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The Association Between Dental Caries and Halitosis in Patients with Substance Use Disorder (SUD) at Lido Rehabilitation Center

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Abstract
Patients with substance use disorders are known to harm their oral health. Drug effects can induce vasoconstriction and reduce the salivary flow. The reduction in salivary flow may alter salivary pH, and a lower pH can accelerate dental caries. Furthermore, dental caries can increase the production of volatile sulfur compounds (VSCs) through bacterial degradation of food debris, contributing to halitosis. This cross-sectional study involved 100 respondents at Lido Rehabilitation Center. Data was collected in August 2025. The independent variable is dental caries, measured using the DMF-T index, and the dependent variable is halitosis, evaluated using the organoleptic method. Other risk factors, including age, sex, education, occupation, smoking history, alcohol consumption history, systemic diseases, type of drugs, and dental scaling history, were identified. The correlation between these variables was analyzed using the Chi-square test. The study found that 98 participants had dental caries and 68 had halitosis, with an average DMF-T score of 8.35. The analysis showed no significant relationship between dental caries and halitosis (p=0.516). However, the history of dental scaling was significantly correlated with halitosis severity (p=0.049). This study shows that the prevalence of dental caries and halitosis among the respondents is relatively high. Dental caries showed no significant correlation with halitosis among patients with substance use disorder (SUD). Routine scaling by a dental professional should be implemented at the Lido Rehabilitation Center.

Keywords: Dental Caries, Halitosis, Patient with Substance Use Disorder (SUD), Lido Rehabilitation Center, Organoleptic Method.

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1. INTRODUCTION

Drug abuse remains a serious public health problem in Indonesia, and can negatively affect overall health, including oral health. According to data from 2023, the prevalence of people using drugs within a year is 1.73%, or 3.33 million (Sulistyorini et al., 2024). Moreover, the Indonesian Drug Report in 2024 shows the most commonly used drugs in Indonesia are reportedly cannabis at 44.69%, methamphetamine at 22.06%, nipamzepamine at 11,17%, trihex at 3.49%, and other types (Sulistyorini et al., 2024). Based on the National Health Research on drug users in 2019, it shows that 59.5% of drug users experience oral cavity infections, while 64.1% suffer from oral cavity disorders (Irianto et al., 2019). Methamphetamine, a type of stimulant drug, is known to induce vasoconstriction and reduce blood flow to the salivary glands, leading to decreased saliva production or xerostomia (Clague et al., 2017).

Saliva is a biological fluid in the oral cavity that helps maintain oral health (Einhorn et al., 2020). A decrease in saliva production can alter saliva pH. A low saliva pH can accelerate dental caries development by creating an acidic environment that favors bacteria that cause dental caries and facilitates demineralization (Markus et al., 2023). Previous studies show that the average DMF-T score for drug users was 7.1 in Makassar and 9 in Lido (Pasiga et al., 2020; Parorrongan et al., 2025). A reduction in saliva production among drug users can lead to xerostomia and make the oral cavity more susceptible to dental caries, periodontal disease, halitosis, and candidiasis (Cossa et al.,2020). Dental caries is generally characterized by localized damage to the tooth structure caused by exposure to acidic substances in the mouth. Dental caries is a multifactorial disease resulting from the interaction among the host (teeth), microorganisms, the substrate, and time. Other than that, several main risk factors contributing to dental caries include decreased saliva flow rate and reduced buffering capacity (Muñoz et al., 2024). Additionally, dental caries can increase levels of Volatile Sulfur Compounds (VSC) by allowing bacteria to decompose food residues, leading to halitosis (Adnyani et al., 2016). Halitosis is a term commonly used for an unpleasant odor that arises from the mouth cavity when breathing or speaking (Khounganian et al., 2023).

