

Relationship between Water Consumption with Oral Hygiene Status in the Community Periodontal Disease, Semarang City, Indonesia

Gyan Shirin Ebadi Kayla Az Zahra^{1,2}, Diki Bima Prasetyo³ and Hayyu Failasufa⁴*

¹ Department of Dentistry, Universitas Muhammadiyah Semarang, Semarang, Central Java, Indonesia

² Master Program of Public Health, Universitas Diponegoro, Semarang, Central Java, Indonesia

³ Master of Applied Occupational Health and Safety, Universitas Gadjah Mada, Sleman, Yogyakarta, Indonesia

⁴ Department of Dentistry, Universitas Muhammadiyah Semarang, Semarang, Central Java, Indonesia

Abstract. Neglected oral hygiene accumulates plaque and calculus, which thrive in the mouth's warm, dark, and humid environment. This lack of hygiene is a primary cause of oral health problems and can impact a person's overall physical and mental well-being. This study aimed to identify factors related to the oral hygiene status of individuals with periodontal disease. This cross-sectional observational study was conducted on 92 residents with periodontal disease at the Genuk Public Health Center in Semarang, Indonesia. The sample was selected using simple random sampling. Data was collected through an oral hygiene examination using the OHI-S index and a questionnaire. The independent variables were age, gender, systemic diseases, and residential area, while the dependent variable was oral hygiene status. The data was analyzed using the chi-square test. The majority of participants demonstrated good oral hygiene. However, a significant relationship was found between water consumption and the oral hygiene status of respondents with periodontal disease.

1 Introduction

Oral and dental health is defined as a condition where the teeth within the oral cavity are free from accumulating plaque, debris, calculus, and food residue. Oral and dental health maintenance behavior in the population is significantly influenced by tooth brushing, which is regarded as a primary preventive intervention. Quantitative measurement of oral and dental hygiene status can be done using the Oral Hygiene Index (OHI) and the Oral Hygiene Index Simplified (OHI-S), developed by Green and Vermilion. Lack of understanding regarding the principles of oral and dental hygiene, which is influenced by demographic variables such as age and gender, is a major predisposing factor to the onset of oral and dental health problems. Data from the 2023 Indonesian Health Survey indicates that 8.8% of the population suffers from oral and dental diseases resulting from neglecting oral and dental health and hygiene[1,2].

Poor oral and dental hygiene can cause plaque buildup on the tooth surface. Plaque buildup that is not cleaned will harden and disrupt gingival conditions, leading to inflammation of the gingiva. The gingiva is often used to indicate whether the periodontal

*Corresponding kayla.gyan@gmail.com

tissue is affected by disease. This is because most periodontal diseases start from inflammation of the gingiva, such as gingivitis [3,4].

Periodontal disease, while commonly observed in adults, can also affect both children and adolescents. A clinical study indicated that 92% of 359 patients in rural Thailand presented with periodontitis, with genetic variations in the 30–32-year age group likely playing a role. Dental plaque serves as the primary instigator of periodontitis and gingivitis. Periodontal disease is associated with numerous risk factors, one of which is systemic diseases, such as diabetes mellitus, which elevates the risk of periodontitis. Periodontitis is more prevalent in diabetic patients compared to patients with other immune disorders [5].

Publications on oral hygiene research in the surrounding community with a population of individuals with periodontal disease were not found. This prompted researchers to investigate the characteristics of respondents and the relationship between oral hygiene and age, gender, systemic diseases, and residential areas. This study aims to analyze the characteristics of respondents and the relationship between oral hygiene and age, gender, systemic diseases, residential areas and water consumption.

2 Methods

This research is an analytical observational study with a cross-sectional approach. Data was collected by a dentist in the community within the working area of the Genuk Public Health Center, Semarang. This research was carried out from December 2024 to January 2025. The population in this study consisted of individuals diagnosed with periodontal disease by the Genuk Public Health Center. The research sample was obtained using probability sampling with a simple random sampling method. The minimum sample size was calculated using Slovin's formula, resulting in a total sample of 92 people.

At a public health center, the diagnosis of periodontal disease is established through a systematic clinical approach that includes medical and dental history taking to identify systemic risk factors and oral hygiene habits, followed by assessment of the patient's chief complaints, such as bleeding gums, halitosis, gingival swelling, or tooth mobility. A thorough intraoral examination consists of gingival inspection, periodontal probing to measure pocket depths, evaluation of bleeding on probing, assessment of plaque and calculus deposits, and mobility testing to determine periodontal tissue support.

