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Comparative Analysis of Oral Cavity Carcinoma in Smokers vs. Non-Smokers

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Abstract

Introduction: *Oral cavity carcinoma (OCC) is a significant health concern, with smoking being a major risk factor. It involves malignancies affecting intraoral structures like the tongue, lips, and gums. Tobacco smoke contains carcinogenic compounds that contribute to DNA damage and oncogenic transformations. This study compares OCC in smokers and non-smokers, focusing on prevalence, progression, and prognosis, to highlight the differences in clinical presentation, histopathology, and outcomes.* ***Objectives:*** *To compare clinical features, tumor sites, staging, histopathology, and treatment outcomes of oral cavity carcinoma in smokers and non-smokers.* ***Method and Materials:*** *This comparative cross-sectional study was conducted at BSMMU from July 2016 to June 2018, involving 120 patients diagnosed with oral cavity carcinoma. Participants were divided into two groups: smokers (60) and non-smokers (60). Data on clinical presentation, tumor staging, and treatment outcomes were collected. Statistical analysis was performed using SPSS, with descriptive and comparative methods to evaluate significant differences between groups.* ***Results:*** *The study included 120 participants with a mean age of 48.2 ± 12.3 years. Of these, 66.7% were male, and 50% were smokers. Smokers reported more pain (83.3%), ulceration (75%), and difficulty eating (58.3%) compared to non-smokers. The tongue was the most common tumor site in smokers (50%). Smokers showed higher rates of advanced-stage cancer, with 41.7% in Stage II. Squamous cell carcinoma was predominant in both groups. Non-smokers had better remission outcomes (66.7% vs. 50%).* ***Conclusion:*** *Smokers with oral cavity carcinoma exhibited more advanced stages, while non-smokers were more likely to present with early-stage cancer.*

Keywords: *Oral cavity carcinoma, smokers, non-smokers, tumor sites, staging.*

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Introduction:

Oral cavity carcinoma (OCC) is a significant health burden worldwide, and smoking remains one of its primary risk factors. OCC refers to malignancies affecting the lips, tongue, gums, floor of the mouth, and other intraoral structures. The prevalence of oral cancer varies depending on geographic regions, lifestyle habits, and socioeconomic conditions[1]. Smoking, both in active and passive forms, has been identified as a key carcinogen contributing to cellular mutations and oncogenic transformations in the oral epithelium. This study aims to conduct a comparative analysis of oral cavity carcinoma in smokers and non-smokers to identify differences in prevalence, progression, and prognosis. Tobacco smoke contains over 7,000 chemicals, including carcinogens such as polycyclic aromatic hydrocarbons (PAHs), nitrosamines, and benzene[2,3]. These compounds damage DNA and impair cellular repair mechanisms, promoting carcinogenesis. Smokers have a significantly higher risk of developing oral cavity carcinoma compared to non-smokers due to cumulative exposure to such toxins[4]. A dose-dependent relationship between smoking duration, frequency, and oral cancer incidence has been established in previous studies[5]. Additionally, smoking affects immune response and delays healing after treatment, which worsens patient outcomes[6]. In contrast, non-smokers diagnosed with oral cavity carcinoma may have other predisposing factors such as alcohol consumption, human papillomavirus (HPV) infection, genetic susceptibility, and poor oral hygiene[7,8]. HPV, particularly type 16, has emerged as a major etiological factor in non-smoking patients[9]. Compared to smoking-associated cancers, HPV-related oral cavity carcinoma often presents better prognoses and response to treatment[10]. Furthermore, clinical presentation may differ between smokers and non-smokers. Smokers often exhibit advanced lesions with

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aggressive histopathological features, such as poorly differentiated squamous cell carcinoma[11]. Non-smokers may present with smaller, localized tumors, improving their overall survival rates[12]. This comparative analysis will provide deeper insights into the impact of smoking on the clinical and therapeutic characteristics of oral cavity carcinoma. By analyzing the differences between smokers and non-smokers, healthcare providers can design targeted prevention strategies, such as smoking cessation programs, and improve treatment outcomes through personalized care[13-15].