Halitosis consists of intra-oral and extra-oral halitosis. Intra-oral halitosis results from gram-negative bacterial synthesis of VSC compounds. It can occur with tongue plaque buildup, extensive dental caries, and xerostomia (Khounganian et al., 2023). Extra-oral halitosis may result from respiratory tract infections, gastrointestinal diseases, and other causes. The volatile sulfur compounds (VSCs) present in intra-oral and extra-oral halitosis differ. In intra-oral halitosis, the detected VSCs include methyl mercaptan and hydrogen sulfide, whereas in extra-oral halitosis, dimethyl sulfide is found. Approximately 85-90% of the leading causes of halitosis are intraoral factors (Izidoro et al., 2022; Kapoor et al., 2016). In assessing halitosis, the organoleptic method is considered the gold standard. This method test is performed by the examiner using their sense of smell to assess the subject's breath odor, which is then evaluated using a specific scale (Dayma et al., 2020) According to the study by Teshome et al., 81.3% of people with dental caries also have halitosis, and individuals with dental caries are at a high risk of halitosis, with a risk factor of 8.74 times compared to individuals without dental caries (Teshome et al., 2021).

The National Narcotics Agency (BNN) plays a vital role in managing the prevention and eradication of drug abuse and illegal drug circulation. It also conducts medical rehabilitation programs for people with addiction and substance use disorders. Lido Rehabilitation Center, one of the largest centers of its kind, is located in Wates Jaya Village, Cigombong District, Lido, Bogor Regency, West Java. It offers community services through integrated rehabilitation for drug abuse and addiction, focusing on medical, psychological, and social aspects. Based on the previous explanation, this study aims to examine the relationship between dental caries and halitosis in individuals with substance use disorders.

2. RESEARCH METHOD

This cross-sectional study was conducted at Lido Rehabilitation Center and involved 100 respondents who were currently undergoing treatment and had provided informed consent. Data collected in August 2025 with the following inclusion criteria: clients who are in the advanced rehabilitation phase, voluntarily agree to participate in the research, and have signed informed consent as research respondents, and exclusion criteria included participants who were unable to attend due to strict observation, and those with infectious diseases (HIV, Hepatitis B and C, Tuberculosis).

The independent variable in this study is dental caries, defined as the total of tooth decay, assessed by calibrated dentists during oral examinations using a mouth mirror and a probe. Dental caries was assessed using the DMFT index, categorized into four groups: no caries, low (total tooth decay 1-3), moderate (total tooth decay 4-6), and high (total tooth decay ≥ 7) (Mohaus, 2019). The dependent variable in this study is halitosis. Halitosis was measured using the organoleptic method, the gold standard for assessing halitosis. This assessment involves a blinding examiner using their sense of smell to detect halitosis (Kameyama et al., 2015; Kapoor et al., 2016). The examination was performed with the respondent exhaling for 5-10 seconds (Teshome et al., 2021). The assessment was carried out at 15 cm from the straw, then at 10 cm and 5 cm. A partition was used between the examiner and the respondents to maintain objectivity in the assessment. Respondents were also instructed not to eat or drink for 2 hours after breakfast to prevent false results (Alasqah et al., 2016; Aydin et al.,2016). Afterwards, the examiner evaluated the halitosis using a 4-point scale: scale 0 (no odor/halitosis), scale 1 (slight odor/mild halitosis and detectable at 5 cm from the straw), scale 2 (moderate halitosis detectable at 10 cm from the straw), and scale 3 (strong halitosis detectable at 15 cm from the straw) (Alasqah et al., 2016). Respondents with a halitosis scale of 0 were categorized as non-halitosis, while those with scales 1-3 were categorized as having halitosis. Potential cofounders in this study included the type of drugs used, age, gender, highest level of education, occupation, history of systemic diseases, smoking history, alcohol consumption history, and history of scaling.

Ethical clearance was obtained from the Ethical Review Committee (No. 949/S3/KEPK/FKG/6/2025). In this study, calibration was employed to ensure consistent and accurate assessments of halitosis. The halitosis calibration was conducted in August 2025 with an oral medicine specialist as the gold standard. The protocol was as follows: three examiners performed the examinations, each assessing 20 subjects, and the examination results were compared. The inter-examiner kappa value was 0.75, indicating strong agreement. For the dental caries variable, since a dentist would conduct the examination, the researcher standardized the measurement instrument to be used, namely the DMFT index.

Data analysis uses descriptive and bivariate analyses to determine the relationship between the dependent variable and each independent variable. Univariate analysis was conducted to characterize respondent characteristics. The normality of the data was evaluated through skewness, histograms, and the Kolmogorov test. According to the skewness value (>2), as well as the histogram graph test, the shape does not resemble a bell-shaped distribution, and the Kolmogorov test ($p<0.05$) indicates that the data are not normally distributed. A bivariate analysis using the chi-square test was conducted to examine the association between dental caries and halitosis. Additionally, the other risk factors were analyzed using the chi-square test.