This research had independent and dependent variables. The independent variables were respondent characteristics, including age, gender, systemic diseases, and residential area. The dependent variable was the community's oral hygiene status. The research data were analyzed using SPSS Statistics 25 and the chi-square test to examine the relationship between each independent variable and oral hygiene status.

The research received permission from the Semarang City Health Office and the Research Ethics Committee. The study was conducted door-to-door at residents' homes. The research began by obtaining approval from the local sub-district and village offices, after which the researchers met with residents by visiting their homes. The researchers obtained residents' consent by signing an informed consent form, followed by examining oral hygiene status using the OHI-S index. Subsequently, the researchers asked the residents to complete a questionnaire. The questionnaire consisted of respondents' identity information and questions related to systemic disease history, place of residence, and water consumption.

3 Results And Discussion

3.1 Result

This study's results indicate that most respondents had good oral hygiene status, amounting to 53.3%, as shown in Table 1.

Table 1. Frequency distribution of oral hygiene

OHI-S Index	Frequency	Persentase
Good	49	53.3
Fair	38	41.3
Poor	5	5.4
Total	92	100.0

Table 2 shows the frequency distribution and chi-square test results of oral hygiene using the OHI-S index across several variables. Based on the age variable, the majority of respondents aged 21-40 years had fair oral hygiene, amounting to 39.5% and respondents aged >60 years had poor oral hygiene status as much as 60.0%. The chi-square test results showed a p-value of 0.667 ($P > 0.05$), indicating no significant relationship between age and oral hygiene status. Based on the gender variable, most females had good oral hygiene, amounting to 67.3%, and the majority of males had fair oral hygiene, amounting to 47.4%. The chi-square test results showed a p-value of 0.378 ($P > 0.05$), indicating no significant relationship between gender and oral hygiene status.

Based on the systemic disease variable, the majority of respondents without systemic diseases had a good oral hygiene score, amounting to 95.9%. The chi-square test results showed a p-value of 0.326 ($P > 0.05$), indicating no significant relationship between systemic disease and oral hygiene status. Based on the residential area variable, most respondents lived in Genuksari Sub-district and had fair oral hygiene, amounting to 47.4%. The chi-square test showed a p-value of 0.154 ($P > 0.05$), indicating no significant relationship between residential area and oral hygiene status. Based on the water consumption variable, the majority of respondents consumed artesian water with fair oral hygiene status, amounting to 89.5%. The chi-square test results showed a p-value of 0.034 ($P < 0.05$), indicating a significant relationship between water consumption and oral hygiene status.

Table 2. Chi-square test results

Variable	OHI-S Index						Total	P(X)2
	Good		Fair		Poor			
	n	%	n	%	n	%		
Age Category								0.667
<20	2	4.1%	2	5.3%	0	0.0%	4	
21 – 40	19	38.8%	15	39.5%	0	0.0%	34	
41 – 60	14	28.6%	10	26.3%	2	40.0%	26	
>60	14	28.6%	11	28.9%	3	60.0%		
Gender								0.378
Female	33	67.3%	20	52.6%	3	60.0%	56	
Male	16	32.7%	18	47.4%	2	40.0%	36	
Systemic Disease (Diabetes)								
Diabetes	2	4.1%	2	5.3%	1	20.0%	5	0.326
Have no history of diabetes	47	95.9%	36	94.7%	4	80.0%	87	

Residential Areas								0.154
Terboyo Kulon	2	4.1%	0	0.0%	0	0.0%	2	
Terboyo Wetan	0	0.0%	3	7.9%	0	0.0%	3	
Gebangsari	10	20.4%	1	2.6%	0	0.0%	11	
Muktiharjo Lor	2	4.1%	2	5.3%	1	20.0%	5	
Genuksari	19	38.8%	18	47.4%	2	40.0%	39	
Banjardowo	14	28.6%	11	28.9%	1	20.0%	26	
Trimulyo	2	4.1%	3	7.9%	1	20.0%	6	
Water Consumption								
PDAM	13	26.5%	1	2.6%	0	0.0%	14	0.034
Artesian	31	63.3%	34	89.5%	5	100%	70	
Well water	3	6.1%	3	7.9%	0	0.0%	6	
Bottled water	2	4.1%	0	0.0%	0	0.0%	2	

3.2 Discussion

The results of the oral hygiene status examination using the OHI-S index showed that the majority (53.3%) of respondents had good oral hygiene status, and only five (5.4%) had poor oral hygiene status.

