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Impact of Smoking on Halitosis and Oral Bacterial Infections

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Abstract

Objective: The present study sought to investigate the frequency of halitosis in a sample of smokers and non-smokers and the association of smoking and perceived oral bacterial infections. **Material and Methods**: A questionnaire was administered to 301 respondents. The structured questionnaire included demographics, oral hygiene behaviors, medical and dental history, lifestyle behaviors, awareness of halitosis and its social consequences in others. Statistical analyses were performed with chi-square tests to identify any associations of halitosis and possible risk factors. **Results**: Among respondents, 22.9% self-reported using tobacco products while 63.4% self-reported experiencing halitosis sometimes or frequently. Smoking, periodontal disease, dental caries, poor clinical hygiene (not brushing, not flossing or using mouthwash) and some systemic diseases were related to self-reporting halitosis ($P < 0.01$). Only 9.6% of respondents accessed treatment. Most respondents (86%) realized their halitosis themselves rather than it being diagnosed professionally. **Conclusion**: This study provides insight into the relationship between smoking and self-reported halitosis and the need for greater awareness and tailored public health initiatives.

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Introduction

Halitosis, also known as bad breath, is a common problem for many people all around the world. It can result from many local or systemic factors – almost 90% of halitosis cases are due to oral factors. Among these oral reasons, oral malodor comes from an imbalance in the oral ecosystem, so that microbial degradation of food debris, epithelial cells and blood products in the mouth cause volatile sulfur compounds (VSCs), including hydrogen sulfide and methyl mercaptan, which are the principal odor components of oral malodor [1].

It is well known that one of the greatest risk factors for halitosis is smoking, due among other factors to multiple effects on the oral ecosystem. For example, smoking worsens plaque accumulations, decreases salivary flow, changes the oral flora, and increases pathogenic anaerobic bacteria producing VSCs [2]. Additionally, smokers are more likely to have periodontal diseases and dental caries, both of which are strongly related to halitosis and bacterial overgrowth [3].

Aside from its physiological effects, halitosis has psychosocial outcomes, such as embarrassment, poor self-esteem, and social isolation among individuals when they do not know they have it or want to treat it [4].

Several studies have examined the relationship between smoking and oral ailment, but focused investigations that assess the combined effect of smoking on halitosis and oral bacterial infections in a population-based research design are still necessary. The survey-based studies provide an insight into the respondents' personal habits and hygiene behavior, as well as their perceptions of themselves regarding oral health.

Consequently, this study, sought to establish the prevalence of halitosis and its relationship with the infection caused from oral bacteria in smokers. The outcomes of this study should help establish the behavioral and clinical aspects of both problems of halitosis and support the development of public health strategies to address the overall oral health issue of smokers [5].

Materials and Methods

The study included 301 participants from all age groups, backgrounds and levels of education. Participants provided the study with social diversity through convenience sampling. Also, participants under 10 years of age were excluded, as well as individuals unwilling to participate. Initially, participants completed verbal informed consent from the

study crew. The study consisted of a fully voluntary written questionnaire.

The questionnaire had both closed-ended and multiple-choice questions. The questionnaire asked basic participant demographical information and was constructed in 5 areas of interest:

- Demographical Information: age, gender, and highest educational level completed.
- Dental Hygiene Practices: frequency of brushing teeth, use of mouthwash, tongue cleaning, flossing, brushing technique, and how the participant brushes.
- Dental and Health History: history of periodontal disease/periodontal disease, history of decay, malocclusion of teeth, and systemic diseases.
- Lifestyle: history of smoking (length of time and quantity of smoking), history of using vape products, consumption of alcohol, and food choices.
- Halitosis: participant self-reported frequency of halitosis, indication of when participants report awareness of halitosis awareness, treatment history, and psychological or social problems associated with halitosis.

In-person administration of the questionnaire was utilized with the researcher clarifying any item that may not have been fully understood to adequately avoid any misinterpretation by the participants. Given that all responses were anonymous, the participants were excited to reflect their thinking honestly and demonstrate their skills to their peers.