3. RESULTS AND DISCUSSION

This study included 100 respondents who met the inclusion criteria, and their characteristics are presented in Table 1. Overall, most of the participants are in the age range of 25-49 years (74%), and national data shows that in 2021, the prevalence of patients with substance use disorder aged 25-49 was higher compared to the 15-24 and 50-64 age groups. The 25-49 age group is considered the productive age. Individuals in this age group face greater

exposure risks, which can be attributed to the phase when they have higher social activity levels and economic independence. As a result, they are more frequently exposed to various risks, such as work demands, extensive social interactions, and easy access to addictive substances (UNODC,2025; Pidada et al., 2021).

Most respondents in this study are male (93%) compared to females (7%). The World Drug Report (2025) indicates that males are significantly more likely to use drugs than females (UNODC, 2025). Males tend to be more susceptible to environmental stimuli or pressures and often act impulsively without considering the consequences, making them more at risk of drug abuse (Pidada et al., 2021).

Based on education level, the majority of respondents have a senior high school education (42%). It aligns with the 2021 national drug abuse survey, which shows that the group with a senior high school education or equivalent constitutes the largest proportion, at 39.9%. It may be explained by the fact that adolescence is a critical phase to external influences, as individuals are experiencing transitional periods socially, physiologically, and psychologically. During this stage, individuals tend to exhibit high curiosity without fully considering potential risks, increasing their vulnerability to drug abuse (Pidada et al., 2021).

Most respondents are known to have a history of smoking (96%) and alcohol consumption (69%). Both behaviors are considered gateway behaviors that increase the risk of experimenting with narcotics, as they may lead individuals to try other addictive substances. Among various types of drugs, the most frequently used in this study is methamphetamine (58%). It may be because methamphetamine is relatively easy to obtain and has a lower cost compared to other types of drugs (Effendi et al., 2025).

Table 1. Characteristics of respondents and statistical results

Variables	No Halitosis (N=32)	Halitosis (N=68)	p-value	OR		95% CI
Dental caries						
No Caries	0	2	ref	ref		ref
Low Caries (1-3)	8	13	0.999	717988 e-	0.000	-
Moderate (4-6)	8	17	0.547	0.722	0.250	2.083
High (>= 7)	16	36	0.913	0.944	0.338	2.635
Age (years)						
15-24	5	19	0.347	3.80	0.201	72.00
25-49	26	48	0.669	1.84	0.111	30.74
50-64	1	1	ref	ref		ref
Sex						
Male	28	65	0.206	0.323	0.068	1.539
Female	4	3	ref	ref	ref	
Education level						
Low	3	6	0.528	0.545	0.83	3.590
Medium	26	51	0.368	0.535	0.137	2.087
High	3	11	ref	ref		ref
Unemployed	13	32	0.698	0.770	0.329	1.803
Employed	19	36	ref	ref		ref
Alcohol Consumption						
No	9	22	0.846	0.818	0.325	2.059
Yes	23	46	ref	ref		ref
Smoking History						

No	2	2	0.591	2.20	0.296	16.36
Yes	30	66	ref	ref		ref
Systemic Diseases						
No	22	49	0.917	0.853	0.341	2.132
Yes	10	19	ref	ref		ref
Type of Drugs						
Single	23	47	0.818	0.817	0.147	4.537
2 or 3 combinations	7	16	0.925	0.914	0.142	5.902
4 combinations	2	5	ref	ref		ref
Dental scaling history						
Never	5	25	0.006*	8.0	1.833	34.90
≤ 6 months	19	38	0.067*	3.2	0.921	11.121
> 6 months	8	5	ref	ref		ref

This study used the DMFT index to assess dental caries and found that 98% of respondents had caries, with decay components of 683, missing teeth of 106, and fillings of 46, yielding an average DMFT score of 8.5. This result is similar to previous studies conducted at the BNN Lido Rehabilitation Center, which reported an average DMF-T of 9, and at BNN Baddoka Makassar, which found an average of 7.13. It indicates that patients with substance use disorder tend to have a higher level of dental caries (Musa, 2018; Parorrongan et al., 2025). Drug abuse can cause negative effects on the oral cavity, such as a decrease in saliva flow rate, which can lead to a more acidic mouth environment, which may increase the risk of dental caries.