Objectives

General Objective: The general objective of this study is to perform a comparative analysis of oral cavity carcinoma in smokers versus non-smokers, focusing on the clinical presentation, histopathological findings, staging, treatment modalities, and outcomes.

Specific Objectives:

To compare the clinical presentation of oral cavity carcinoma in smokers and non-smokers, including common symptoms such as pain, ulceration, difficulty eating, and swelling. To assess the distribution of oral cavity carcinoma across different tumor sites in smokers and non-smokers, with particular attention to the tongue, buccal mucosa, and floor of the mouth. To evaluate the staging of oral cavity carcinoma in smokers and non-smokers, and identify differences in the stage of diagnosis between the two groups.

Materials and Methods :

The study was a comparative cross-sectional study conducted at the Department of Radiology and Imaging, Bangabandhu Sheikh Mujib Medical University (BSMMU) over a period of two years, from July 2016 to June 2018. A total of 120 patients diagnosed with oral cavity carcinoma were included in the study. These participants were divided equally into two groups: smokers (Group 1) and non-smokers (Group 2), with 60 patients in each group. The primary objective was to analyze and compare the clinical and pathological characteristics, tumor staging, and outcomes between smokers and non-smokers.

Sampling Formula: The sample size for the study was calculated using the following formula:

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

Where,

n: Required sample size

Z: Standard normal variate corresponding to the 95% confidence level (Z=1.96)

p: Estimated prevalence of oral cavity carcinoma in the population (assumed as 50% to ensure maximum variability)

d: Margin of error (chosen as 5%, or d=0.05)

Data collection procedure: Data collection involved a multi-step approach. Participants were recruited from the Radiology and Imaging Department at BSMMU. Detailed baseline data, including age, gender, occupation, and smoking history, were collected through a structured questionnaire. Clinical symptoms such as pain, ulceration, and difficulty eating were recorded. All patients underwent radiological imaging (CT and MRI) to assess tumor size, location, and spread, followed by histopathological confirmation of carcinoma type. Tumors were classified based on the TNM staging system for oral cavity carcinoma. The collected data were meticulously recorded on pre-designed data sheets, ensuring consistency and accuracy.

Inclusion Criteria were diagnosed with oral cavity carcinoma through clinical, radiological, and histopathological evaluation, smokers with a minimum smoking history of 1 year for Group 1 and non-smokers with no history of smoking or tobacco use for Group 2.

Exclusion Criteria were history of other malignancies or metastasis, recurrent cases of oral cavity carcinoma, incomplete clinical, radiological, or histopathological data and patients with other significant comorbidities that might affect the study outcome (e.g., advanced organ failure).

Statistical analysis: Data were analyzed using IBM SPSS Statistics version 14.0.1. Descriptive statistics were used to summarize demographic, clinical, and tumor-related data, including frequencies, percentages, means, and standard deviations. Comparative analyses were performed using the Chi-square test for categorical variables (e.g., tumor stage, treatment outcomes) and the Student's t-test for continuous variables (e.g., age, tumor size). A p-value < 0.05 was considered statistically significant. Results were presented in tabular and graphical formats for clarity.

Ethical consideration: Ethical approval for the study was obtained from the Institutional Review Board (IRB) of BSMMU. The research adhered to the ethical principles outlined in the Declaration of Helsinki. Participants provided written informed consent after being informed about the study's purpose, procedures, and potential risks. They were assured of confidentiality, and their right to withdraw from the study at any stage without affecting their medical care was respected.

