

The Relationship between pH (Potential Of Hydrogen) of Water in Clean Water Sources and Gastritis Complaints in Household around Temporary Waste Shelter Site in Bandar Lampung City

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Abstract Clean water is an important need in human life and is a natural resource that has a very vital function. Bandar Lampung City, especially households around temporary waste shelter site, have the potential to have health problems due to poor drinking water quality. Waste that has strong acids can cause pollution to the acidity quality of water. The normal pH value for water suitable for consumption is between 6.5 and 8.5. The quality of drinking water, including its acidity level, can affect human digestive health, one of which is gastritis. This study aims to determine the relationship between pH (potential of Hydrogen) of clean water and complaints of gastritis in temporary waste shelter site households in Bandar Lampung City. The research design was cross-sectional with proportionate stratified random sampling technique. The sample size is 100 households divided into 20 subdistricts and 56 temporary shelter. The research was conducted in November 2024 using a questionnaire and laboratory water examination using a pH conductivity meter aqua searcher AB33M1-F and pH meter EZ-9909. Data were analyzed using the chi square test **Results:** A significant relationship was found between the pH (potential of Hydrogen) of clean water and gastritis complaints in households around the Bandar Lampung City temporary waste shelter site due to the Chi square test ($p=0.017$) and Odds Ratio ($OR=2,667$). There is a significant relationship between the pH (potential of Hydrogen) of clean water and complaints of gastritis in temporary waste shelter site households in Bandar Lampung City.

1 INTRODUCTION

The main problem facing air resources today is the decline in air quality for domestic needs. This decline is caused by ongoing environmental pollution. Rapid population growth, environmental degradation, land use changes, industrialization and environmentally unfriendly agricultural practices all contribute to the decline in air quality. The increase in population also increases the need for air, while the volume of waste produced continues to increase (Putri, 2020).

One of the causes of the lack of pH (Hydrogen Potential) air quality is due to the presence of waste from increased consumption, modern lifestyles, and lack of environmental awareness that makes household waste not managed properly, which has a negative impact and becomes one of the serious problems that must be faced by the environment and public health (Ikhsan et al., 2020). Based on the Environmental Health Quality Standards (SBMKL) for water media for sanitation hygiene purposes number 32 of 2017, the use of water that contains toxic chemicals and chemical substances that exceed the maximum permissible levels has negative consequences for health and materials used by

humans. The pH should be neutral. The preferred pH for clean water is 6.5-8.5.

The pH scale is measured with a pH meter or litmus. Pure water has a pH of 7. If the pH of the water is below 7, it means the water is acidic, while if it is above 7, it is alkaline (Rafika et al., 2022). According to data from the Ministry of Environment and Forestry (KLHK), the water quality in Indonesia has reached 53.88 points, an increase of 2.01% compared to 2021 which was only 52.82 points. Aceh Province has the worst water quality with a value of 60.41 and the province with the best water quality is Yogyakarta Province with 31.20 points (WHO, 2022).

Lampung Province is one of the top 5 provinces with the worst water pH or water quality in Indonesia with a score of 54.72 (KEMENLHK, 2023). The impact of low water quality will affect public health with the emergence of various indications of disease, one of which is Gastritis (Suwindiri & Yulius Tiranda, 2021). Gastritis is one of the diseases that is often found in clinics or internal medicine rooms and is one of the diseases that is widely complained of by the public, both adolescents and adults. Gastritis or pain in the pit of the stomach is inflammation of the mucosa and submucosa of the stomach. Gastritis is characterized by nausea, vomiting, bleeding in advanced cases, weakness and decreased appetite (Sepdianto et al., 2022).

The incidence of gastritis that occurs in the world is 1.8 - 2.1 million of the population each year. According to data from the World Health Organization (WHO), the incidence of gastritis in the world, including England 22.0%, China 31.0%, Japan 14.5%, Canada 35.0%, and France 29.5%. Around 583,635 incidents of gastritis occur in Southeast Asia from the total population each year. The prevalence of gastritis confirmed

by endoscopy in the population in Shanghai is around 17.2% which is substantially higher than the population in the west which is around 4.1% and is asymptomatic (WHO, 2022).

