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ORIGINAL ARTICLE

Relationship between clean water quality and sanitation with health problems in Rambung Baru Village, Sibolangit Sub-district

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ABSTRACT

The global challenge of inadequate access to clean water and sanitation continues to impose a substantial burden on public health, especially in developing regions. This study investigates the relationship between water quality, sanitation conditions, and health disorders among residents of Rambung Baru Village, Sibolangit Subdistrict, Indonesia. Employing a cross-sectional analytical design, data were collected from 130 households utilizing spring water as their primary source. Water quality was evaluated through physical, chemical, and microbiological analyses, while sanitation hygiene and health disorder data were gathered via questionnaires and health center records. The results indicate that over half of the respondents consumed water failing to meet quality standards, and nearly half experienced inadequate sanitation hygiene around water sources. A statistically significant association was found between poor water quality and the incidence of health disorders ($p = 0.007$), with affected individuals showing higher prevalence of diarrhea, acute respiratory infections, and skin diseases. Conversely, no significant relationship emerged between sanitation hygiene and health disorders ($p = 0.289$), although trends suggest a potential influence. These findings underscore the critical role of water quality in disease transmission and point to the need for prioritized interventions targeting water source protection and household water treatment. Given the complex interactions among water quality, sanitation, and hygiene behaviors, integrated approaches combining infrastructure improvements with community education on hygiene practices are essential. Further longitudinal research incorporating confounding factors is recommended to deepen understanding and guide effective public health strategies in similar rural contexts.

Keywords: water quality, sanitation hygiene, health disorders, rural health, drinking water contamination

Introduction

The clean water and sanitation crisis is one of the most urgent global health issues, affecting billions of people worldwide. Recent reports indicate that more than 2.2 billion people still lack access to safely managed drinking water, while approximately 3.6 billion do not have adequate sanitation facilities.¹ WHO and UNICEF reports estimate that roughly one in four people globally does not have access to safe drinking water.² This situation directly contributes to the high prevalence of preventable water-borne diseases, imposing a significant health and economic burden, particularly in developing countries. The inability to address this crisis poses a major obstacle to achieving the Sustainable Development Goals (SDGs), especially those related to public health and social well-being.³

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In Indonesia, the quality and availability of clean water have also become major public health concerns. Water resource degradation has been widely reported across various regions, primarily due to pollution from industrial, domestic, agricultural (pesticide use), and mining activities.⁴ Data from the Central Bureau of Statistics (Badan Pusat Statistik, BPS) indicate that approximately 28 million Indonesians still face difficulty accessing clean water.⁵ As a result, the incidence of water- and sanitation-related diseases such as diarrhea, acute respiratory infections (ARI), and skin diseases remains high. To address this, the Indonesian government continues to strengthen water supply and sanitation infrastructure to enhance national water resilience and reduce the resulting disease burden.^{6,7}

Specifically, Rambung Baru Village in the Sibolangit Subdistrict of Deli Serdang Regency faces similar challenges. Most households in the village, many with growing children, rely entirely on spring water from surrounding forest areas for daily needs, including drinking, cooking, bathing, and washing. However, the sanitation conditions around the water source are highly inadequate. Poor hygiene practices, improper waste management, and drainage systems located in close proximity to residential areas create a high risk of contamination. This concern is supported by primary data. Laboratory analysis of water samples from the source revealed contamination by *Escherichia coli* at a concentration of 72 mg/L—far exceeding the safety threshold established by the Indonesian Ministry of Health Regulation No. 32 of 2017. Consistent with these findings, data from the local community health center (puskesmas) between 2024 and 2025 reported high incidences of water- and sanitation-related diseases, including diarrhea (30 cases), ARI (57 cases), and gastritis (42 cases).

