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Prevalence and Associated Factors of Oral Candidiasis among Patients Attending Selected Health Facilities in North-East Nigeria: A Cross-sectional Study

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Abstract

Oral candidiasis remains a common opportunistic fungal infection worldwide. Despite its public health relevance, data on its prevalence and risk factors in the general population of North-eastern Nigeria are limited. This study assessed the prevalence of oral candidiasis and identified associated demographic, behavioral, and oral health determinants. A cross-sectional study was conducted among 427 participants. Data were collected on demographic characteristics and determinants of the infection using structured questionnaires. Oral examination and laboratory confirmation were performed to identify oral candidiasis cases. Associations were assessed using Chi-square and logistic regression analyses, with significance set at $p < 0.05$. The overall prevalence of oral candidiasis was 10.07% (43/427). Prevalence was significantly higher among females (7.49%, $p = 0.000$), adolescents aged 11–19 years (7.26%, $p = 0.000$), and rural residents (4.45%, $p = 0.012$). Significant risk factors identified included rural residence (AOR = 2.25, 95% CI: 1.18–4.28), brushing less than twice daily (AOR = 9.68, 95% CI: 2.04–46.03), irregular toothbrush replacement (AOR = 5.83, 95% CI: 1.91–17.89), and lack of flossing (AOR = 0.23, 95% CI: 0.10–0.50). Oral candidiasis remains a significant health concern, particularly among females, adolescents, and rural residents. Modifiable factors such as poor oral hygiene practices and infrequent toothbrush replacement were strongly associated with the infection. Public health interventions focusing on oral health education, regular dental care, and antibiotic stewardship are essential to reduce the burden of oral candidiasis in North-east Nigeria.

Introduction

The human oral cavity hosts a complex microbiome comprising bacteria, fungi, and viruses, which normally exist in equilibrium and contribute to oral health (WHO, 2022). Disturbance of this balance however, predisposes individuals to opportunistic infections such as oral candidiasis, the most common fungal disease of the oral cavity (Williams & Lewis, 2011).

Oral candidiasis also referred to as oropharyngeal candidiasis or oral thrush is one of the most prevalent opportunistic fungal infections of the oral cavity. It is primarily caused by *Candida albicans* although non-albicans species such as *C. glabrata*, *C. tropicalis*, and *C. krusei* are increasingly implicated especially among immunocompromised populations (Lu, 2021; Williams et al., 2011). *Candida* species are part of the normal oral flora with colonization rates in healthy adults ranging between 30% and 60%, but under favorable conditions they can shift from commensals to pathogenic organisms (Williams et al., 2011).

The infection manifests in several clinical forms including pseudomembranous, erythematous, hyperplastic, and angular cheilitis each associated with distinct risk factors and may cause significant discomfort, dysphagia, and altered taste perception (Samaranayake, 2009; Patil et al., 2015). Importantly, oral candidiasis often serves as a marker of underlying systemic disease or immune dysfunction, occurring more frequently in patients with HIV/AIDS, poorly controlled diabetes mellitus, cancer or those on immunosuppressive or broad-spectrum antibiotic therapy (Samaranayake, 2009).

Globally, oral candidiasis affects diverse populations with prevalence ranging from 2% to 88%, depending on study settings, diagnostic methods, and host-related factors (Coronado-Castellote and Jiménez-Soriano, 2013). This problem remains substantial particularly in resource-limited settings. In Africa, a systematic review reported prevalence rates among people living with HIV ranging from 4.9% in Nigeria to as high as 79.4% in Côte d'Ivoire (Nweze et al., 2023). Within Nigeria, the prevalence of oral candidiasis varies by population group and study location. Omoruyi *et al*. (2023) documented a prevalence of 13.4% among HIV-infected patients in Ilorin Kwara State, with *C. albicans* being the most common isolate (6.7%), followed by *C. tropicalis* (2.0%), *C. krusei* (2.0%) and *C. glabrata* (0.7%). Similarly, Magaji & Moi (2022) found a prevalence of 51.1% among HIV-positive patients at the Federal Medical Center Azare Bauchi State, with *C. albicans* accounting for 51% of the isolates. These findings highlight a significant burden of disease in North-East Nigeria.