Based on data from the Indonesian Ministry of Health, gastritis is ranked sixth with a total of 33,580 cases of inpatients in hospitals reaching 60.86%. Lampung Province itself has the second largest prevalence of gastritis cases after acute nasopharyngitis, with 163,318 cases, a fairly high figure for a disease that should have a percentage below 10%, one of the environments with the highest prevalence of gastritis cases in Lampung Province according to data is the city of Bandar Lampung, which has a significant increase of 333 inpatient visits in all Bandar Lampung City Health Centers (BPS, 2022). The reason why Bandar Lampung city is one of the areas with the highest prevalence of gastritis is due to the lack of knowledge and behavior of the community not to maintain environmental cleanliness, so that the quality of water consumed and used as a source of life becomes one of the main causes of gastritis (Ferry & Jaya Putra, 2023). Another factor is because the pH of the water or poor water quality is the cause of gastritis (Chaves, 2020). Based on this explanation, a more specific review is needed to determine the relationship between the pH of water in clean water sources and complaints of gastritis in households around the temporary waste shelter site in Bandar Lampung city, in order to review and evaluate the implementation process and resolution of environmental problems around the temporary shelter in Bandar Lampung city.

2 METHOD

Study design and area

This research employs a quantitative method with a cross-sectional study design. It aims to observe the relationship between independent and dependent variables simultaneously at a single point in time.

The study will be conducted in residential areas surrounding the temporary waste shelter site in Bandar Lampung and at the Chemical Engineering Laboratory of the University of Lampung. The research period spans from September to December 2024.

Sample collection

The population of this study includes all registered households or family cards recorded by the Department of Population and Civil Registration (Disdukcapil) of Bandar Lampung, totaling 336,887 households. The sampling technique applied is *Proportionate Random Sampling*, allowing each unit in the population an equal chance to be selected. The sample size was calculated using the Slovin formula, resulting in a total of 100 samples.

Samples were proportionally distributed across 20 districts based on the number of temporary waste shelter site within each district. The respondents were selected based on inclusion and exclusion criteria, including proximity to the temporary waste shelter site (200–1,500 meters) and availability of complete health and demographic data. Water samples were collected using sterile bottles and analyzed in the laboratory using pH meters (AB33M1-F and EZ-9909). Questionnaires were also administered to collect information related to gastritis symptoms and water usage.

Data analysis

The collected data include primary data from household water quality tests and questionnaire responses, as well as secondary data from local health centers regarding the location of the temporary waste shelter site in each district. Water pH levels were measured using calibrated pH meters, and data were analyzed to identify any associations between the pH level of water sources and the incidence of gastritis among the respondents. The analysis focused on the relationship between the independent variables (pH and water source) and the dependent variable (gastritis occurrence), utilizing nominal scale measurement and appropriate statistical methods.

Statistical analysis

Data obtained will be analyzed using descriptive and inferential statistics. Descriptive statistics will summarize the characteristics of respondents, including water pH levels, water source types, and prevalence of gastritis symptoms. Inferential statistics, such as chi-square tests, will be used to determine the association between independent variables (pH level and water source) and the dependent variable (gastritis incidence). All statistical analyses will be conducted using statistical software such as SPSS or a similar program, with a significance level set at $p < 0.05$.

3. CASE PRESENTATION

This study was conducted on November 7, 2024 in Bandar Lampung City on households domiciled around the temporary waste shelter site, as evidenced by their Family Card identity. The study respondents consumed clean water from various sources, such as dug wells, springs, bottled water, or other sources available in their environment. The location of the temporary waste shelter site in Bandar Lampung City was selected with a radius of 200 to 1,500 meters from the respondent's residence to assess the potential impact of cleanliness and water quality on public health. This study involved respondents from 20 sub-districts and 126 villages. The area of Bandar Lampung City reaches $\pm 183.77 \text{ km}^2$ with a coastline of 35.6 km and a water area of around $\pm 11.56 \text{ ha}$ (Bandar Lampung Health Office, 2023). This geographical condition allows for a comprehensive evaluation of the availability and quality of clean water in the area.