Dental caries can promote the growth of anaerobic bacteria and produce volatile sulfur compounds (VSCs), which are the main etiological factors of halitosis (Khounganian et al., 2023). These compounds can increase the risk factors for halitosis. According to a 2018 study by Silva et al., the global prevalence of halitosis was estimated at 31.8% (Silva et al., 2018). Another study by Aimetti et al. found that the prevalence of halitosis in Northern Italy was 53.51%, and a study by Du et al. found that 65.9% of their respondents experienced halitosis (Aimetti et al., 2015; Du et al., 2019). In this study, 68% of patients with SUD experienced halitosis, with the highest score being 1 (mild halitosis, reported by 34 respondents). It was followed by a score of 2 (moderate) among 22 respondents and 3 (strong) among 12 respondents. Therefore, the prevalence of halitosis in this study is higher than the global average prevalence and the two previous studies. Halitosis was commonly found in respondents with severe dental caries.

Table 1 also presents the statistical results for dental caries and halitosis, along with other risk factors. In this study, halitosis was observed frequently among respondents in the high caries category. However, statistical analysis revealed no significant association between caries and halitosis (p=0.516). Halitosis is known to arise from bacterial synthesis of volatile sulfur compounds (VSCs). Caries assessment in this study used the DMFT index, with decayed teeth defined as clear cavities, enamel damage, soft base or walls, and CPI probe penetration into the cavity (Naji et al., 2024). The application of these criteria resulted in respondents with dentine caries and deep caries being classified into the same category, despite their potentially different risks of halitosis. In other words, the severe caries category may have been predominantly comprised of enamel caries, whereas VSC compounds are typically found in deep caries or cases involving pulp exposure (Bollen & Beikler, 2012; Khounganian et al., 2023).

Based on the analysis of the relationship between other risk factors and halitosis, the 25-49 age group had the highest number of halitosis cases (n=48). However, the chi-square test indicated no significant relationship between age and halitosis (p=0.367). The high prevalence of halitosis in the 25-49 age group among patients with substance use disorder can be explained by the use of drugs, cigarettes, and alcohol, which are known to decrease saliva flow rate and promote the growth of anaerobic bacteria, thereby contributing to the development of halitosis.

Additionally, poor oral hygiene, periodontal disease, and plaque buildup can be more dominant factors in the occurrence of halitosis (Du et al., 2019).

By gender, males (n=65) were more frequently found to have halitosis than females (n=3), but the difference was not statistically significant (p=0.206). The high prevalence among drug patients with substance use disorder in male respondents can be explained by the use of alcohol and smoking among patients with substance use disorder. These habits decrease salivary flow and increase plaque, key factors in VSC formation, leading to halitosis. (Du et al., 2019). Additionally, males tend to have poorer oral hygiene, such as less frequent toothbrushing. It can lead to poor oral health and increase the risk of halitosis (AlSadhan, 2016).

At the educational level, respondents with a medium level of education had the highest number of halitosis cases (n=51), but the analysis showed no significant correlation between education level and halitosis (p=0.658). In this study, the prevalence of halitosis was higher in the group with a medium education level than in those with low or high education levels. This may be due to a knowledge gap and to the lack of implementation of oral and dental health behaviors. Respondents with a high school education generally have basic knowledge about oral and dental health. However, this knowledge is often not followed by optimal oral hygiene practices, which can lead to plaque accumulation, a major factor causing halitosis (Kristianingsih, 2019).

Regarding employment status, employed respondents (n=36) reported more halitosis cases than unemployed respondents (n=32), but the difference was not statistically significant (p=0.698). The high prevalence of halitosis among employed respondents may be due to lifestyle factors and stress, which can affect oral hygiene. Employed individuals generally have busy schedules, long working hours, and higher stress levels, which can lead them to delay or neglect dental care. This condition can increase plaque accumulation and tongue coating, both of which are primary causes of halitosis. Additionally, stress is known to affect the autonomic nervous system and reduce saliva flow rate. This decrease can impair self-cleaning, supporting the growth of anaerobic bacteria that produce VSCs, potentially causing halitosis (Briguglio et al., 2021).

