to reduce it.[7] Coffee is one of the most widely consumed and culturally significant beverages worldwide.[8] Data from the International Coffee Organization show that global coffee consumption has been increasing every year. In the 2019/2020 survey, total consumption reached 166 million bags, marking a 0.5% increase from the previous year.[9] Indonesia is also among the countries with high coffee consumption. According to data from 2012, Indonesians consumed approximately 3.6 million packs of coffee annually, ranking second in Asia after Japan and eighth globally.[10,11]

The high prevalence of GERD in Indonesia, alongside the country's significant level of coffee consumption, prompted the authors to study the associationbetween GERD and coffee consumption in individuals aged 18 to 65 years living in Jakarta. The aim is to assess the prevalence of coffee consumption and examine the association between coffee consumption and incidence of GERD among Jakarta residents.

METHODS

This was a cross-sectional study. Participants were selected using a consecutive sampling method, targeting Jakarta residents aged 18 to 65 years. A total of 105 respondents were included. Data collection was conducted using the Gastroesophageal Reflux Disease Questionnaire (GERD-Q), developed by Jonal et al., which is widely used for diagnosing GERD and has been adapted into Bahasa Indonesia by Simadibrata et al.[12] The GERD-Q has been proven to have 65% sensitivity and 71% specificity.[13] To quantify the level of coffee consumption of the respondents, the study employed the Coffee Consumption and Consumer Habits with Coffee Questionnaire, developed by Pielak et al.[14] This instrument evaluates both the quantity of coffee consumed and various behavioral patterns associated with coffee intake. Prior to the main study, the questionnaire underwent validity and reliability testing on a sample of 34 respondents.

The external validity of the Coffee Consumption and Consumer Habits with Coffee Questionnaire was assessed using Pearson correlation analysis. The calculated r value was compared against the critical value from the correlation table ($r > 0.339$), indicating that the questionnaire demonstrated good validity. For reliability testing, the Cronbach's alpha coefficient was 0.732, exceeding the acceptable threshold of 0.6, which confirms that the questionnaire is reliable.

The inclusion criteria of this study were Jakarta residents aged 18 to 65 years who provided informed consent to participate. The exclusion criteria included individuals who consumed alcohol, smoked cigarettes, or had anatomical abnormalities such as hiatal hernia. Data collected from the study were processed using SPSS Statistics software version 26. Statistical analysis with Chi-square test was used to analyze the association between coffee consumption and incidence of gastroesophageal reflux disease (GERD).

RESULTS

According to **Table 1**, out of 105 respondents in this study, the majority were female, totaling 64 respondents (61.0%). The most common age group was 18-25 years, comprising 60 respondents (57.1%). The most frequent location for coffee consumption was at home, reported by 59 respondents (56.2%). The most commonly type of coffee was coffee beverages, chosen 36 respondents (34.3%). Additionally, most participants had completed a university or college education, with 95 respondents (90.5%).

Table 1. Demographic Characteristics of Respondents

Characteristics	n (%)
Sex	
Male	41 (39)
Female	64 (61)
Age	
18-25 years old	60 (57.1)
26-30 years old	13 (12.4)
31-40 years old	8 (7.6)
41-50 years old	8 (7.6)
51-65 years old	16 (15.2)
Location of coffee consumption	
At a café	31 (29.5)
At a canteen	2 (1.9)
At home	59 (56.2)
At a colleague's or relative's house	3 (2.9)
At work	10 (9.5)
Types of coffee	
Roasted coffee beans	13 (12.4)
Instant coffee	28 (26.7)
Flavored coffee	5 (4.8)
Low acidity coffee	2 (1.9)
Powdered roasted coffee	21 (20)
Coffee beverage	36 (34.3)
Educational level	
University/College	95 (90.5)
Vocational school or Primary school	2 (1.9)
Secondary school	8 (7.6)

According to **Table 2**, out of 105 respondents, the majority (65 individuals or 61.9%) reported consuming coffee at moderate to high levels. Within this group, the most common consumption habit was drinking coffee once a day, reported by 33 respondents (31.4%). Meanwhile, 40 respondents (38.1%) consumed coffee at none to low levels. Among this group, the most frequent habit was drinking coffee once a month, reported by 20 respondents (19.0%).