Overview and Characteristics of Respondents

The characteristics of respondents show that the majority are in the age range of 45–59 years as much as 56%, followed by ages >59 years as much as 24%, ages 20–44 years as much as 20%, and there are no respondents from the age group of 18–19 years. In terms of gender, the majority are women (87%) and men as much as 13%. The most widely used water sources are dug wells as much as 73%, then bottled water as much as 22%, springs 3%, and water tanker trucks 2%.

Table 4. Respondent Characteristics

Characteristics	n	%
Age		
18–19 years	0	0%
20–44 years	20	20%
45–59 years	56	56%
>59 years	24	24%
Gender		
Male	13	13%
Female	87	87%
Water Source		
Dug well	73	73%
Packaged water	22	22%
Spring	3	3%
Water tanker	2	2%

Univariate Analysis

The frequency distribution of respondents shows that most households (62%) consume water from unclean sources, while 38% use clean water. In addition, the results of pH measurements show that 51% of respondents use water with an acidic pH, while 49% use water with a neutral or alkaline pH. Regarding gastritis complaints, 55% of respondents experienced gastritis complaints, while 45% did not experience any.

Table 5. Frequency Distribution of Clean Water

No	Clean Water Source	n	%
1	Unclean Water	62	62%
2	Clean water	38	38%
	Total	100	100%

Table 6. Water pH in Bandar Lampung City

No	pH Level	n	%
1	Acidic	51	51%
2	Neutral and Alkaline	49	49%
	Total	100	100%

Table 7. Distribution of Gastritis Complaints

No	Gastritis Complaints	n	%
1	Gastritis	55	55%
2	No Gastritis	45	45%
	Total	100	100%

Bivariate Analysis

The results of the bivariate analysis showed a significant relationship between water pH levels and gastritis complaints. Among respondents who used acidic water, 61.8% experienced gastritis symptoms. In contrast, among those who used neutral or alkaline water, only 38.2% reported gastritis. The p-value of 0.017 (<0.05) and an odds ratio (OR) of 2.667 indicate that acidic water poses a 2.667 times higher risk of causing gastritis compared to neutral or alkaline water.

Table 8. Relationship Between Water pH and Gastritis Complaints

No	Water pH	Gastritis n (%)	No Gastritis n (%)	Total n (%)	p-value	OR (95% CI)
1	Acidic	34 (61.8 %)	17 (37.8 %)	51 (51 %)	0.017	2.667 (1.184–6.005)
2	Neutral/Alkaline	21 (38.2 %)	28 (62.2 %)	49 (49 %)		
Total		55 (100 %)	45 (100 %)	100 (100 %)		

Meanwhile, the relationship between water source quality and gastritis complaints also showed significant results. Among respondents who used unclean water sources, 70.9% experienced gastritis. In contrast, only 29.1% of those who used clean water reported gastritis. A p-value of 0.042 and OR of 2.332 indicate that the use of unclean water increases the risk of gastritis by 2.332 times.

Table 9. Relationship Between Water Source Quality and Gastritis Complaints

No	Water Source Quality	Gastritis n (%)	No Gastritis n (%)	Total n (%)	p-value	OR (95% CI)
1	Unclean	39 (70.9%)	23 (51.1%)	62 (62%)	0.042	2.332 (1.022–5.319)
2	Clean	16 (29.1%)	22 (48.9%)	38 (38%)		
Total		55 (100%)	45 (100%)	100 (100%)		

4. DISCUSSION

Frequency Distribution of Clean Water Sources in Bandar Lampung City

The analysis shows that 62% of respondents in Bandar Lampung use unclean water sources, while only 38% use clean ones. This indicates uneven water quality in the area. Poor access to clean water increases the risk of gastritis, primarily due to *Helicobacter pylori*, a bacteria commonly transmitted through contaminated water. Contaminated water can damage the stomach lining, triggering inflammation and symptoms like nausea and vomiting. Studies also highlight the presence of *Escherichia coli* and coliform bacteria in low-quality water, contributing to digestive issues. Poor sanitation and unhygienic practices further increase the risk. Thus, clean water is essential to prevent gastritis by reducing bacterial infections and promoting better hygiene.

