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Comparison Of The Effectiveness Of Povidone Iodine, Chlorhexidine, And Aquadest Mouthwash On Plaque Index In Students Of MTsN 2 Banda Aceh

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Abstract

Dental plaque is one of the main factors causing various dental and oral diseases such as caries and periodontal disease. Plaque control can be done mechanically or chemically, one of which is by using mouthwash. This study aims to compare the effectiveness of povidone iodine, chlorhexidine, and distilled water mouthwash on reducing plaque index in students of MTsN 2 Banda Aceh. In this study was a Quasi Experiment method use a pretest-protest three Group Design conducted on 72 respondents divided into 3 groups with 24 respondents each. Data analysis used the Shapiro-Wilk normality test, Paired Samples T-test, Homogeneity, One Way Anova and Post Hoct Test. Showed that the average plaque index score in students before rinsing with povidone iodine, chlorhexidine, and distilled water was 1.5. The average plaque index score after gargling with povidone iodine was 0.8, the average plaque index score after gargling with chlorhexidine was 0.5 and the average plaque index score after gargling with distilled water was 1.5. Is that there is a difference in effectiveness between povidone iodine, chlorhexidine, and distilled water mouthwashes in reducing plaque index in students of MTsN 2 Banda Aceh, with chlorhexidine as the most effective mouthwash in reducing plaque index. It is recommended that students of MTsN 2 Banda Aceh can use chlorhexidine mouthwash as a complement in maintaining dental and oral health after brushing their teeth.

Keywords: Mouthwash, Povidone Iodine, Chlorhexidine, Aquadest, Plaque Index

INTRODUCTION

Oral health is an integral part of general health, playing a crucial role in supporting chewing ability, speech, and an individual's quality of life. Oral health problems remain a significant public health issue in Indonesia. Results from the 2023 Indonesian Health Survey (SKI) indicate that 56.9% of the Indonesian population aged three years and older suffer from oral health disorders, including dental caries, cavities, and periodontal tissue conditions such as gingivitis and periodontitis (SKI, 2023).

The primary factor contributing to the development of various oral diseases is the accumulation of dental plaque. Dental plaque is a soft biofilm composed of accumulated bacteria, food debris, and microbial metabolic products adhering to tooth surfaces. If plaque is not effectively removed, increased bacterial metabolic activity can lead to acid production, triggering damage to both the tooth structure and its supporting tissues. Dental plaque is also a major factor in the development of periodontal diseases such as gingivitis and periodontitis (Newman et al., 2020).

Efforts to prevent and control dental plaque can be achieved through routine oral hygiene maintenance. The primary measure is mechanical cleaning, specifically regular and proper tooth brushing. However, in practice, mechanical cleaning alone is often insufficient, particularly among school-aged children. Consequently, additional measures—such as chemical cleaning using mouthwash—are required as a supplement to help reduce the number of microorganisms in the oral cavity and inhibit dental plaque formation (Putri & Suri, 2022).

Povidone-iodine and chlorhexidine are two types of antiseptic mouthwashes frequently used in dental practice. Povidone-iodine is known as an antiseptic with broad-spectrum antimicrobial activity, capable of inhibiting various species of bacteria, viruses, and fungi (Amtha & Kanagalingam, 2020). Chlorhexidine is a long-established antiseptic known for its effectiveness in controlling dental plaque; it possesses the ability to adhere to oral tissues, thereby providing a prolonged antimicrobial effect (Pillai et al., 2023).

Although both mouthwashes exhibit antimicrobial effects, they differ in their mechanisms of

action, antimicrobial spectra, and effectiveness in controlling dental plaque. Chlorhexidine is often considered the gold standard for plaque control; however, its long-term use carries the potential for side effects such as tooth discoloration and taste disturbances (Kour & Kaur, 2020). Conversely, povidone-iodine is relatively accessible and possesses a broad antimicrobial spectrum, making it a compelling subject for further research regarding its effectiveness compared to chlorhexidine, particularly among school-aged children (Ferdinand Paulus Ginting et al., 2025).