Several predisposing factors for oral candidiasis have been identified. Locally, poor oral hygiene, denture use, smoking and high carbohydrate intake increase the risk of colonization (Williams et al., 2011; Samaranayake, 2009). Systemic risk factors include immunosuppression, low CD4 counts, prolonged use of broad-spectrum antibiotics, corticosteroid therapy, pregnancy, xerostomia and nutritional deficiencies such as iron, folate and vitamin B12 (Moyes & Naglik 2011; Pappas et al., 2018; Ngawukume et al., 2020). In a Cameroonian study, poor oral hygiene practices (brushing once daily), recent antibiotic use, pregnancy, and low CD4 counts (<200 cells/μL) were significantly associated with oral candidiasis (Ngawukume et al., 2020). These findings underscore the multifactorial etiology of the infection and the importance of addressing modifiable risk factors.

In Nigeria, candidiasis remains a significant oral health burden. Studies have demonstrated its high prevalence among both healthy individuals and at-risk populations including HIV and diabetic patients (Salehi et al., 2022; Waseem & Deeb, 2023; Ayamolowo et al., 2024). Magaji & Moi (2022) for example, reported candidiasis as one of the most frequent opportunistic infections among HIV patients in Azare Bauchi State. However there is limited epidemiological data focusing exclusively on oral candidiasis in the general population of North-East Nigeria. This gap is critical as the region is characterized by widespread poverty, poor oral hygiene practices, limited access to dental services and high prevalence of systemic diseases that

predispose individuals to fungal infections (Magaji & Moi, 2022).

Given the public health importance of candidiasis and the paucity of data in this region, this study was conducted to determine the prevalence of oral candidiasis among patients attending health facilities in North-East Nigeria and to identify the associated demographic, behavioral and medical risk factors. The findings provided evidence for targeted preventive strategies and improved oral healthcare interventions.

Materials and Methods

Study Area, Design and Sampling

This cross-sectional study was conducted between March and August 2025 in two selected health facilities located in Bauchi and Gombe States, North-East Nigeria. The study was hospital-based and involved eligible patients attending the selected facilities during the study period. The facilities were selected to provide representation of the study areas, and eligible participants were recruited using a random sampling approach. Participants of all ages and genders who met the inclusion criteria and consented to participate were eligible for recruitment. Because the study was facility-based, the findings are interpreted in relation to patients attending the selected health facilities and should not be generalized directly to the entire population of North-East Nigeria.

Study Population

The study population comprised patients of all ages and genders who attended the selected facilities during the study period. Inclusion criteria were individuals who consented to participate and provided oral swab samples. Patients who were critically ill, unwilling to participate or unable to provide adequate samples were excluded.

Sample size determination

The sample size was determined using the single-population proportion formula:

$$n = \frac{Z^2 \times P(1-P)}{d^2}$$

Where n represents the minimum required sample size, Z is the standard normal deviate at a 95% confidence level (1.96), p is the estimated prevalence of oral candidiasis (0.511), based on a previously published study (Magaji & Moi, 2022), and d is the desired margin of error (0.05). Substitution into the formula gave a minimum sample size of approximately 384 participants. To account for a potential 10% non-response rate, the sample size was increased to 427 participants. Because participants were selected individually within the selected health facilities rather than through cluster sampling, no design effect was applied. A total of 427 participants were ultimately recruited and included in the analysis.

Ethical Considerations

Ethical approval was obtained from the Research and Ethics Committees of the Federal Medical Centre Gombe (NHREC/25/10/2013) and Extreme Hospital Azare Bauchi State (EXHA/02/25/033). Written informed consent was obtained from adult participants, while parental consent and child assent were obtained for participants under 18 years. Confidentiality of participants' information was maintained throughout the study, and all procedures adhered to the Declaration of Helsinki (2013).