The data were statistically analyzed using IBM SPSS Statistics (version 26), (2019). Descriptive statistics were used to summarize frequencies and percentages. Chi-square tests (χ^2) were utilized to determine the associations between halitosis and other categorical variables such as smoking status, oral hygiene behaviors, sickness and health conditions.

The statistical significance was examined at two levels:

- $P \leq 0.05$: Statistically significant
- $P \leq 0.01$: Highly statistically significant
- NS: Not Significance ($P > 0.05$)

This analysis provided significant associations between smoking and halitosis and other oral health indicators.

Results

A total of 301 participants were included in this study; 218 (72.4%) were male, and 83 (27.6%) were female. The age group 21-31 years had the highest representation of participants (56.8%), followed by the 10-20 years group (20.9%). Most participants were educated at the university level (78.4%), with no participants having attained postgraduate education (10.6%) or had less than high school education.

Oral Hygiene Practices

Most (94.4%) of the participants reported brushing their teeth, with 46.2% responding they brushed their teeth twice a day and 14.3% brushing three or more times. Approximately 32.2% of individuals used mouthwash, while 52.8% cleaned their tongue. Nonetheless, a considerable number of participants (67.8%) did not use mouthwash consistently. With respect to the frequency of visiting the dentist, half of the participants (51.5%) visited the dentist once per year and just 14.3% reported having more than three visits a year.

Smoking and Halitosis

Of the participants, 69 (22.9%) reported smoking. Most of them had been smoking for more than 3 years (10%); 6% and 4.3% reported smoking for 3 and 2 years respectively. A small number of participants reported daily smoking of 1-20 cigarettes (9.3%), and 12.6% reported vaping.

Self-reported halitosis was prevalent:

- 59.1% said they sometimes had it,
- 4.3% often had it,
- and 36.5% said they rarely or never had it.

Just 3% admitted to suffering from bad breath and 12% said they had bad breath sometimes. In fact, 86% of the respondents said they realized they had bad breath by having self-realization and only 10.3% were notified of having bad breath.

Oral and Systemic Health

- 32.2% of respondents had periodontal disease,
- 62.1% had dental caries,
- 35.9% reported malocclusion.
- 11.6% had systemic disease, with the most common being paranasal sinus conditions (27.9%), allergies (12.6%) and respiratory issues (7%).

There was a significant association for halitosis and smoking status ($P < 0.0001$), dental caries ($P < 0.0001$), and periodontal disease ($P < 0.0001$). Lifestyle factors including not cleaning the tongue, irregular brushing habits and infrequent floss or mouthwash use were also statistically associated with bad breath.

Social Impact of Halitosis

Only 9.6% of participants indicated that they had received any treatment for halitosis, with 17.3% used techniques associated with oral hygiene (like cleaning the mouth). Most (59.9%) did not have a method for dealing with halitosis. Some social effects were also related, such as 8% indicated they had social problems due to bad breath and 40.9% were concerned about how others perceived their breath.

Statistical Summary

Using the Chi-square test, statistically significant relationships ($P \leq 0.01$) were found between halitosis and the following factors, see table 1:

- Smoking Habits
- Technique and frequency of tooth brushing
- Use of floss and rinses
- Periodontal and dental disease
- Pattern of breathing
- The presence of systemic illness

Discussion

The results of this study shown a marked association between smoking and the prevalence of halitosis and oral microbial infections for the participants surveyed. The majority of participants reporting halitosis were smokers, indicating a strong connection between tobacco use and the presence of oral malodor. This agrees with other studies that demonstrated smoking predisposes individuals to pathogenic dental plaque and periodontal pathogens, and smoking is known to reduce salivary flow [3,6].

The high percentage of individuals reporting occasional halitosis (59.1%) shows how common this condition is. However, the much lower percentage of individuals seeking care for this condition (9.6%) speaks to the public's lack of awareness. Halitosis is a socially sensitive, stigmatizing condition, including data from this study that indicated that most participants (86%) reported noticing their own halitosis and did not have a medical professional document their apparent halitosis [1]. This may delay or ignore appropriate management.