In oral health research, the use of antiseptic agents necessitates a comparison or control group to evaluate the agent's effectiveness in reducing dental plaque. Distilled water (*aquadest*) is commonly used as a control because it lacks antibacterial substances and thus exerts no direct effect on oral microorganisms. The inclusion of a distilled water control group allows for a more objective assessment of an antiseptic agent's effectiveness in reducing the plaque index.

Given these differing characteristics, research is needed to compare the effectiveness of povidone-iodine, chlorhexidine, and distilled water mouthwashes in reducing the dental plaque index. The plaque index serves as an indicator for assessing oral hygiene levels and the efficacy of plaque control measures. This study aims to provide insight into which mouthwash is more effective and suitable for use among school-aged children.

Previous studies have compared the effectiveness of chlorhexidine and povidone-iodine regarding plaque indices in the general population; however, results have been inconsistent, and many studies focused on adult populations or clinical settings. Research examining the differences between these two agents in school-aged children remains limited, preventing the formulation of optimal conclusions for practical application in school environments (Basha et al., 2023).

Madrasah Tsanawiyah Negeri (MTsN) 2 Banda Aceh, located in Batoh (Lueng Bata District), operates a canteen that provides various food and beverage options for students. However, the majority of items sold—including snacks like chocolate—are sweet or cariogenic. Observations of 12 students at the school revealed a tendency to purchase sugary snacks. Furthermore, after consuming these sweet foods, students often fail to take preventive measures such as rinsing their mouths or brushing their teeth, resulting in poor oral hygiene.

Data from the Batoh Community Health Center (Puskesmas) in Banda Aceh City regarding adolescent patient visits over the past year (January to December) indicate that 132 children visited the dental clinic for caries, 96 for pulp disease, and 12 for gum and periodontal tissue diseases.

Preliminary data collected on January 26, 2026, involving 12 students at MTsN 2 Banda Aceh—assessed using the Silness and Löe plaque index—revealed that 11 students (91.7%) fell into the "poor" category for dental plaque accumulation, while one student (8.3%) fell into the "moderate" category. These findings indicate that the students' oral hygiene status is suboptimal.

Given this background, the author is interested in conducting a study titled "Comparison of the Effectiveness of Povidone-Iodine, Chlorhexidine, and Distilled Water Mouthwashes on Plaque Index in MTsN 2 Banda Aceh Students."

RESEARCH METHODS

This study employs a quantitative quasi-experimental design using a pretest-posttest three-group approach. The design involves three groups: the first group received povidone-iodine mouthwash, the second group received chlorhexidine mouthwash, and the third group received distilled water (aquadest) as the control group. Dental plaque levels in all three groups were measured before (pretest) and after (posttest) the intervention to determine changes in the plaque index and to compare the effectiveness of the two types of mouthwash. The study was conducted in April 2026.

The study population consisted of all 249 eighth-grade students at MTsN 2 Banda Aceh, distributed across seven classes. The sample comprised students who met the study's inclusion criteria and consented to participate as respondents. Purposive sampling—a technique based on specific criteria established by the researcher—was used to select the sample.

Data collection was carried out through direct examination of the respondents to assess plaque index scores among students at MTsN 2 Banda Aceh, Lueng Bata District. The instruments and materials used included a diagnostic set, a disclosing agent, povidone-iodine mouthwash, chlorhexidine mouthwash, distilled water, and the Silness & Löe Plaque Index (KSP). The collected data underwent editing, coding, tabulation, and entry processes. Subsequently, the data were analyzed descriptively by calculating frequencies and percentages and were presented in the form of tables and narrative descriptions.