Data Collection

Sociodemographic and clinical information were collected using a structured questionnaire. Variables included age, gender, residence, oral hygiene practices (brushing frequency, flossing and use of traditional methods of cleaning), medical history (diabetes, HIV status and antibiotic use) and lifestyle habits like sugary food consumption.

Sample Collection and Laboratory Analysis

Oral swabs were aseptically collected from the buccal mucosa, tongue and palate of each participant using sterile cotton swabs. The samples were immediately transported in sterile transport medium to the microbiology laboratories of the study centers.

The swabs were inoculated onto Sabouraud dextrose agar (SDA) supplemented with chloramphenicol and incubated at 30 °C for 48–72 hours. Colonies suspected to be *Candida* were sub-cultured on CHROMagar Candida (HiMedia,

India) to allow presumptive identification of species based on colony color. Further confirmation was performed using germ tube test, sugar assimilation tests, and microscopy with lactophenol cotton blue mount following standard procedures (Magaji & Moi, 2022).

Laboratory procedures

Oral specimens were collected aseptically from the buccal mucosa, tongue and palate of each participant using sterile swabs. The specimens were inoculated onto Sabouraud dextrose agar supplemented with chloramphenicol and incubated under the conditions specified in the laboratory protocol. Suspected Candida isolates were further characterized using CHROMagar Candida based on colony morphology and pigmentation. Additional identification was performed using germ-tube testing, microscopic examination and sugar assimilation tests.

Where a specimen showed evidence suggestive of more than one Candida species, individual morphologically distinct isolates were evaluated separately to minimize the possibility of reporting mixed growth as a single isolate. Species identification was based on the phenotypic procedures used in the study.

Data Analysis

Data were analyzed using IBM SPSS Statistics version 23.0 (IBM Corp. Armonk NY USA). Descriptive statistics were used to summarize demographic and clinical variables. Associations between risk factors and occurrence of oral candidiasis were assessed using chi-square tests. Logistic regression analysis was applied to determine independent predictors of oral candidiasis with odds ratios (ORs) and 95% confidence intervals (CIs) reported. A p-value <0.05 was considered statistically significant.

Results

Prevalence of Oral Candidiasis

The results of the current study as presented in Table 1 showed that, out of the 427 individuals screened, 43 tested positive for oral candidiasis giving an overall prevalence of 10.070%. Prevalence was highest among adolescents aged 11–19 years (7.260%), followed by children below 10 years (0.470%). The lowest prevalence was observed in the 20–24 years age group (0.230%). A statistically significant association was found between age and oral candidiasis prevalence ($\chi^2 = 35.915$, $p < 0.001$). Females had a significantly higher prevalence (7.490%) compared to males (2.580%) ($\chi^2 = 33.877$, $p < 0.001$). Residence was also significantly associated with the infection with rural dwellers having a higher prevalence (5.620%) than urban dwellers (4.450%) ($\chi^2 = 6.333$, $p = 0.012$).

Association of oral candidiasis with Oral Hygiene Practices

The relationship between oral hygiene behaviors and oral candidiasis is summarized in Table 2. Brushing frequency showed a significant association ($\chi^2 = 20.459$, $p < 0.001$). Individuals who brushed more than twice daily had the lowest prevalence (0.940%) compared to those who brushed once daily (5.390%). Toothbrush replacement habits were significantly associated with infection ($\chi^2 = 11.939$, $p = 0.008$). Participants who replaced their toothbrushes monthly had a lower prevalence (1.170%) compared to those who replaced them after six months (4.220%). Flossing practices were also significantly related ($\chi^2 = 16.907$, $p < 0.001$). Those who never flossed had the highest prevalence (5.150%), whereas daily flossers had the lowest (2.340%). Mouth rinsing after meals and mouth cleaning materials did not show significant association ($p = 0.863$ and $p = 0.669$ respectively).

Association of the Infection with Lifestyle Factors

As shown in Table 3, wearing dental appliances was significantly associated with oral candidiasis ($\chi^2 = 21.452$, $p < 0.001$), with higher prevalence among users (7.030%). Similarly participants who had never visited a dentist for oral infection's treatments had higher prevalence (5.390%) compared to those who did (4.680%) ($\chi^2 = 5.071$, $p = 0.024$). Consumption of sugary snacks or drinks, sharing toothbrushes and frequency of sugary food intake were not significantly associated ($p > 0.05$).