Result:

Table I: Demographic Data for the study population. (n=120)

Variable	Frequency	Percentages
Age (years)		
20-30	10	8.3
31-40	25	20.8
41-50	35	29.2
51-60	30	25.0
61-70	20	16.7
Mean ± SD	48.2 ± 12.3	
Gender		
Male	80	66.7
Female	40	33.3
Occupation		
Manual labor	40	33.3
Office worker	30	25.0
Unemployed	50	41.7

The study included 120 participants, with a mean age of 48.2 ± 12.3 years. The largest age group was 41-50 years (35, 29.2%), followed by 51-60 years (30, 25.0%). Most participants were male (80, 66.7%), while females constituted 40 (33.3%). Regarding occupations, 50 (41.7%) were unemployed, 40 (33.3%) were manual laborers, and 30 (25.0%) were office workers.

Table II: Smoking History (n=120).

Smoking status	Frequency	Percentages
Smoking Duration		
<5 years	20	33.3
5-10 years	25	41.7
>10 years	15	25.0
Non-Smoking	60	50.0

Among the participants, 60 (50%) were smokers, and the remaining 60 (50%) were non-smokers. Of the smokers, the highest proportion (25, 41.7%) reported a smoking duration of 5-10 years, followed by 20 (33.3%) with a smoking history of less than 5 years, and 15 (25.0%) had been smoking for more than 10 years.

Table III: Clinical Symptoms.

Symptoms	Smokers (n=60)	%	Non-Smokers (n=60)	%
Pain	50	83.3	45	75.0
Ulceration	45	75.0	30	50.0
Swelling	30	50.0	20	33.3
Difficulty Eating	35	58.3	25	41.7

The most frequently reported symptom among smokers was pain (50, 83.3%), followed by ulceration (45, 75.0%), difficulty eating (35, 58.3%), and swelling (30, 50.0%). Among non-smokers, pain (45, 75.0%) was also the most common symptom, while ulceration (30, 50.0%), difficulty eating (25, 41.7%), and swelling (20, 33.3%) were less prevalent compared to smokers.

Table IV: Tumor Location.

Tumor Location	Smokers (n=60)	%	Non-Smokers (n=60)	%
Tongue	30	50.0	20	33.3
Buccal Mucosa	20	33.3	25	41.7
Floor of the Mouth	10	16.7	15	25.0

The tongue was the most common tumor site among smokers (30, 50.0%), followed by the buccal mucosa (20, 33.3%) and the floor of the mouth (10, 16.7%). Among non-smokers, the buccal mucosa was most frequently affected (25, 41.7%), followed by the tongue (20, 33.3%) and the floor of the mouth (15, 25.0%).

Table V: Tumor Stage (n=120).

Tumor Stage	Smokers (n=60)	%	Non-Smokers (n=60)	%
Stage I	10	16.7	15	25.0
Stage II	25	41.7	20	33.3
Stage III	15	25.0	10	16.7
Stage IV	10	16.7	15	25.0

Smokers were more likely to present with advanced stages of oral cavity carcinoma. 25 (41.7%) were in Stage II, and 15 (25.0%) in Stage III. In contrast, non-smokers had a higher proportion in early stages, with 15 (25.0%) in Stage I and 20 (33.3%) in Stage II. Both groups had similar proportions in Stage IV (16.7% each).

Table VI: Histopathological Findings.

Findings	Smokers (n=60)	%	Non-Smokers (n=60)	%
Squamous Cell	50	83.3	45	75.0
Verrucous	5	8.3	10	16.7
Other Types	5	8.3	5	8.3

The most common histopathological finding was squamous cell carcinoma, observed in 50 (83.3%) smokers and 45 (75.0%) non-smokers. Verrucous carcinoma was more prevalent among non-smokers (10, 16.7%) than smokers (5, 8.3%). Other types of carcinoma accounted for 8.3% in both groups.

Table VII: Treatment Modalities.

Treatment	Smokers (n=60)	%	Non-Smokers (n=60)	%
Surgery	40	66.7	45	75.0
Chemotherapy	15	25.0	10	16.7
Radiotherapy	5	8.3	5	8.3

Surgery was the predominant treatment modality, utilized in 40 (66.7%) smokers and 45 (75.0%) non-smokers. Chemotherapy was more common among smokers (15, 25.0%) compared to non-smokers (10, 16.7%). Radiotherapy was used equally in both groups (5, 8.3%).