Poor oral hygiene practices were significantly related to halitosis and are consistent with previous literature. Irregular brushing habits, no flossing habits, and limited use of mouthwash and tongue cleaning had statistically significant associations with bad breath. These behaviors provide areas for retention of food debris and bacterial plaque and are compounded in smokers who have an already altered oral microbiome [2]. The amount of mouthwash use (32.2%) is

important because it is known to reduce anaerobic bacteria loads and VSCs when utilized regularly [7] and highlights the need for educating the population on the importance of preventive care.

This study also confirmed the strong association of halitosis and oral diseases, especially periodontal disease (32.2%) and dental caries (62.1%). These two diseases have been established in previous literature to promote oral malodor due to the colonization of anaerobic bacteria in periodontal pockets and carious lesions [8]. Furthermore, systemic illnesses such as rhinosinusitis, allergies, and respiratory diseases also showed signification correlation with halitosis and lends itself to some consideration of the notion that it should be recognized that extraoral sources must be determined as part of diagnosis and treatment [4].

The psychosocial burden of halitosis was evident with 40.9% of respondents concerned with how others perceived their breath and 8% of participants reported social problems. These findings corroborate previous research demonstrating a psychological burden related to halitosis including embarrassment, social anxiety and reduction in self-esteem [9]. The gap between symptom perception and action supports the need for public health materials around halitosis, as well as provide some access to dental services. Overall, our findings highlight the multifactorial etiology of halitosis, where smoking is an important modifiable risk factor. Addressing smoking cessation while supporting oral hygiene practices and regular visits to the dentist, may lessen the burden of halitosis and infections.

Conclusions

This study showed a strong relationship between tobacco use and the incidence of halitosis and oral bacterial disease. Smokers were more likely to report symptoms of bad breath, and had higher prevalence of periodontal disease and dental caries, both of which are major contributors to oral malodor. Inadequate oral hygiene such as sporadic brushing habits, lack of tongue cleaning, and less frequent mouthwash and flossing habits were also strongly associated with halitosis.

These results suggest that halitosis is not just a social or aesthetic issue; it may be a clinical reflection of serious oral health issues, especially when observed in an individual with poor hygiene behaviors or tobacco habits. Finally, the observed low levels of treatment-seeking behavior and awareness of halitosis, highlights the need for more public education and the need for preventive strategies.

In conclusion, halitosis can be limited by addressing risk factors that are potentially modifiable (e.g. tobacco habits, oral hygiene practices), and implementing better access to dental care, and/or awareness programs will potentially reduce the burden of halitosis or related oral bacterial infections among non-clinical populations.

References

1.Porter, S. R., & Scully, C. (2006). Oral malodor (halitosis). *BMJ*, 333(7569), 632–635. https://doi.org/10.1136/bmj.38954.631968.AE

2.Lee, S. S., Zhang, W., & Li, Y. (2007). The antimicrobial potential of 14 natural herbal dentifrices: A comparative study using an in vitro biofilm model. *Journal of the American Dental Association*, 138(3), 351–357.

3.Aylıkcı, B. U., & Çolak, H. (2013). Halitosis: From diagnosis to management. *Journal of Natural Science, Biology, and Medicine*, 4(1), 14–23. https://doi.org/10.4103/0976-9668.107255

4.Miyazaki, H., Sakao, S., Katoh, Y., Takehara, T. (1995). Correlation between volatile sulfur compounds and certain oral health measurements in the general population. *Journal of Periodontology*, 66(8), 679–684.

5.Alkhafaji, S. H. A., Al-Sudani, S. F. K., & Alsunbuli, M. M. B. (2025). Smoking and the hidden consequences: Bad breath and oral infection of bacteria. Microbial Biosystems, 10(4), [in press].