Association of the Infection with Oral Health History

Only persistent bad breath was significantly associated with oral candidiasis ($\chi^2 = 4.625$, p =

0.032), with a prevalence of 2.810% among affected individuals indicating that, persistent bad breath is not always an indication of oral candidiasis. Gum bleeding, visible cavities and mouth sores or ulcers were not statistically significant ($p > 0.05$) (Table 4).

Table 1. Prevalence of oral Candidiasis stratified by demographic characteristics

Stratum	N tested	n Positive	Prevalence (%)	Df	χ^2	*p value*
Age						
Below 10 years	30	2	0.470	3	35.915	< 0.001*
11-19 years	136	31	7.260			
20-24 years	27	1	0.230			
25 64 years	234	9	2.110			
Gender						
Female	147	32	7.490	1	33.877	< 0.001*
Male	280	11	2.580			
Residence						
Rural	119	24	5.620	1	6.333	0.012*
Urban	308	19	4.450			

Table 2. Association between oral hygiene practices and Prevalence of Oral Candidiasis

Variables	N	Positive	Prevalence (%)	χ^2	Df	p value
Cleaning material used						
Toothbrush and toothpaste	412	41	9.600	0.183	1	0.669
Chewing stick	15	2	0.470			
Charcoal/ash	0	0	0.000			
Brushing frequency						
Once daily	214	23	5.390	20.459	2	< 0.001*
Twice daily	167	16	3.750			
More than twice daily	3	4	0.940			
Toothbrush replacement						
Monthly	58	5	1.170	11.939	3	0.008*
Every 3 months	154	16	3.750			
Every 6 months	102	18	4.220			
Only when worn out	113	4	0.940			
Flossing practice						
No	186	22	5.150	16.907	2	< 0.001*
Occasionally	131	11	2.580			
Yes, daily	110	10	2.340			
Mouth rinsing after meals						
Always	170	18	4.220	0.294	2	0.863
Never	2	0	0.000			
Sometime	255	25	5.850			

Table 3. Association between lifestyle factors and Prevalence of Oral Candidiasis

Variables	Negative	Positive	Prevalence (%)	χ^2	df	p value
Sugary snack/drink consumption						
Daily	124	17	3.980	2.564	2	0.278
Occasionally	84	7	1.640			
Rarely	219	19	4.450			
Sharing toothbrush						
Yes	364	34	7.960	1.450	1	0.229
No	63	9	2.110			
Wearing dental appliances						
Yes	370	30	7.030	21.452	2	< 0.001*
No	57	13	3.040			
Visit						
Yes	138	20	4.680	5.071	1	0.024*
No	246	23	5.390			

Table 4. Association between oral health history and Prevalence of Oral Candidiasis

Variables	Negative	Positive	Prevalence (%)	χ^2	df	*p value*
Gum bleeding during brushing						
Yes	193	20	4.680	0.033	1	0.855
No	234	23	5.390			
Persistent bad breath						
Yes	70	12	2,810	4.625	1	0.032*
No	357	31	7.260			
Visible tooth decay/cavities						
Yes	124	12	2,810	0.030	1	0.863
No	303	31	7.260			
Mouth sores/ulcers						
Yes	87	10	2.340	0.245	1	0.621
No	340	33	7.730			

Socio-Demographic and Behavioral Predictors

Multivariate logistic regression (Table 5) revealed that, female gender was associated with a markedly higher risk (OR = 6.805, 95% CI: 3.316–13.966, $p < 0.001$), possibly due to pregnancy or other physiological factors that may predispose women to the high risk of the infection. Rural residence also increased the odds of infection (OR = 2.248, 95% CI: 1.181–4.279, $p = 0.014$). Similarly brushing once daily significantly increased risk compared to brushing more than twice daily (OR = 9.681, 95% CI: 2.036–46.031, $p = 0.004$). Furthermore, irregular toothbrush replacement also predicted the infection, particularly replacing every six months (OR = 5.839, 95% CI: 1.905–17.899, $p = 0.002$). Interestingly, visiting a dentist with oral issues (OR = 0.488, 95% CI: 0.259–0.920, $p = 0.027$) and flossing habits (OR = 0.227, 95% CI: 0.103–0.501, $p < 0.001$) showed a reduced odds ratio, indicating their protective capacities to the infection.

