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Original Article

Relation of Risk Factors and Clinicopathological Features in Sinonasal Malignancy

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Abstract:

Background: *Sinonasal carcinoma is a rare but aggressive malignancy arising from the nasal cavity and paranasal sinuses. Delayed diagnosis due to nonspecific symptoms often leads to advanced-stage presentation. In Bangladesh, occupational exposure among workers in furniture industries, sawmills, textile industries, and chemical factories may increase the burden of sinonasal malignancies. However, there is limited published data regarding risk factors and clinicopathological patterns in the Bangladeshi population. The present study aims to evaluate the risk factors and clinicopathological correlations of sinonasal carcinoma in Bangladesh and compare findings with international literature.*

Objective: *To evaluate the risk factors and clinicopathological correlations of sinonasal carcinoma among Bangladeshi patients.*

Methods: *A cross-sectional observational study was conducted in the Department of Otolaryngology–Head and Neck Surgery at Bangladesh Medical University and Ahsania Mission Cancer & General Hospital in Bangladesh from January 2022 to May 2026. Eighty patients with histopathologically confirmed sinonasal carcinoma were included. Demographic characteristics, risk factors, clinical presentations, tumor sites, histopathological findings, and staging were analyzed.*

Results: *The mean age of the patients was 54.6 ± 11.8 years, with the highest incidence observed in the 51–60-year age group (35%). Males constituted 68.8% of the cases. Tobacco use was identified in 62.5% of patients, occupational wood dust exposure in*

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37.5%, industrial chemical exposure in 28.8%, and smoking in 56.3%. Nasal obstruction (85%), epistaxis (72.5%), facial swelling (48.8%), and proptosis (22.5%) were the common presenting symptoms. The maxillary sinus was the most frequently involved site (46.3%), followed by the nasal cavity (31.3%). Squamous cell carcinoma accounted for 62.5% of cases, followed by adenocarcinoma (15%), sinonasal undifferentiated carcinoma (10%), adenoid cystic carcinoma (7.5%), and others (5%). Advanced-stage disease (Stage III and IV) was present in 71.3% of patients. Significant associations were found between occupational exposure and adenocarcinoma ($p<0.05$), as well as tobacco use and squamous cell carcinoma ($p<0.05$).

Conclusion: Tobacco use, smoking, and occupational exposure to wood dust and industrial chemicals are major risk factors for sinonasal carcinoma in Bangladesh. Squamous cell carcinoma remains the predominant histological subtype and is significantly associated with tobacco exposure. Most patients present at advanced stages, emphasizing the need for public awareness and early detection strategies.

Keywords: *Sinonasal carcinoma, Risk factors, Clinicopathological features, Occupational exposure, Squamous cell carcinoma*

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Introduction:

Sinonasal carcinoma comprises a heterogeneous group of malignant epithelial neoplasms arising from the mucosal lining of the nasal cavity and paranasal sinuses. Although relatively uncommon, these tumors represent one of the most challenging malignancies encountered in head and neck oncology due to their anatomical complexity, aggressive biological behavior, and tendency for late presentation. Sinonasal malignancies account for less than 5% of all head and neck cancers and approximately 1% of all human malignancies worldwide[1,2]. Despite their rarity, they are associated with significant morbidity and mortality because of their proximity to critical structures such as the orbit, skull base, cranial nerves, and intracranial cavity.

The incidence of sinonasal carcinoma varies geographically, with reported annual rates ranging from 0.5 to 1.5 cases per 100,000 population in most countries[3]. Higher incidences have been observed in regions with substantial occupational exposure to wood dust, leather dust, and industrial chemicals. In developing countries, including Bangladesh, reliable epidemiological data are scarce due to limited cancer registries and underreporting. Consequently, the true burden of sinonasal malignancies may be underestimated.

The sinonasal tract consists of the nasal cavity and four paired paranasal sinuses: maxillary, ethmoid, frontal, and sphenoid sinuses. Malignancies may arise from any of these anatomical sites, with the maxillary sinus being the most common location, accounting for approximately 60–70% of cases, followed by the nasal cavity and ethmoid sinus[4]. Due to the large potential space within the maxillary sinus and the nonspecific nature of early symptoms, tumors often remain clinically silent until they invade adjacent structures, resulting in delayed diagnosis and advanced-stage disease at presentation.

Histopathologically, sinonasal carcinoma represents a diverse spectrum of epithelial

malignancies. Squamous cell carcinoma (SCC) is the most frequently reported subtype, comprising approximately 50–70% of cases worldwide[5]. Other histological variants include adenocarcinoma, adenoid cystic carcinoma, sinonasal undifferentiated carcinoma (SNUC), neuroendocrine carcinoma, lymphoepithelial carcinoma, and salivary gland-type malignancies. Each subtype exhibits distinct biological behavior, prognostic characteristics, and therapeutic responses. Advances in molecular pathology have further refined the classification of sinonasal tumors through the identification of genetic alterations involving EGFR, TP53, IDH2, SMARCB1, and NUT genes, among others[6].