6.Scully, C., & Greenman, J. (2012). Halitosis (breath odor). *Periodontology 2000*, 48(1), 66–75. https://doi.org/10.1111/j.1600-0757.2008.00267.x

7.Young, A., Jonski, G., & Rölla, G. (2003). A study of triclosan and zinc citrate as combined agents in mouthwash: the effect on volatile sulfur compounds. *Journal of Clinical Periodontology*, 30(4), 300–306.

8.Rosenberg, M., & McCulloch, C. A. G. (1992). Measurement of oral malodor: current methods and future prospects. *Journal of Periodontology*, 63(9), 776–782.

9.Kumar, S., Tadakamadla, J., & Johnson, N. W. (2016). Effect of self-perceived halitosis on social interactions: A systematic review. *Journal of Oral Rehabilitation*, 43(10), 875–883. https://doi.org/10.1111/joor.12438

Table 1. Associations between halitosis and the different factors.

Questionnaire	Number of respondents	Percentage (%)	χ^2 (P-value)
Gender			
Males	218	72.4%	60.548 ** (0.0001)
Females	83	27.6%	
Total	301	100%	--
Age			
10-20	63	20.9%	72.605 ** (0.0001)
21-31	171	56.8%	
32-43	47	15.6%	
44-55	14	4.7%	
56-66	5	1.7%	
More than 66	1	0.3%	
Total	301	100%	--
Education level			
Primary School	8	2.7%	648.11 ** (0.0001)
Junior high school	8	2.7%	
High School	17	5.6%	
University	236	78.4%	
Master degree	32	10.6%	
Total	301	100%	
Frequency of dental visit per year			
1	155	51.5%	114.82 ** (0.0001)
2	59	19.6%	

3	44	14.6%	
3<	43	14.3%	
Total	301	100%	
Do you brush your teeth?			
Yes	284	94.4%	236.84 ** (0.0001)
No	17	5.6%	
Total	301	100%	
Frequency of toothbrush per day			
1	116	38.5%	159.26 ** (0.0001)
2	139	46.2%	
3	43	14.3%	
3<	3	1%	
Total	301	100%	
Do you use mouthwash?			
Yes	97	32.2%	38.04 ** (0.0001)
No	204	67.8%	
Total	301	100%	
Tongue cleaning			
Yes	159	52.8%	0.960 NS (0.3272)
No	142	47.2%	
Total	301	100%	
Suffering from halitosis			
Never/rarely	110	36.5%	122.87 **

Sometimes	178	59.1%	(0.0001)
Frequently	13	4.3%	
Total	301	100%	
Frequency of tooth brushing			
After every meal	41	13.6%	107.67 ** (0.0001)
Twice/day	136	45.2%	
Once/day	100	33.2%	
Some times	24	8%	
Total	301	100%	
Timing of tooth brushing			
Before bed	55	18.3%	86.920 ** (0.0001)
Morning	46	15.2%	
Morning and before bed	145	48.2%	
No fixed time	55	18.3%	
Total	301	100%	
Way of tooth brushing			
Vertical stroke	63	20.9%	11.758 ** (0.0083)
Horizontal stroke	61	20.3%	
Semi-circular	79	26.2%	
Gum to incisal edge	98	32.6%	
Total	301	100%	
Carbohydrate foods			
Yes	240	79.7%	106.44 ** (0.0001)

No	61	20.3%	
Total	301	100%	
Breathing Pattern			
Through the mouth	29	9.6%	78.160 ** (0.0001)
Through the nose	144	47.8%	
Both	128	42.5%	
Total	301	100%	
Smoking history			
Yes	69	22.9%	157.89 ** (0.0001)
No	232	77.1%	
Total	301	100%	
Systemic disease			
No	266	88.4%	177.28 ** (0.0001)
Yes	35	11.6%	
Total	301	100%	
Periodontal disease			
Yes	97	32.2%	38.036 ** (0.0001)
No	204	67.8%	
Total	301	100%	
Dental caries			
Yes	187	62.1%	17.704 ** (0.0001)
No	114	37.9%	
Total	301	100%	