Clinical and Medical Predictors

As shown in Table 6, recent antibiotic use (OR = 0.410, 95% CI: 0.217–0.774). Chronic illness such as diabetes and HIV (OR = 0.212, 95% CI: 0.051–0.879) and persistent bad breath (OR = 0.460, 95% CI: 0.223–0.947) showed reduced odds ratios for the infection. Similarly, no significant associations were observed for gum bleeding, visible cavities, or mouth sores and ulcers ($p > 0.05$).

Table 5: Binary and multivariate logistic regression for Socio=demographic and behavioral factors associated with oral candidiasis

Variables	Negative	Positive	Total	P value	OR	Ci	
Age							
Below 10 years	28	2	30	< 0.001*	4.133	0.932	18.330
11-19 years	105	31	136		0.538	0.046	6.297
20-24 years	26	1	27		0.560	0.115	2.723
25 64 years	225	9	234		1		
Gender							
Female	115	32	147	< 0.001*	6.805	3.316	13.966
Male	269	11	280		1		
Residence							
Rural	100	19	119	0.014*	2.248	1.181	4.279
Urban	284	24	308		1		
Brushing practice							
Once daily	214	23	230	0.001*	9.681	0.278	1.060
Twice daily	167	16	190		0.543	2.036	46.031
More than twice daily	3	4	7		1		
Visit to dentist							
Yes	118	20	138	0.027*	0.488	0.259	0.920
No	223	23	246		1		
Sugary foods consumption							
Daily	107	17	124	0.284	1.672	0.835	3.352
Many times daily	77	7	84		0.957	0.387	2.367
Rarely	200	19	219		1		
Sharing tooth brush							
Yes	54	9	63	0.232	0.618	0.281	1.361
No	330	34	364		1		
Replacement of tooth brush							
Monthly	84	18	102	0.015*	3.159	1.027	9.723
Every 3 months	138	16	154		2.571	.663	9.968
Every 6 months	53	5	58		5.839	1.905	17.899
Only when worn out	109	4	113		1		
Flossing habit							
Yes, daily	176	10	186	< 0.001*	0.227	0.103	0.501
Occasionally	120	11	131		0.367	0.169	0.795
No	88	22	110		1		
Rinse mouth							
Always	152	18	170	0.966	1.089	0.575	2.065
Never	2	0	2		0.000	0.000	.
Sometime	230	25	255		1		
Dental appliances							
Yes	42	12	54	< 0.001*	7.000		
No	341	29	370		0.298		
Rarely	1	2	3		1		

Table 6: Binary and multivariate logistic regression for Clinical and Medical factors associated with oral candidiasis

Variables	Negative	Positive	Total	P value	Odds ratio	Ci	
Recent antibiotic use							
Yes	123	23	146	0.006*	0.410	0.217	0.774
No	261	20	281		1		
Chronic illness (any)							
Yes	6	3	9	0.033*	0.212	0.051	0.879
No	378	40	418		1		
Persistent bad breath							
Yes	58	12	70	0.035*	0.460	0.223	0.947
No	326	31	357		1		
Mouth sores/ulcers							
Yes	77	10	87	0.621	0.828	0.391	1.753
No	307	33	340		1		
History of oral issues							
Yes	128	15	143	0.838	0.933	0.481	1.810
No	256	28	284		1		
Gum bleeding							
Yes	173	23	196	0.855	0.943	0.501	1.774
No	211	20	231		1		
Visible oral cavity							
Yes	112	12	124	0.863	1.064	0.527	2.146
No	272	31	303		1		