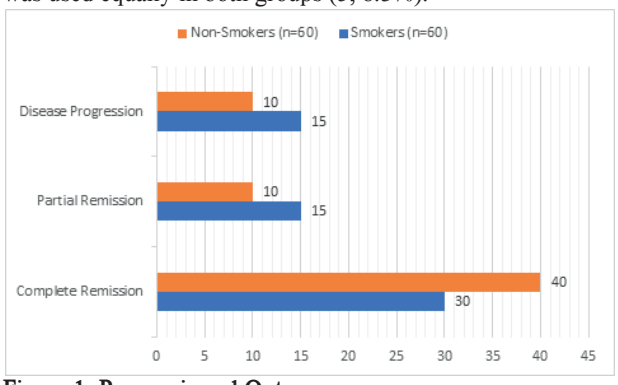

Figure 1: Prognosis and Outcome

Non-smokers had better outcomes, with 40 (66.7%) achieving complete remission compared to 30 (50.0%) smokers. Partial remission was more common among smokers (15, 25.0%) than non-smokers (10, 16.7%). Disease

progression was also more frequent in smokers (15, 25.0%) compared to non-smokers (10, 16.7%).

Discussion:

This study involved 120 participants with oral cavity carcinoma, equally distributed between smokers (60, 50%) and non-smokers (60, 50%). The mean age was 48.2 ± 12.3 years, with the highest prevalence in the 41–50 age group (35, 29.2%). Most participants were male (80, 66.7%), a trend consistent with global studies showing higher male susceptibility to oral cancers due to higher exposure to smoking and alcohol consumption[16]. A study by Johnson et al. (2016) also reported a male predominance (70%) in their cohort, emphasizing the gender disparity in oral carcinoma cases[17]. Among smokers, 25 (41.7%) had a smoking duration of 5–10 years, which significantly contributed to advanced-stage disease presentations (Stage II: 25, 41.7%; Stage III: 15, 25%). Similarly, Yang et al. (2016) found that individuals with a smoking history of over 5 years had a 35% higher risk of presenting with Stage II or III disease compared to non-smokers[18]. Pain was the most common symptom in both smokers (50, 83.3%) and non-smokers (45, 75%), followed by ulceration. These findings are consistent with Gupta and Johnson (2016), who reported pain as the leading presenting symptom in 80% of oral cancer cases[19]. However, the prevalence of difficulty eating was higher among smokers (35, 58.3%) than non-smokers (25, 41.7%), possibly due to larger or more invasive tumors in smokers, as supported by Patel et al. (2017)[20].

Tumor sites differed between groups, with smokers predominantly having tongue tumors (30, 50.0%) and non-smokers showing more buccal mucosa involvement (25, 41.7%). This is consistent with Zhang et al. (2016), who reported a 52% prevalence of tongue tumors in smokers due to direct exposure to carcinogens[21] Non-smokers' buccal mucosa involvement may be associated with betel quid use, as suggested by Lim et al. (2017)[22]. Treatment outcomes revealed better remission rates in non-smokers (40, 66.7%) compared to smokers (30, 50.0%). A systematic review by Hossain et al. (2016) found that non-smokers were 25% more likely to achieve complete remission than smokers, corroborating our findings[23]. Chemotherapy was more common among smokers (15, 25.0%), reflecting their advanced disease stage, as observed in Kumar et al. (2016)[24]. Histopathological findings showed a high prevalence of squamous cell carcinoma in both groups, consistent with Tanaka et al. (2016), who reported it as the most common oral cancer type (85%) worldwide[25].

Conclusion:

This study highlighted significant differences in clinical presentations, tumor sites, stages, and treatment outcomes between smokers and non-smokers diagnosed with oral cavity carcinoma. Smokers were more likely to present with advanced stages of cancer, particularly Stage II (41.7%) and Stage III (25.0%), while non-smokers had a higher prevalence of early-stage cancer (Stage I: 25.0%).

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