Malocclusion			
Yes	108	35.9%	24.003 ** (0.0001)
No	193	64.1%	
Total	301	100%	
Medical history regarding diseases of the blood, heart, respiratory system, intestines, liver, kidneys, and known allergies			
Heart diseases	21	7%	52.702 ** (0.0001)
Respiratory diseases	21	7%	
Liver diseases	12	4%	
Renal diseases	18	5.9%	
allergies	38	12.6%	
paranasal sinuses	84	27.9%	
Other than that	61	20.3%	
Don't have any diseases	46	15.3%	
Total	301	100%	
a history of diabetes was recorded			
Yes	13	4.3%	251.24 ** (0.0001)
No	288	95.7%	
Total	301	100%	
Do you use floss			
Yes	53	17.6%	37.266 ** (0.0001)
Sometimes	137	45.5%	
Never	111	36.9%	
Total	301	100%	

Do you use any mouth rinses			
Yes	58	19.3%	33.948 ** (0.0001)
sometimes	103	34.2%	
Never	140	46.5%	
Total	301	100%	
Consumption of alcoholic beverages			
Never	272	90.4%	690.61 ** (0.0001)
Rarely	25	8.3%	
Dilly	3	1%	
Several times per day	1	0.3%	
Total	301	100%	
Smoking: The exact number of cigarettes smoked daily			
1-20	28	9.3%	163.85 ** (0.0001)
20-40	4	1.3%	
40-60	2	0.7%	
Never	229	76.1%	
Vape	38	12.6%	
Total	301	100%	
How long have you been smoking?			
1 Year	9	3%	207.44 ** (0.0001)
2 Year	13	4.3%	
3 Year	18	6%	
More than 3 Year	30	10%	

Never	231	76.7%	
Total	301	100%	
Do you suffer from bad breath odor ?			
Yes	9	3%	369.63 ** (0.0001)
Sometimes	36	12%	
Never	256	85%	
Total	301	100%	
How did you know that you suffer from bad breath odor			
Someone told me	31	10.3%	218.91 ** (0.0001)
People act funnily around me	0	0%	
I just know	259	86%	
My dentist	11	3.7%	
Total	301	100%	
Have you had any treatments for bad breath odor			
Yes	29	9.6%	196.17 ** (0.0001)
No	272	90.4%	
Total	301	100%	
If you got it treated, what measurement did you use			
Drugs	9	2.9%	328.74 ** (0.0001)
Don't Suffering from halitosis	10	3.3%	
Cleaning mouth	52	17.3%	
Don't use any things	180	59.9%	
Other than that	50	16.6%	

Total	301	100%	
Do you have any social problems because of your bad breath odor			
Yes	24	8%	212.65 ** (0.0001)
No	277	92%	
Total	301	100%	
Are you concerned about other people's behavior toward yourself on account of your breath odor			
Yes	123	40.9%	10.049 ** (0.0015)
No	178	59.1%	
Total	301	100%	
* (P≤0.05), ** (P≤0.01), NS: Non-Significant.			