According to **Table 3**, out of 105 respondents who completed the GERD-Q questionnaire, 79 individuals (75.2%) were classified as not having GERD. Among this group, the most frequent score was 6, reported by 26 respondents (50.5%). Meanwhile, 26 respondents (24.8%) were identified as having GERD, with a score of 9 being the most frequent, reported by 9 individuals (8.6%).

Table 2. Frequency Distribution of Coffee Consumption Among People in Jakarta

Coffee consumption	n (%)
None – Low	
Once a week	13 (12.4)
Three times per month	7 (6.7)
Once a month	20 (19.0)
Moderate – High	
Once a day	33 (31.4)
Twice a day	13 (12.4)
Three or four times per day	4 (3.8)
Three or four times per week	15 (14.3)

Table 3. Distribution of GERD-Q Score Among People in Jakarta

GERD-Q Score		n (%)
Score ≤ 7 (No GERD)		
	0	1 (1)
	3	2 (1.9)
	4	7 (6.7)
	5	6 (5.7)
	6	53 (50.5)
	7	10 (9.5)
Score 8 – 18 (GERD)		
	8	8 (7.6)
	9	9 (8.6)
	10	4 (3.8)
	11	2 (1.9)
	12	1 (1)
	13	1 (1)
	14	1 (1)

According to **Table 4**, which presents the results of the Chi-square statistical analysis, the p-value was 0.006, indicating a statistically significant association between coffee beverage consumption and the incidence of gastroesophageal reflux disease (GERD) among Jakarta residents aged 18 to 65 years.

Table 4. Association Between Coffee Consumption and Incidence of GERD

Coffee consumption	GERD		Total (%)	p
	Yes	No		
	n (%)	n (%)		
Moderate - high	22 (84.6)	43 (54.4)	65 (61.9)	0.006
None - low	4 (15.3)	36 (45.5)	40 (38.1)	
Total	26 (100)	79 (100)	105 (100)	

Based on the results of the Gamma correlation analysis presented in **Table 5**, a positive correlation was observed, with a correlation coefficient (r) of + .610. This indicates a strong correlation between age and the incidence of GERD. In other words, these results indicate a strong and positive correlation between the two, suggesting that increasing age increases the incidence of GERD.

Table 5. Correlation Between Age and Incidence of GERD

Age	GERD		Correlation coefficient (r)	p
	Yes n (%)	No n (%)		
18-25 years old	54 (68.4)	6 (23.1)	+ 0.610	<0.001
26-30 years old	8 (10.1)	5 (19.2)		
31-40 years old	4 (5.1)	4 (15.4)		
41-50 years old	5 (6.3)	3 (11.5)		
51-65 years old	8 (10.1)	8 (30.8)		
Total	79 (100.0)	26 (100.0)		

DISCUSSION

A total of 105 respondents participated in this study, of whom 26 (24.8%) were identified as having GERD. Among these 26 individuals, 17 (65.4%) were female. This finding aligns with a study conducted by Abdullah et al., which examined the prevalence of GERD in Depok, Indonesia. Their study reported that 10.8% of female respondents had GERD, compared to 5.2% of male respondents.[15] A similar result was reported by Alsuwat et al., who studied the prevalence of GERD in Saudi Arabia. Out of 2,043 respondents, 587 (28.7%) was identified as having GERD. Among those, 51.4% were female and 48.5% were male.[16] This finding is suspected to be associated with a risk factor of GERD, which is obesity. According to studies by Sun Kim et al. and Yoon Kim et al., the increased prevalence of GERD in females is associated with increased age, particularly in women over 50. At this stage, many women undergo menopause, which is often accompanied by significant weight gain. This increase in body weight, especially visceral or abdominal fat, is largely attributed to a decline in estrogen levels. Estrogen plays a key role in regulating lipolysis in women, and its reduction during menopause leads to increased fat accumulation, particularly in the abdominal area. The resulting rise in intra-abdominal pressure is believed to contribute to a higher risk of developing GERD.[17-19]