RESULTS AND DISCUSSION

General Data

Respondent Characteristics Based on Class

Table 1. Frequency Distribution of Respondents (Grade VIII Students at MTsN 2 Banda Aceh, Lueng Bata District, Banda Aceh City, 2026)

No	Respondent Category	Frequency	(%)
1	VIII-1	10	13,9%
2	VIII-2	12	16,7%
3	VIII-3	10	13,9%
4	VIII-4	10	13,9%
5	VIII-5	10	13,9%
6	VIII-6	10	13,9%
7	VIII-7	10	13,9%
Total		72	100%

Source: 2026 Secondary Data

Based on Table 1, the majority of respondents fall into the Class VIII-2 category, totaling 12 respondents (16.7%), whereas the other class categories each comprise 10 respondents (13.9%).

Respondent Characteristics by Gender

Table 2. Frequency Distribution of Respondents by Gender: Grade VIII Students at MTsN 2 Banda Aceh, Lueng Bata District, Banda Aceh City, 2026

No	Gender	Frequency	(%)
1	Female	40	55,6%
2	Male	32	44,4%
Total		72	100%

Table 2 shows that the majority of respondents were female (40 respondents, 55.6%), while the lowest number fell into the male category (32 respondents, 44.4%).

Specific Data

Frequency Distribution Based on Plaque Index (Silness and Löe) Before Rinsing with Povidone-Iodine, Chlorhexidine, and Distilled Water.

Table 3. Plaque Index (Silness and Löe) Before Rinsing with Povidone-Iodine, Chlorhexidine, and Distilled Water.

No	Category	Frequency			(%) Before		
		PVP-I	CHX	Aquadest	PVP-I	CHX	Aquadest
1	Excellent (0)	0	0	0	0%	0%	0%
2	Good (0.1–0.9)	1	0	0	4,2%	0%	0%
3	Fair (1–1.9)	21	20	22	87,5%	83,3%	91,6%
4	Poor (2–3)	2	4	2	8,3%	16,7%	8,4%
Total		24			100%		

Source: Primary data (2026)

Table 3 shows that, prior to rinsing with povidone-iodine mouthwash, the Plaque Index scores (Silness and Löe) fell into the following categories: poor (2 respondents, 8.3%), moderate (21 respondents, 87.5%), and good (1 respondent, 4.2%). Before rinsing with chlorhexidine mouthwash, the scores were distributed as follows: poor (4 respondents, 16.7%) and moderate (20 respondents, 83.3%). Before rinsing with distilled water, the scores were: poor (2 respondents, 8.4%) and moderate (22 respondents, 91.6%).

Frequency Distribution Based on Plaque Index (Silness and Löe) After Rinsing with Povidone-Iodine, Chlorhexidine, and Distilled Water.

Table 2. Plaque Index (Silness and Löe) After Rinsing with Povidone-Iodine, Chlorhexidine, and Distilled Water.

No	Category Frequency (%) After	Category Frequency (%) After			Category Frequency (%) After		
		PVP-I	CHX	Aquadest	PVP-I	CHX	Aquadest
1	Excellent (0)	0	0	0	0%	0%	0%
2	Good (0.1–0.9)	19	20	0	79,2%	83,3%	0%
3	Moderate (1–1.9)	5	4	22	20,8%	16,7%	91,6%
4	Poor (2–3)	0	0	2	0%	0%	8,4%
Total		24			100%		

Source: Primary data (2026)

Table 4 shows that, following rinsing with povidone-iodine mouthwash, 19 respondents (79.2%) fell into the "good" category for the Plaque Index (Silness and Loe), while 5 respondents (20.8%) fell into the "moderate" category. After rinsing with chlorhexidine mouthwash, 20 respondents (83.3%) were in the "good" category and 4 respondents (16.7%) were in the "moderate" category. Following rinsing with distilled water, 22 respondents (91.6%) fell into the "moderate" category, and 2 respondents (8.4%) fell into the "poor" category.