Frequency Distribution of Water pH in Bandar Lampung City

The analysis shows that 51% of respondents use water with an acidic pH, while 49% use neutral pH water. No respondents reported using alkaline water. This indicates a general tendency toward acidic water sources in the area. Acidic water (pH <6.5) can corrode pipes, potentially leading to contamination by heavy metals like lead or copper, which harm human health and affect water taste and smell. Extreme pH also reduces the effectiveness of filtration and water treatment systems. Moreover, pH affects microbial activity. An imbalanced pH can support the growth of harmful microorganisms, increasing the risk of

digestive issues such as gastritis. Ideally, water pH should range between 6.5 and 8.5 to minimize contamination risks. Alkaline water (pH 7–9.5) has recently gained popularity due to its antioxidant properties and potential benefits in improving digestive health, such as reducing stomach acidity, fermentation, dyspepsia, and chronic diarrhea.

Frequency Distribution of Gastritis Complaints in Bandar Lampung City

In Bandar Lampung, 55% of respondents reported gastritis complaints, indicating a high prevalence of stomach inflammation. The majority of cases occurred in areas 200–1,500 meters from clean water sources, likely due to poor water quality and inadequate sanitation. Even when close to clean water sources, contamination from pathogens like *Helicobacter pylori*—a primary cause of gastritis—can occur if water is not properly treated. These areas often lack proper sanitation infrastructure, increasing the risk of cross-contamination. Poor hygiene practices and low public awareness further contribute to the spread of gastrointestinal infections. Additionally, women were found to be more affected, possibly due to higher stress levels and restrictive eating habits aimed at weight control, which can lead to prolonged empty stomachs and gastritis.

Relationship Between Clean Water Sources and Gastritis Complaints in Bandar Lampung City

The bivariate analysis revealed a significant relationship between clean water sources and gastritis complaints in Bandar Lampung City ($p = 0.042$). Among 62 respondents using unclean water, 70.9% experienced gastritis, compared to only 29.1% among those using clean water. This suggests that unclean water increases the risk of gastritis. Contaminated water can transmit *Helicobacter pylori*, a major cause of gastritis, especially in areas with poor water access. Harmful substances like heavy metals or pesticides in water can also damage the stomach lining, increasing the likelihood and severity of gastritis. Thus, access to clean and safe water is crucial for preventing gastritis and maintaining digestive health.

Relationship Between Water pH and Gastritis Complaints in Bandar Lampung City

Based on the analysis, there is a significant relationship between water pH and gastritis

complaints in Bandar Lampung City. Among 51 respondents using acidic pH water, 34 (61.8%) experienced gastritis, while 17 (37.8%) did not. In the neutral pH group, 21 (38.2%) experienced gastritis, and 28 (62.2%) did not. The P-value of 0.017 (<0.05) indicates a significant correlation between water pH and gastritis. The stomach's natural acidic environment (pH 1.5-3.5) aids digestion and protects against pathogens, but if the pH becomes excessively acidic or uncontrolled, it can irritate the stomach lining, leading to gastritis. Uncontrolled acidity can damage the mucosal protective layer and cause inflammation. Additionally, the bacteria *Helicobacter pylori*, which thrives in acidic conditions, can further exacerbate gastritis. Excess stomach acid may also cause acid reflux (GERD). Maintaining the stomach's pH balance is crucial for preventing gastritis. Furthermore, substances like caffeine in coffee can irritate the stomach lining and accelerate inflammation, potentially triggering gastritis if not properly managed.

5. CONCLUSION

Based on a study conducted on 100 households around the Bandar Lampung City, the temporary waste shelter site, several important conclusions were obtained. This study shows a relationship between the pH of water in clean water sources and gastritis complaints experienced by households in the area. This is based on the results of statistical tests with a p-value of 0.017, which indicates that there is a significant relationship between water pH and gastritis complaints (because the p-value <0.05). In addition, a significant relationship was also found between the type of clean water source and gastritis complaints, with a p-value of 0.042. Of the 100 respondents studied, 55 people (55%) experienced gastritis complaints, while 45 people (45%) did not experience these complaints. The pH level of water consumed by respondents showed that 51 households (51%) used water with an acidic pH, while 49 households (49%) used water with a neutral pH. These findings indicate the importance of attention to the quality of water consumed by the community, especially those around TEMPORARY WASTE SHELTER SITE.

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