Previous studies have confirmed the strong relationship between clean water quality and community health status in areas with similar environmental and socio-economic characteristics in Indonesia.^{6,8,9} Sheel et al.¹⁰ further emphasized that access to uncontaminated water is a fundamental determinant of human health. Nevertheless, there remains a lack of specific research analyzing the relationship between water quality, sanitation conditions, and health disorders in Rambung Baru Village.

Based on the above background, this study aims to analyze the relationship between clean water quality and sanitation conditions with health disorders among the residents of Rambung Baru Village, Sibolangit Subdistrict. The findings of this study are expected to provide robust empirical evidence to inform local government authorities and relevant stakeholders in designing more effective environmental health interventions and water resource management programs, ultimately improving the quality of life of the local community.

Method

This study employed a quantitative approach with an analytical observational design and a cross-sectional methodology aimed at determining the relationship between the quality and sanitation of clean water and community health disorders in Rambung Baru Village, Sibolangit District. The research was conducted in Rambung Baru Village, Deli Serdang Regency, North Sumatra, from March to May 2025. The study population consisted of all residents of the village, totaling 1,220 individuals, with a sample of 130 households that utilized public bathing facilities as their primary source of clean water. The sampling technique used was cluster sampling, in which samples were selected based on predetermined geographic clusters to ensure representativeness of the population using public bathing water in the village.

Primary data were collected through self-administered questionnaires distributed directly to respondents and through field observations, while secondary data were obtained from health records at the local community health center (Puskesmas). Instruments used in data collection included water quality measurement tools to assess physical parameters such as turbidity, pH, and temperature, as well as laboratory-based chemical and biological analyses conducted at an accredited facility in accordance with the Indonesian Ministry of Health Regulation No. 32 of 2017. The collected data were processed and analyzed using SPSS statistical software. Univariate analysis was performed to describe variable characteristics, bivariate analysis was conducted using the chi-square test to identify relationships between variables, and multivariate analysis using logistic regression was employed to determine dominant factors influencing health disorders. The results were presented in the form of frequency tables accompanied by systematic narrative interpretations.

Results

This study included a total of 130 respondents from Rambung Baru Village, Sibolangit District. The demographic profile of the participants shows a majority were female (66.2%; n=86) and over the age of 35 (62.3%; n=81). Regarding the primary variables, more than half of the respondents (55.4%; n=72) were found to use water that did not meet quality standards. Furthermore, sanitation hygiene at the water source was also a concern, with nearly half of the cases (46.2%; n=60) categorized as inadequate. The prevalence of reported health disorders, including diarrhea, acute respiratory infections (ARIs), and skin diseases, was high, affecting 64.6% (n=84) of the participants.

Table 1. Respondent demographic characteristics

Variable	n	%
Age		
17-35 years	49	37,7
35-60 years	81	62,3
Gender		
Male	44	33,8
Female	86	66,2
Water Quality		
Meets Standards	72	55,4
Does Not Meet Standards	58	44,6
Sanitation Hygiene		
Meets Standards	70	53,8
Does Not Meet Standards	60	46,2
Health Disorder		
Present	46	35,4
Absent	84	64,6

Bivariate analysis was performed to test the association between the independent and dependent variables, with the findings summarized in Table 2. The chi-square test revealed a statistically significant association between water quality and the incidence of health disorders ($p = 0.007$). Specifically, the proportion of respondents experiencing health disorders was substantially higher among those using poor-quality water (80.0%) compared to those using water that met quality standards (58.3%). This finding indicates that the risk of suffering from a health disorder is significantly increased in the community exposed to inadequate water quality.

Table 2. Association between water quality, sanitation hygiene, and health disorders

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Variable	Health Disorder						p
	Present		Absent		Total		
	n	%	n	%	n	%	
Water Quality							
Meets Standards	25	41.7	35	58,3	60	100	0,007
Does Not Meet Standards	14	20	56	80	60	100	
Sanitation Hygiene							
Meets Standards	35	31.8	75	68,2	110	100	0,289
Does Not Meet Standards	4	20	16	80	60	100	

In contrast, no significant association was found between the sanitation hygiene of the water source and the prevalence of health disorders ($p = 0.289$). Nevertheless, the data showed a trend where the group with inadequate sanitation hygiene had a higher proportion of individuals with health disorders (80.0%) compared to the group with adequate sanitation (68.2%), although this difference was not statistically significant.