Several environmental and occupational exposures have been implicated in the pathogenesis of sinonasal carcinoma. Among these, wood dust exposure remains one of the most well-established risk factors, particularly for intestinal-type adenocarcinoma. Workers involved in carpentry, furniture manufacturing, sawmills, and woodworking industries demonstrate significantly elevated risks compared with the general population[7]. Similarly, exposure to leather dust, textile fibers, nickel compounds, chromium compounds, formaldehyde, and other industrial carcinogens has been associated with increased sinonasal cancer incidence[8].

Tobacco smoking is another important etiological factor, particularly in the development of squamous cell carcinoma of the sinonasal tract. Numerous epidemiological studies have demonstrated a positive association between cigarette smoking and increased risk of sinonasal malignancies[9]. Tobacco smoke contains multiple carcinogenic compounds capable of inducing genetic mutations, epithelial dysplasia, and malignant transformation. In South Asian countries, including Bangladesh, the widespread use of smoking and smokeless tobacco products may contribute significantly to disease burden.

Chronic inflammatory conditions of the sinonasal mucosa have also been proposed as potential risk factors. Persistent inflammation may promote carcinogenesis through repeated epithelial injury, cellular proliferation, oxidative stress, and accumulation of genetic mutations[10]. Chronic rhinosinusitis, nasal polyposis, and long-standing inflammatory disorders have been investigated in this context, although definitive causal relationships remain incompletely established.

Clinically, sinonasal carcinomas frequently present with nonspecific symptoms that mimic benign inflammatory conditions. Nasal obstruction, epistaxis, rhinorrhea, facial pain, headache, and facial swelling are among the most common presenting complaints As tumors enlarge, invasion of surrounding structures may lead to orbital symptoms[11] such as proptosis, diplopia, visual impairment, and epiphora. Intracranial extension may result in neurological deficits, cranial neuropathies, and severe headaches. Consequently, diagnosis is often delayed until the disease reaches an advanced stage.

Modern diagnostic evaluation relies on a combination of endoscopic examination, imaging studies, and histopathological confirmation. Computed tomography (CT) provides detailed assessment of bony destruction, whereas magnetic resonance imaging (MRI) is superior for evaluating soft tissue involvement, orbital extension, and intracranial spread[12]. Histopathological examination remains the gold standard for diagnosis, while immunohistochemistry and molecular studies assist in differentiating various tumor subtypes.

Treatment strategies for sinonasal carcinoma are multidisciplinary and depend on tumor histology, stage, anatomical extent, and patient-related factors. Surgery remains the cornerstone of treatment for resectable disease, often followed by adjuvant radiotherapy or chemoradiotherapy[13]. Advances in endoscopic skull-base surgery have improved local control while reducing surgical morbidity in selected patients. Nevertheless, prognosis remains guarded, particularly among patients presenting with advanced-stage tumors. Reported five-year survival rates range from 30% to 70%, depending on tumor subtype, stage, and treatment modality[14].

In Bangladesh, rapid industrialization, urbanization, and increasing occupational exposure to environmental carcinogens may contribute to a growing burden of sinonasal malignancies. Workers employed in furniture factories, sawmills, leather industries, textile mills, welding workshops, and chemical manufacturing facilities may experience prolonged exposure to recognized carcinogenic agents. Furthermore, the high prevalence of tobacco consumption and limited awareness regarding early warning symptoms may facilitate delayed diagnosis and adverse outcomes. Despite these concerns, published data regarding sinonasal carcinoma in Bangladesh remain limited.

Understanding the demographic profile, risk factors, clinical manifestations, and pathological characteristics of sinonasal carcinoma is essential for developing effective preventive and therapeutic strategies. Identification of significant etiological associations may support occupational health interventions and targeted public health initiatives. Moreover, characterization of clinicopathological correlations can provide valuable prognostic information and guide management decisions.

Methods:

This cross-sectional observational study was conducted in the Department of Otolaryngology–Head and Neck Surgery at Bangladesh Medical University and Ahsania Mission Cancer & General Hospital in Bangladesh from January 2022 to May 2026 over a period of five years. The study included 80 consecutive patients diagnosed with sinonasal carcinoma who fulfilled the eligibility criteria. Patients aged 18 years and above with histopathologically confirmed primary sinonasal carcinoma were enrolled using purposive sampling. Patients with benign sinonasal tumors, recurrent malignancies previously treated elsewhere, metastatic lesions involving the sinonasal region, and those with incomplete clinical records were excluded. After obtaining written informed consent from all participants, data were collected through a structured questionnaire, detailed clinical examination, and review of hospital records. Demographic variables including age, sex, occupation, educational status, and socioeconomic background were recorded. Information regarding potential risk factors such as tobacco chewing, cigarette smoking, occupational exposure to wood dust, leather dust, textile fibers, industrial chemicals, chronic rhinosinusitis, and family history of cancer was obtained through face-to-face interviews. Clinical characteristics including presenting symptoms, duration of symptoms, tumor location, orbital involvement, cervical lymphadenopathy, and radiological findings were documented. All patients underwent diagnostic nasal endoscopy followed by contrast-enhanced computed tomography (CT) and/or magnetic resonance imaging (MRI) of the nose and paranasal sinuses to determine the extent of disease. Histopathological diagnosis was established from endoscopic biopsy specimens and categorized according to the