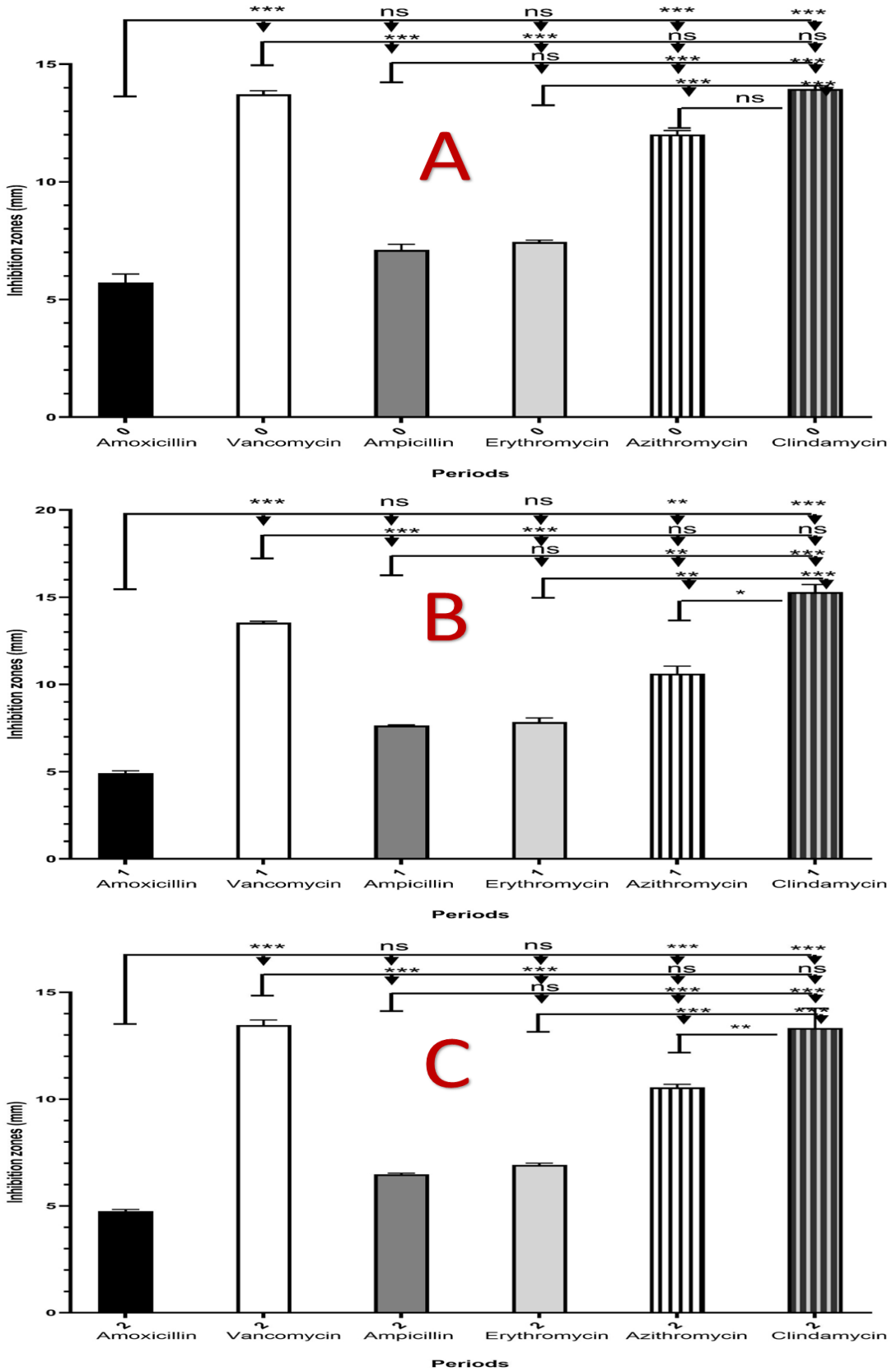

Figure 1. The bar graph illustrates the inhibition zones (mm) for Staphylococcus aureus isolates at three-time intervals (T0 (A), T1 (B), T2 (C)), when exposed to six different antibiotics: Amoxicillin, Vancomycin, Ampicillin, Erythromycin, Azithromycin, and Clindamycin. Statistical comparisons between groups are indicated with asterisks (* for $p < 0.05$, ** for $p < 0.01$, *** for $p < 0.001$) and "ns" for non-significant differences.