Discussion

The findings of this study demonstrate a statistically significant association between water quality and the incidence of health disorders in Rambung Baru Village. This result reinforces previous evidence highlighting the critical role of clean water as a principal determinant of public health. Poor water quality, particularly due to fecal bacterial contamination such as *Escherichia coli* identified in the village's water sources, constitutes a major transmission pathway for pathogens responsible for gastrointestinal infections, including diarrhea. Globally, it is estimated that 502,000 deaths from diarrhea each year are attributable to the consumption of unsafe drinking water. These findings are consistent with the extensive work of Prüss-

Ustün et al.¹¹ which underscores that inadequate water, sanitation, and hygiene are leading risk factors for the global burden of disease, particularly in low- and middle-income countries. Other study has found a direct correlation between coliform contamination in household drinking water and the prevalence of diarrhea in children under five.¹²

Interestingly, this study did not find a statistically significant relationship between sanitation hygiene around water sources and health disorders. Nonetheless, the data reveal a trend indicating that poor sanitation correlates with a higher proportion of health disorder incidents. The absence of statistical significance does not diminish the importance of sanitation; rather, it is likely influenced by other factors not measured in this study. As emphasized in a systematic review by Freeman et al.¹³, the health impact of sanitation interventions is often moderated by various factors, including individual hygiene behaviors, the degree of sanitation facility utilization, and other environmental pathways for pathogen exposure. Thus, while sanitation surrounding water sources may be suboptimal, the dominant exposure factor causing illness in Rambung Baru Village is likely the direct consumption of contaminated water, rendering the effect of sanitation variables less apparent statistically.

These findings carry important implications for public health interventions in Rambung Baru Village and similar settings. The fact that water quality is a significant predictor of health disorders suggests that interventions aimed at improving water sources—such as the development of simple filtration systems, spring protection, or household-level water disinfection—should be prioritized. However, given the complex interplay between sanitation, hygiene, and health, technical interventions alone will be insufficient. Integrated educational programs are needed to enhance community knowledge and awareness regarding the importance of clean and healthy living behaviors. The seminal study by Luby et al.¹⁴ convincingly demonstrated that promoting handwashing with soap can significantly reduce the incidence of diseases such as diarrhea and respiratory infections. Therefore, effective intervention programs should combine infrastructure improvements (water quality) with behavioral changes (hygiene and sanitation).

For future research, a longitudinal study design is recommended to monitor changes in health status over time following interventions. Additionally, subsequent studies should incorporate more comprehensive measurement of confounding variables—such as socioeconomic status, education level, and specific household hygiene practices—to obtain a deeper understanding of the complex dynamics among water, sanitation, and health.

Conclusion

This study confirms a significant association between water quality and health disorders in Rambung Baru Village, highlighting fecal contamination of water sources as a major risk factor for gastrointestinal and other infections. Although sanitation hygiene around the water sources showed no statistically significant correlation with health disorders, the observed trend suggests its contributory role, likely modulated by other unmeasured factors such as personal hygiene behaviors. These results emphasize that improving water quality through source protection, treatment technologies, and household-level disinfection must be a public health priority. However, technical interventions alone are insufficient; comprehensive educational programs are necessary to promote consistent hygiene and sanitation practices. Future longitudinal studies should address confounding variables including socioeconomic and behavioral factors to better elucidate these complex relationships. The evidence generated can guide policymakers and stakeholders in designing targeted, integrated interventions to reduce disease burdens and enhance community health outcomes in rural settings similar to Rambung Baru.

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