Normality Test

Table 5. Normality Test of Data Distribution Comparing the Effectiveness of Povidone-Iodine, Chlorhexidine, and Distilled Water Mouthwashes on Plaque Index Among MTsN 2 Banda Aceh Students in Intervention and Control Groups

Tested data P value (sig) Conclusion	Tested data P value (sig) Conclusion	Tested data P value (sig) Conclusion
Intervention Group		
Plaque index before Povidone-iodine rinsing	0,211	Normal
Plaque index after Povidone-iodine rinsing	0,099	Normal
Plaque index before Chlorhexidine rinsing	0,169	Normal
Plaque index after Chlorhexidine rinsing	0,202	Normal
Control Group		
Plaque index before rinsing with distilled water	0,652	Normal
Plaque index after rinsing with distilled water	0,863	Normal

Source: Primary data (2026)

Table 5 shows that the obtained data are normally distributed—consistent with the results presented in Table 4.5—where the Shapiro-Wilk normality test yielded a p-value of 0.05. This allows for the performance of parametric tests on the research data, specifically the Paired Samples t-test and the One-Way ANOVA.

Paired Samples t-test

Tabel 6. Uji Paired Samples T-Test Perbandingan Efektivitas Obat Kumur *Povidone Iodine, Chlorhexidine* dan *Aquadest* Terhadap Indek Plak pada Siswa MTsN 2 Banda Aceh Pada Kelompok Intervensi dan Kontrol

	N	Mean		Mean Difference	P value (sig.2 Tailed)
		Before	After		
Gargling with Povidone-iodine	24	1.504	0.817	0.6875	0.001
Gargling with Chlorhexidine	24	1.575	0.596	0.9792	0.001
Gargling with distilled water	24	1.546	1.567	0.0208	0.022

Source: Primary data (2026)

Based on Table 6, the significance value (sig. 2-tailed) for the groups rinsing with povidone-iodine, chlorhexidine, and distilled water was 0.001 ($p < 0.05$). In the povidone-iodine group, the mean plaque index was 1.504 before rinsing and 0.817 after rinsing, with a mean reduction of 0.6875.

In the chlorhexidine group, the mean plaque index was 1.575 before rinsing and 0.596 after rinsing, with a mean reduction of 0.9792.

Meanwhile, in the distilled water group, the mean plaque index was 1.546 before rinsing and 1.567 after rinsing, with a mean difference of 0.0208.

Homogeneity Test

Table 7. Homogeneity Test Results Comparing the Effectiveness of Povidone-Iodine, Chlorhexidine, and Distilled Water Mouthwashes on Plaque Index Among MTsN 2 Banda Aceh Students in Intervention and Control Groups

	P value (sig)	Conclusion
Post-test Plaque Index	0.150	Homogeneous

Source: Primary data (2026)

Based on the results of the homogeneity of variance test shown in Table 7, a significance value of 0.150 ($p > 0.05$) was obtained; thus, it can be concluded that the post-test data for the three groups exhibit homogeneous variances. Consequently, the requirements for conducting a One-Way ANOVA have been met.

One-Way ANOVA Test

Table 8. Results of the One-Way ANOVA Test Comparing the Effectiveness of Povidone-Iodine, Chlorhexidine, and Distilled Water Mouthwashes on Plaque Index Among MTsN 2 Banda Aceh Students in Intervention and Control Groups

	Df	P value
Between groups	2	0.001
Within groups	69	
Total	71	

Source: Primary data (2026)

Based on Table 8, the One-Way ANOVA results yielded a p-value of 0.001 ($p < 0.05$), with degrees of freedom (df) of 2 between groups, 69 within groups, and a total of 71; these findings indicate a significant difference in the effectiveness of povidone-iodine, chlorhexidine, and distilled water mouthwashes in reducing the plaque index among students at MTsN 2 Banda Aceh.

Post Hoc Test

Table 9. Post-hoc test results comparing the effectiveness of povidone-iodine, chlorhexidine, and distilled water mouthwashes on the plaque index of MTsN 2 Banda Aceh students in the intervention and control groups.