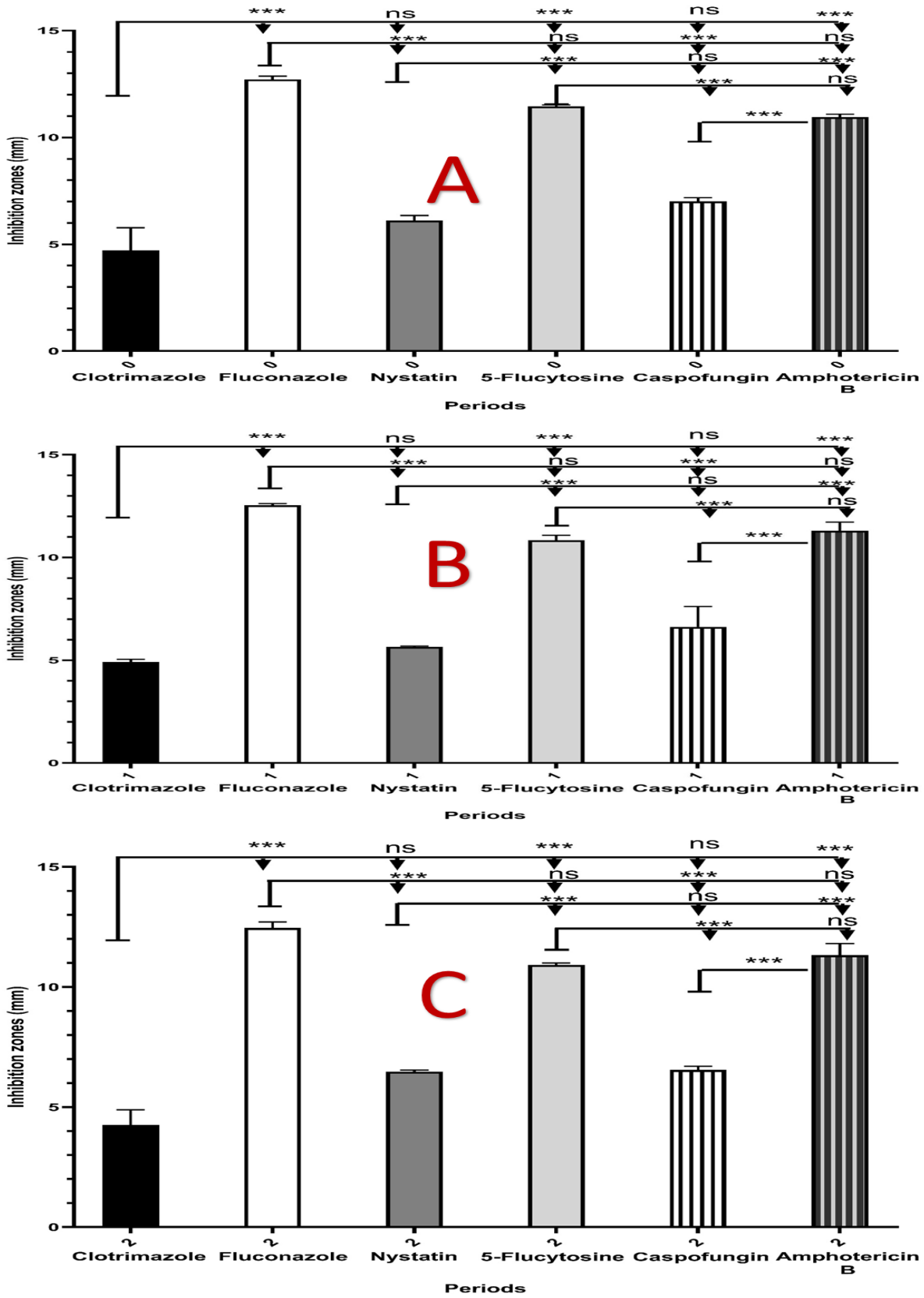

Figure 2. The bar graph illustrates the inhibition zones (mm) for *Candida albicans* isolates at three-time intervals (T0 (A), T1 (B), T2 (C)), when exposed to six antifungal agents: **Clotrimazole**, **Fluconazole**, **Nystatin**, **5-Flucytosine**, **Caspofungin**, and **Amphotericin B**. Statistical comparisons between groups are annotated with *** for $p < 0.001$ and "ns" for non-significant differences.