The analysis also shows that smoking history (n=66) and alcohol consumption (n=46) are associated with a higher number of halitosis cases compared to respondents without these histories. However, the analysis indicates no significant relationship between smoking history (p=0.591) or alcohol consumption (p=0.846) and halitosis. The higher prevalence of halitosis among respondents with smoking and alcohol histories is mainly related to the effects of these substances on saliva and the microbial environment in the oral cavity. Smoking is known to decrease saliva flow rate, reducing the mouth's self-cleaning ability and facilitating the growth of VSC-producing anaerobic bacteria, which are the main cause of halitosis (Wu et al., 2020). Alcohol consumption can also contribute to halitosis by decreasing saliva flow, leading to a dry mouth that supports anaerobic bacterial growth, thereby increasing the occurrence of halitosis (Kapoor et al., 2016).

Based on the type of drugs used, respondents who used single-type drugs showed that there was no significant relationship between the type of drug and halitosis (p=0.957). In this study, the most commonly used type of drug was single-type, especially methamphetamine. Among patients with substance use disorder, particularly stimulants like methamphetamine, which can cause vasoconstriction leading to narrowing of blood vessels and reducing blood flow to the salivary glands, resulting in decreased saliva production or xerostomia in drug abusers (Clague et al., 2017). Xerostomia can reduce self-cleansing ability, accelerate plaque accumulation, promote tongue coating formation, and worsen periodontal disease, which is a primary source of VSC production (Kapoor et al., 2016). The effects of drug use can persist even after the substance use has stopped, so halitosis is still commonly found in patients with substance use disorder (Mukherjee et al., 2018).

Unlike other risk factors, the analysis results indicate a significant relationship between scaling procedures and halitosis (p=0.014). Among respondents who had never undergone scaling, 25 of 30 (83.3%) experienced halitosis. Meanwhile, among respondents who had undergone scaling less than 6 months ago, 38 of 57 (66.7%) experienced halitosis, and among those who had undergone scaling more than 6 months ago, 5 of 13 (38.5%) experienced halitosis. The lower halitosis rate in the group with a history of scaling for over 6 months may be influenced by the smaller sample size, leading to uneven data distribution. Additionally, respondents in this group may have been in rehabilitation longer, stopped smoking, alcohol consumption, and drug use, and received education about oral health, resulting in better oral cavity conditions and a lower incidence of halitosis. Furthermore, a study by Silveira et al. found that scaling treatment can reduce organoleptic scores. It suggests that removing bacterial deposits from the oral cavity may lower organoleptic scores (Silveira et al., 2017).

This study has several limitations that should be acknowledged. First, the cross-sectional design restricts the ability to establish causal relationships between dental caries and halitosis, as data were collected at a single time point without longitudinal follow-up to observe disease progression or temporal associations. Second, the DMFT index categorization used in this study may have limited the ability to detect a true association between caries severity and halitosis. The criteria for decayed teeth defined as clear cavities, enamel damage, soft base or walls, and CPI probe penetration into the cavity resulted in respondents with dentine caries and deep caries being classified into the same severity category. Consequently, the severe caries group may have been predominantly comprised of enamel caries rather than deep caries involving pulp exposure. In contrast, volatile sulfur compounds (VSCs) are typically found in advanced lesions involving pulpal tissue.

The findings of this study carry important implications for clinical practice, healthcare policy, and future research. Clinically, the significant association between scaling history and halitosis (p=0.014) suggests that professional dental scaling should be prioritized and implemented as a mandatory component of oral health programs in rehabilitation centers for patients with substance use disorders. Given the high prevalence of both dental caries (98%) and halitosis (68%) observed in this population, routine comprehensive oral examinations and prophylactic scaling should be integrated into standard care protocols at rehabilitation facilities.

4. CONCLUSION

Based on the study results, the prevalence of dental caries and halitosis in respondents is relatively high. There is no significant correlation found between caries and halitosis among drug users at the BNN Lido Rehabilitation Center. However, scaling factors showed a significant correlation with halitosis. This study recommends dental scaling as a mandatory treatment for clients in Lido to maintain oral health.

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