This study identified that among 26 respondents diagnosed with GERD, the age group of 51–65 years had the highest incidence, with 8 individuals (30.8%). This result aligns with findings from Hapsari et al., who conducted a study in Kebun Bawang, Jakarta. In their research, 12 respondents (13.3%) were found to have GERD, with 8 of them (66%) being over the age of 50.[20] A similar trend was observed in a study by Wang et al., conducted in South India, where 238 respondents (22.2%) were diagnosed with GERD, and 61 individuals (25.6%) were over 50 years old.[21] These findings suggest that age may be a contributing risk factor for GERD According to Syam et al., older age may lead to a decrease in lower esophageal sphincter pressure, thereby increasing the risk of GERD.[3,6]

In this study, out of 105 respondents, 36 individuals (34.3%) reported consuming coffee beverages, followed by 28 respondents (26.7%) who preferred instant coffee. When analyzed by gender, 19 of the 36 coffee beverage consumers (52%) were male, while 21 of the 28 instant coffee consumers (75%) were female. This finding is supported by a study conducted by Cordero et al., which found that women tend to have a higher sensitivity to sweetness compared to men. Additionally, the convenience of instant coffee preparation may contribute to its popularity among female consumers.[22]

This study also found that out of 105 respondents, 59 individuals (56.2%) consumed coffee at home. This result is consistent with findings from Penafort et al., where 326 out of 498 coffee consumers (90.6%) reported drinking coffee at home.[23] A similar trend was observed in a study by Pielak et al., in which 95.5% of 1,500 respondents consumed coffee at home. This preference may be attributed to the intimate nature of drinking coffee in a personal setting, offering comfort and the opportunity to enjoy the experience.[14]

This study also examined the frequency of coffee consumption and found that the most common pattern was drinking coffee once a day, with 33 respondents (31.4%). This result is consistent with a study by Zhang et al., which found that from a total of 365,682 respondents, 59,558 (16,29%) consumed coffee once daily, making it the most frequent consumption pattern observed in that study.[24]

Based on the association analysis conducted in this study, a statistically significant relationship was found between the frequency of coffee consumption and the incidence of GERD, with a p-value of 0.006. This finding aligns with a study by Raaj et al. in Massachusetts, The United Stated, which reported a higher incidence of GERD among individuals who consumed coffee. In their study, the incidence rate among non-coffee drinkers was 2,812, compared to 3,819 among coffee drinkers. These results suggest a meaningful correlation between coffee consumption and the occurrence of GERD.[7] A similar finding was reported in a meta-analysis conducted by Singh et al., which reviewed 14 studies examining coffee as a potential risk factor for GERD. Across these studies, a total of 17,104 participants were included. Of those, 3,387 individuals, approximately 21.02%, were coffee consumers who also had GERD. This reinforces the observed association between coffee intake and the prevalence of GERD.[25]

GERD is a multifactorial disease, meaning it can be triggered by various factors.[1] In a study conducted by Tao Yang Wei et al., no significant association was found between coffee consumption and the incidence of GERD.[26] Similarly, research by Jemiholum et al. reported no correlation between the two variables, with a p-value of 0.089.[27] These different results may be attributed to variations in socioeconomic conditions, cultural practices, lifestyle habits, genetic backgrounds, and age distributions across the studied populations.[6,28]