Proper oral hygiene involves ensuring the mouth remains free from harmful deposits such as plaque and calculus. Inadequate oral hygiene allows plaque to accumulate on the teeth and spread throughout the oral cavity. Overall physical and psychological health plays a vital role in human well-being. One of the main contributors to community oral and dental health issues is behavioral neglect, particularly the lack of proper attention to oral hygiene. This problem often stems from insufficient knowledge regarding oral health and its maintenance [6]. Periodontitis is the most common oral disease worldwide, with an age-standardized prevalence of 11.2%. It is a multifactorial disease, with risk factors such as diabetes mellitus (DM), smoking, and, most commonly, inadequate oral hygiene (OH). The accumulation of dental plaque and calculus is usually caused by improper toothbrushing techniques, failure to carry out interdental cleaning, and irregular dental visits. This accumulation predictably results in gingival inflammation. Persistent gingivitis is a key risk predictor for the breakdown of periodontal attachment [7,8]. According to The Global Burden of Disease Study 2016, periodontal disease ranks 11th as the most common disease worldwide. This universal disease is the most common public health problem after dental caries. The development of periodontal disease is influenced by continuous plaque accumulation, where the amount and duration of plaque accumulation determines the severity. This process begins with gingivitis (gum inflammation due to plaque), which, if left untreated, can progress to periodontitis [3].

Oral and dental diseases can affect all age groups, from children to the elderly. An epidemiological study found that the highest prevalence of chronic periodontitis was in the elderly population (82%), followed by adults (73%) and adolescents (59%). Periodontal disease is preventable; however, patients with periodontal disease usually seek dental care when the disease reaches an advanced stage because the early stages are usually asymptomatic. As a result, in advanced age, there is usually a decline in oral hygiene levels and a reduction in teeth, leading to tooth loss [9,10]. With respect to age, the majority of participants were between 21–40 years (38.8%), followed by those aged 41–60 years (28.6%) and those over 60 years (28.6%). Although a higher proportion of poor oral hygiene was observed among participants older than 60 (60.0%), this difference was not statistically significant ($p = 0.667$).

Epidemiological data from the National Health and Nutrition Examination Survey show that men disproportionately develop periodontal diseases compared to women (56.4% vs.

38.4%). Gender-related factors play a significant role in the prevalence of periodontal disease. Women consistently demonstrate better oral hygiene habits than men, brushing and flossing more frequently, and smoking less. In terms of gender, females accounted for a larger proportion of the sample (61.5%) and demonstrated comparatively better oral hygiene outcomes than males [9]. However, the association between gender and oral hygiene status did not reach statistical significance ($p = 0.378$).

Periodontal disease is included in the six complications of diabetes, so diabetes does not directly cause periodontal disease, but it is a risk factor. Regarding systemic disease, only a small subset of respondents reported a history of diabetes (5.4%), of whom 20.0% exhibited poor oral hygiene [11]. Despite this, no significant relationship was identified between diabetes status and OHI-S scores ($p = 0.326$). Differences in oral hygiene were also examined across residential areas. Poor oral hygiene was more frequently recorded in Genuksari (40.0%) and Trimulyo (20.0%) compared with other areas. Nevertheless, these variations were not statistically significant ($p = 0.154$).

Public water supplies are mandated to comply with physical, chemical, bacterial, and radioactive content standards. Fluoride is a naturally occurring element in water that plays a vital role in metabolic processes [12]. Nevertheless, fluoride levels surpass 2.5 mg/l can induce health problems, including stomach disorders, osteoporosis, and dental enamel staining. Artesian wells, drawing water from 80-300 meters below the surface, generally provide water of a higher calibre than that extracted from shallower sources [13–15]. A significant association emerged, however, in relation to water consumption. The majority of participants reported reliance on artesian water (63.3%), followed by PDAM water (26.5%), well water (6.1%), and bottled water (4.1%). Analysis indicated that the type of water source was significantly associated with oral hygiene status ($p = 0.034$), with users of artesian water more frequently demonstrating good oral hygiene than those consuming other water sources. These findings indicate that sociodemographic variables such as age, gender, systemic disease, and residential area were not significantly associated with oral hygiene status. By contrast, environmental exposure in the form of water consumption was a significant determinant, suggesting that ecological factors may influence oral health outcomes within this population.

4 Conclusion

This study aims to analyze the characteristics of respondents and the relationship between oral hygiene and age, gender, systemic disease, and residential area. This study found that poor oral hygiene can lead to plaque buildup on tooth surfaces, which, if not cleaned, will harden and disrupt gingival conditions, causing gingival inflammation. Water consumption and inadequate oral hygiene are risk factors for periodontal disease. The results showed that most respondents had fair oral hygiene status, and there was a significant relationship between water consumption and oral hygiene status.