Group (I)	Group (J)	Mean Difference (I-J)	P value (sig)
Povidone Iodine	*Chlorhexidine*	0.2208	0.031
	Aquadest	-0.7500	0.001
Chlorhexidine	*Povidone Iodine*	-0.2208	0.31
	Aquadest	-0.9708	0.001
Aquadest	*Povidone Iodine*	0.7500	0.001
	Chlorhexidine	0.9708	0.001

Source: Primary data (2026)

Based on Table 9, the Bonferroni post-hoc test results (shown in the Multiple Comparisons table) yielded a significance value of $p < 0.05$ between groups, indicating a significant difference among the treatment groups.

The comparison between the povidone-iodine group and the chlorhexidine group showed a significance value of 0.031 ($p < 0.05$), indicating a significant difference in effectiveness between the two groups. The comparison between the povidone-iodine group and the distilled water group showed a significance value of <0.001, signifying a significant difference in effectiveness.

Furthermore, the comparison between the chlorhexidine group and the distilled water group also showed a significance value of <0.001 ($p < 0.05$), indicating a significant difference in effectiveness between these two groups.

These results demonstrate that the treatment groups differed in their effectiveness in reducing the plaque index. The group using chlorhexidine mouthwash exhibited the highest effectiveness in reducing the plaque index compared to the povidone-iodine and distilled water groups.

Discussion

Based on Table 4.3, the Plaque Index scores (Silness and Loe) prior to rinsing with povidone-iodine mouthwash showed 2 respondents (8.3%) in the poor category, 21 respondents (87.5%) in the moderate category, and 1 respondent (4.2%) in the good category. Prior to rinsing with chlorhexidine mouthwash, 4 respondents (16.7%) were in the poor category and 20 respondents (83.3%) were in the moderate category. Prior to rinsing with distilled water, 2 respondents (8.4%) were in the poor category and 22 respondents (91.6%) were in the moderate category.

Based on Table 4.4, the Plaque Index scores (Silness and Loe) after rinsing with povidone-iodine mouthwash showed 19 respondents (79.2%) in the good category and 5 respondents (20.8%) in the moderate category. After rinsing with chlorhexidine mouthwash, 20 respondents (83.3%) were in the good category and 4 respondents (16.7%) were in the moderate category. After rinsing with distilled water, 22 respondents (91.6%) were in the moderate category and 2 respondents (8.4%) were in the poor category.

The Paired Sample T-test analysis revealed a mean plaque index of 1.5 before rinsing and 0.8 after rinsing, representing a reduction of 0.68, with a significance value of $p = 0.001$ ($p < 0.05$). This indicates that rinsing with povidone-iodine effectively reduces the plaque index among students at MTsN 2 Banda Aceh.

The reduction in plaque index observed in the povidone-iodine group is attributed to the agent's broad-spectrum antibacterial activity, which inhibits the growth of bacteria responsible for dental plaque. Free iodine works by disrupting bacterial cell membranes and interfering with microbial metabolism, thereby hindering optimal bacterial proliferation. According to Amtha and Kanagalingam (2020), povidone-iodine is an effective oral antiseptic capable of reducing plaque bacterial counts and inhibiting biofilm formation.

These findings are supported by research conducted by Fauzia et al. (2021), which demonstrated that the use of povidone-iodine mouthwash significantly reduces plaque indices in secondary school

students. Additionally, a study by Basha et al. (2023) showed that povidone-iodine is effective in controlling dental plaque and gingival inflammation in children.

Although effective at reducing plaque index, research findings indicate that the efficacy of povidone-iodine remains lower than that of chlorhexidine. This is because povidone-iodine lacks strong substantivity regarding oral tissues. The antibacterial effect of povidone-iodine tends to be shorter-lived; consequently, its ability to sustain plaque reduction is not as optimal as that of chlorhexidine.