Several theories have been proposed to explain the association between coffee consumption and GERD. According to Jensen et al. and Raaj et al., compounds in coffee, particularly caffeine, may contribute to reduced pressure, or hypotension, of the lower esophageal sphincter (LES) by relaxing its muscles. However, the precise mechanism behind this effect remains a subject of ongoing debate.[7,29,30] Contrasting findings were reported in studies by Alsuwat et al. and Lizst et al., which proposed a different mechanism for the development of GERD. In these studies, GERD was attributed to increased gastric acid secretion, with caffeine identified as the primary trigger. The proposed mechanism centers on caffeine's nature as a bitter alkaloid, which activates bitter taste receptors known as TAS2Rs (Type 2 Bitter Receptors). These receptors are located both in the oral cavity and the stomach. Activation of TAS2Rs in the oral cavity stimulates an exaggerated cephalic phase response, leading to elevated gastric acid production. Meanwhile, when caffeine binds to TAS2Rs in the stomach, it overstimulates enteroendocrine G-cells, prompting excessive secretion of the hormone gastrin. This, in turn, results in heightened gastric acid output through the interaction between gastrin and gastric parietal cells. Importantly, this effect is not exclusive to caffeine. The same studies found that other bitter substances, such as those found in beer and procyanidins, a pigment compound present in various fruits, can also trigger increased gastric acid secretion.[16,31]

This study also assessed the correlation between GERD incidence in different age groups. Based on correlation analysis, a positive relationship was observed—older age groups were associated with a higher incidence of GERD, with a correlation coefficient (r) of + .610.. These findings are similar to previous studies conducted by Hapsari et al. and Wang et al.[20,21] An epidemiological study conducted by Yamasika et al. demonstrated a consistent association between aging and the incidence of GERD, with a notable increase observed in patients aged 30–39 years and above.[32] Furthermore, a systematic review by Becher et al., which examined the impact of aging on GERD symptoms, esophageal function, and reflux esophagitis, found that 24-h esophageal acid exposure time tends to increase with age, further supporting the findings of this study. Becher et al. identified three primary mechanisms through which aging may contribute to heightened reflux symptoms. First, anatomical changes at the gastroesophageal junction and a shortened lower esophageal sphincter increase the likelihood of acid reflux. Second, aging is associated with reduced esophageal peristaltic motility, which impairs the clearance of refluxed acid. Together, these factors lead to prolonged acid exposure and greater potential for tissue damage.[33]

One of the limitations of this study was the lack of detailed information regarding the specific types and contents of the coffee consumed by respondents. Given the wide variety of coffee types and preparation methods, this diversity could have influenced the outcomes related to GERD incidence. Additionally, the study was conducted online due to restrictions during the COVID-19 pandemic, which meant there was no direct interaction between researchers and participants. As a result, if respondents encountered questions they did not fully understand, they had limited access to clarification or further explanation. This may have led to responses that did not accurately reflect the intended objectives of the research instrument. Moreover, the questionnaire contained many items, which may have contributed to respondent fatigue or reluctance in completing it thoroughly. This could have resulted in answers that were inconsistent with the respondents' actual conditions or experiences.

Despite these limitations, based on our knowledge, this is the first population- based study investigating about the association between coffee consumption and the incidence of GERD in Jakarta. One of the key strengths of this study is its high response rate, with a total of 105 participants taking part. This level of engagement adds weight to the findings and provides a valuable foundation for future research in this area.

CONCLUSION

In this study, data were collected from 105 respondents, all Jakarta residents aged between 18 and 65 years. Among them, 26 individuals (24.8%) were identified as having GERD, while 79 respondents (75.2%) did not have GERD. Regarding coffee consumption, 65 respondents (61.9%) reported consuming coffee at moderate to high levels, whereas 40 respondents (38.1%) consumed coffee at none to low levels.

This study found a statistically significant association ($p = 0.006$) between the frequency of coffee consumption and the incidence of gastroesophageal reflux disease (GERD).

Conflict of Interest:

The authors have no competing interests to disclose.

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Author contribution

FRZH: Collected, analyzed the data, and contributed to manuscript drafting.

KT: Analyzed the data and participated in manuscript editing and final checking.

VS: Checked the accuracy and clarity of the manuscript and provided feedback for improvement.

RT: Conceived the study concept, analyzed data, supervised the manuscript preparation and final editing.

Data Avaibility

All data have been provided within the manuscript.

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