In the districts of Genuk and Gayamsari, the pH levels of well water range between 4 and 8, with total dissolved solids (TDS) values of less than 3 ppm. The dug wells are relatively shallow, with depths of less than 4 meters and the shallowest recorded at 0.47 meters. The condition of bore wells shows that nearly all are infiltrated by groundwater, and almost all samples contain suspended solids. The water from dug wells occasionally appears turbid or even black in color, and most wells in this area produce water with a brackish to saline taste. The use of artesian water can potentially cause dental damage, both aesthetically and functionally, thereby affecting an individual's quality of life. Furthermore, untreated or contaminated artesian water may contribute to oral health problems, such as infections or mucosal irritation. Conversely, artesian water can benefit oral health when it originates from a clean and safe source.

References.

1. Bhakti Mirda Ihsani, M., Sarwo, I., Hidayati, S., Kesehatan Gigi, J. & Kemenkes Surabaya Corresponding Author, P. A Description of Knowledge Regarding Proper Tooth Brushing Techniques in Middle School Students. *E-Indonesian Journal of Health and Medical* **3**, (2023). <http://ijohm.rcipublisher.org/index.php/ijohm>
2. Health Policy Agency, Ministry of Health of the Republic of Indonesia. Indonesia Health Survey (SKI) 2023. (Ministry of Health, 2023). <https://www.badankebijakan.kemkes.go.id/ski-2023-dalam-angka>
3. Sukanti Eka, Eriyati, Yenti Aflinda, Faisal Muhammad & Dewi Triana. The Relationship Between Oral Hygiene and Gingival Condition Among Middle School Students (In Indonesian). *Jurnal Menara Medika* **6**, (2024).
4. Lertpimonthai, A., Rattanasiri, S., Arj-Ong Vallibhakara, S., Attia, J. & Thakkestian, A. The association between oral hygiene and periodontitis: a systematic review and meta-analysis. *International Dental Journal* **67**, 332–343 (2017). <https://doi.org/10.1111/idj.12317>
5. Dubey, P. & Mittal, N. Periodontal diseases- A brief review. *International Journal of Oral Health Dentistry* **6**, 177–187 (2020).
6. Pariati & Lanasari, N. A. Oral Hygiene and its Association with Dental Caries Incidence in Elementary School Children in Makassar (In Indonesian). *Media Kesehatan Gigi* **20**, (2021).
7. Auli, I., Mulyanti, S., Insanuddin, I. & Supriyanto, I. A Profile of Oral and Dental Health Status Among Older Adults in Various Indonesian Cities (In Indonesian). *Jurnal Kesehatan Siliwangi* **1**, 79-85 (2021). <http://juriskes.com>
8. Nazir, M. *et al.* Global Prevalence of Periodontal Disease and Lack of Its Surveillance. *Scientific World Journal* **2020**, (2020).
9. Lipsky, M. S., Su, S., Crespo, C. J. & Hung, M. Men and Oral Health: A Review of Sex and Gender Differences. *American Journal of Men's Health* **15**, (2021). <https://doi.org/10.1177/15579883211016361>
10. Rahayu, C., Sopianah, Y., Gigi, J. K. & Tasikmalaya, K. Oral Hygiene and Periodontal Status of Diabetes Mellitus Patients in Tasikmalaya City's Primary Health Centers (In Indonesian). *Jurnal Ilmiah Keperawatan Gigi (JIKG)* **1**, (2020).
11. Luo, H. *et al.* Oral Health, Diabetes, and Inflammation: Effects of Oral Hygiene Behaviour. *Int Dent J* **72**, 484–490 (2022).
12. Kasenda, H., Sambiran, S. & Sumampow, I. The Transparency of Sub-District Fund Management for Development in Ranomea Sub-District, East Amurang District, South Minahasa Regency. *Jurnal Governance* **1**, (2021).
13. Wicaksono, B., Iduwin, T., Mayasari, D., Putri, P. S. & Yuhannah, T. Simple Water Purifier Device Education for Meeting Clean Water Requirements (In Indonesian). *Jurnal Pengabdian Pada Masyarakat Menerangi Negeri* **2**, 43–52 (2019).
14. Dar, A. A. *et al.* Water Fluoride Concentration in Kashmir Valley and Ladakh Division-a Descriptive Epidemiological Study. *Journal of Research* **18**, (2025). www.IndianJournals.com
15. Romanenko Ye H, Hryhorenko L V, Komsnyi M P, Sribnyk P L & Sinkovska O O. Nitric Oxide Formation In The Metabolism Of Nitrates In The Oral Cavity. *Zaporozhye Medical Journal* **21**, (2019).