Discussion

The current study assessed the prevalence, risk factors and predictors of oral candidiasis among general population in North-east Nigeria. In the study we found a prevalence of oral candidiasis of 10.070%, with clear associations with socio-demographic, oral hygiene and clinical factors. The findings contribute important insights into the burden of oral candidiasis outside of special clinical populations (such as HIV or hospitalized patients) and have implications for community oral health strategies. While much of the literature on oral candidiasis focuses on immunocompromised groups, some studies among general or non-HIV populations provide useful comparisons. In a large oral mucosal disease screening involving 160,357 patients, the prevalence of oral candidiasis was about 6.090%, somewhat lower than in our study. Females had higher infection rates than males in every age subgroup (Sharma et al., 2025). Among type 2 diabetic patients the prevalence of candidal lesions was 17.600% suggesting higher risk in those with metabolic disease (Sharma et al., 2025). A study on oral fungal infections in a general outpatient population reported that candidiasis was significantly more frequent in females (Li et al., 2024). These show that our prevalence in a general population (10.070%) is somewhat higher than in broadly defined outpatient/general populations in some settings (~6%) but lower than in high-risk clinical groups (e.g., diabetics). This suggests that even among the "healthy" or general public oral candidiasis is a non-negligible problem

Our finding that females had significantly higher prevalence parallels several general population studies. The oral mucosal disease screening study reported higher rates in females (Chen et al., 2019). Also, in diabetic and other comorbid populations female predominance in candidal lesions has been observed (Sharma et al., 2025). Possible

explanations include hormonal variations, differences in oral hygiene routines, more frequent antibiotic exposure, and sociocultural factors such as dietary practices and access to dental care. These suggest that in a general population gender is an important discriminator for risk and may guide targeted preventive strategies.

Age and residence of the patients were also found to be significant risk factors of the infection. Younger age groups (adolescent) showed higher prevalence and rural residence also increased risk. Other studies have shown extremes of age (children, elders) are more vulnerable. For example in complete denture wearers elderly individuals had greater burden of Candida infections (Kowalski et al., 2017). Rural residence likely indicates less access to healthcare services and limited resources for oral hygiene which can exacerbate risk.

Also our findings indicated that, infrequent brushing, flossing, and irregular toothbrush replacement are associated with higher prevalence of oral candidiasis. These are consistent with general literature. Poor oral hygiene is a well-recognized local factor for candidal overgrowth even in healthy populations (Medscape, 2025).

Although we studied the general population, systemic factors such as recent antibiotic use and chronic illnesses were found to be significant risk factors of the infection. These findings are supported by literature identifying antibiotic use and metabolic diseases as risk factors in non-immunocompromised individuals (Medscape, 2025).

Conclusion

This study demonstrated that oral candidiasis remains a notable public health concern among patients attending tertiary health centers in North-East Nigeria, with a moderate prevalence. The infection was significantly associated with female gender, adolescent age group, and rural residence. Importantly, several modifiable behavioral and clinical factors were identified as key predictors of the infection, including poor oral hygiene practices, infrequent tooth brushing and irregular toothbrush replacement. These findings underscore the need for targeted public health strategies including oral health education, improved access to dental services and rational antibiotic use. Implementing these interventions could help reduce the incidence and associated morbidity of oral candidiasis, especially in rural and underserved communities.

Based on the study findings, it is recommended that, government and healthcare institutions should intensify community-based oral health education programs focusing on proper tooth brushing frequency, flossing habits, and routine toothbrush replacement. Expansion of affordable and accessible dental services, particularly in rural communities, is also essential to facilitate early diagnosis, routine screening, and prompt management of oral infections.

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Author contribution

Auwal Magaji designed the study, conducted Laboratory investigation, and drafted the manuscript. Nathaniel Luka Kwarau performed language edit. Ibrahim Hussaini and Muhammad Abdullahi collected samples. While Muhammad Kabir Babayo and Mohammed Mohammed Usman proofread the manuscript.

Conflict of Interest

The authors declare that, there is no conflict of interest.

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