Paired-samples t-test analysis for the chlorhexidine group revealed a mean plaque index of 1.5 before rinsing and 0.5 after rinsing, with a mean reduction of 0.97 and a significance value of $p = 0.001$ ($p < 0.05$). These results indicate that chlorhexidine has a significant effect on reducing the plaque index.

The researchers observed that the chlorhexidine group exhibited the greatest reduction in plaque index compared to the other groups. This is attributed to chlorhexidine's substantivity—its ability to adhere to tooth surfaces, oral mucosa, and soft tissues—which allows its antibacterial effect to persist longer within the oral cavity. Chlorhexidine functions by disrupting bacterial cell membranes and causing the leakage of intracellular components, leading to bacterial death.

0.12% chlorhexidine possesses high substantivity due to its ability to bind to tooth surfaces, oral mucosa, and salivary pellicle, subsequently releasing its active ingredient gradually. This property enables chlorhexidine to remain active in inhibiting bacterial growth for some time after use as a mouthwash. Its antibacterial activity has been reported to persist for approximately 7 hours post-application, thereby providing a more prolonged plaque-control effect than many other oral antiseptics (Herrera et al., 2010).

According to Newman et al. (2019), chlorhexidine is the gold standard for plaque control due to its high antibacterial efficacy and its ability to inhibit plaque biofilm formation. Jones (1997) also stated that chlorhexidine possesses stronger antimicrobial capabilities than other antiseptics in reducing dental plaque accumulation.

The results of this study align with research by Fauzia et al. (2021), which demonstrated that chlorhexidine is more effective than povidone-iodine in reducing plaque indices. A study by Boyapati et al. (2024) also indicated that chlorhexidine yields the greatest reduction in gingival inflammation and plaque compared to several other types of mouthwash. The superior efficacy of chlorhexidine compared to the other groups is evident from the greatest mean reduction in plaque index scores. This indicates that chlorhexidine is capable of inhibiting plaque formation more optimally among students at MTsN 2 Banda Aceh.

The difference in efficacy between 0.12% chlorhexidine and 1% povidone-iodine may be attributed to the differing substantivity of these two active ingredients. Chlorhexidine has the ability to adhere to tooth surfaces, mucosa, and the salivary pellicle, allowing its antibacterial effect to persist for several hours after use. In contrast, while povidone-iodine exhibits rapid antimicrobial activity, its duration of action is relatively shorter due to a lack of strong retention capabilities within oral tissues.

Data analysis using the Paired Samples T-Test for the distilled water group showed a mean plaque index of 1.5 before rinsing and 1.5 after rinsing, with a mean difference of 0.02 and a significance value of $p = 0.022$. Rinsing with distilled water did not result in a significant reduction; this is because distilled water—which lacks antibacterial agents—merely dissolves α(1–6)-linked dextrans in dental plaque but fails to inhibit the growth or activity of bacteria that continuously form new plaque.

Distilled water was used as the control group because it lacks active antibacterial agents capable of inhibiting the growth of plaque bacteria. Its use merely aids in the mechanical removal of food debris without exerting any antiseptic effect on oral microorganisms. According to Rahman et al. (2022), distilled water is frequently employed as a control in oral health research due to its lack of direct antibacterial activity against dental plaque.

The study results indicate that the use of distilled water is not as effective as povidone-iodine or chlorhexidine in reducing the plaque index. This demonstrates that the antiseptic content of mouthwashes plays a significant role in controlling dental plaque.

Consequently, chlorhexidine is the most effective mouthwash for reducing the plaque index among MTsN 2 Banda Aceh students, followed by povidone-iodine, while distilled water shows the lowest effectiveness. These findings are expected to serve as a reference when selecting effective mouthwashes to help maintain oral hygiene among school-aged children.

CONCLUSION

Based on the research findings, chlorhexidine is the most effective mouthwash for reducing plaque scores among eighth-grade students at MTsN 2 Banda Aceh. This is evidenced by a greater mean reduction in plaque scores compared to the povidone-iodine and distilled water groups.

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