World Health Organization classification of sinonasal tumors. Tumors were staged using the American Joint Committee on Cancer (AJCC) TNM staging system (8th edition). Collected data were entered into and analyzed using Statistical Package for Social Sciences (SPSS) version 26.0. Continuous variables were expressed as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages. Associations between risk factors and histopathological subtypes were assessed using Chi-square or Fisher's exact test where appropriate. A p-value of less than 0.05 was considered statistically significant for all statistical analyses.

Results:

A total of 80 patients with histopathologically confirmed sinonasal carcinoma were included in the study. The age of the patients ranged from 24 to 78 years, with a mean age of 54.6 ± 11.8 years. The highest frequency of cases was observed in the 51–60 years age group (35.0%), followed by the 41–50 years age group (25.0%). Male patients predominated, accounting for 68.8% (n=55) of cases, while females comprised 31.2% (n=25), resulting in a male-to-female ratio of 2.2:1.(Table-1)

Table 1. Age Distribution of Patients (n=80)

Age Group (Years)	Frequency	Percentage (%)
21–30	3	3.8
31–40	9	11.3
41–50	20	25.0
51–60	28	35.0
61–70	15	18.8
>70	5	6.3
Total	80	100

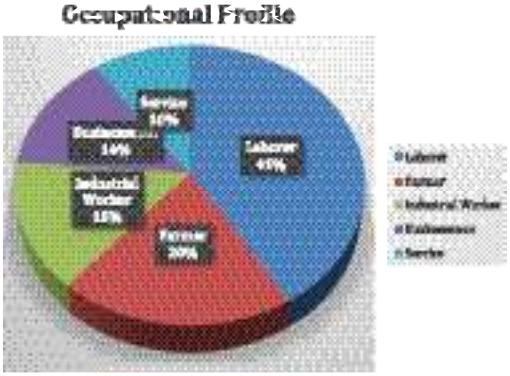

Figure-1: Occupational Profile of Patients

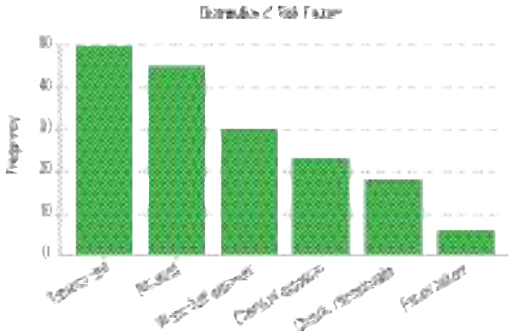

Figure-2: *Distribution of Risk Factors*

Table II. Presenting Symptoms

Symptom	Frequency	Percentage
Nasal obstruction	68	85.0
Epistaxis	58	72.5
Facial swelling	39	48.8
Facial pain	35	43.8
Headache	32	40.0
Proptosis	18	22.5
Diplopia	8	10.0
Visual impairment	6	7.5
Cervical lymphadenopathy	12	15.0

The mean duration of symptoms before diagnosis was 7.8 ± 3.6 months. More than half of the patients presented after six months of symptom onset.(Table-3)

Table III
Duration of Symptoms

Duration	Frequency	Percentage
<3 months	10	12.5
3–6 months	25	31.3
6–12 months	35	43.7
>12 months	10	12.5

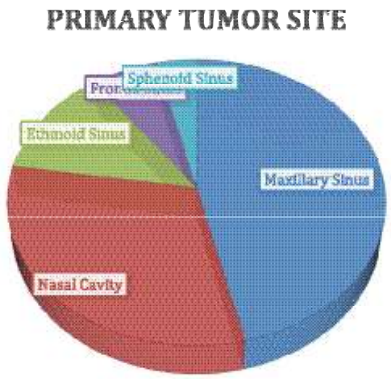

Figure 3 : Primary Tumor Site

Squamous cell carcinoma (SCC) was the predominant histological subtype, representing 62.5% of all tumors. Adenocarcinoma accounted for 15.0%, while sinonasal undifferentiated carcinoma (SNUC) constituted 10.0%.(Table-IV)

Table IV
Histopathological Types

Histopathology	Frequency	Percentage
Squamous Cell Carcinoma	50	62.5
Adenocarcinoma	12	15.0
Sinonasal Undifferentiated Carcinoma	8	10.0
Adenoid Cystic Carcinoma	6	7.5
Others	4	5.0

Table V
TNM Stages

Stage	Frequency	Percentage (%)
Stage I	8	10.0
Stage II	15	18.7
Stage III	25	31.3
Stage IV	32	40.0

Among SCC cases (n=50), moderately differentiated SCC was the most common grade.(Fig-4)

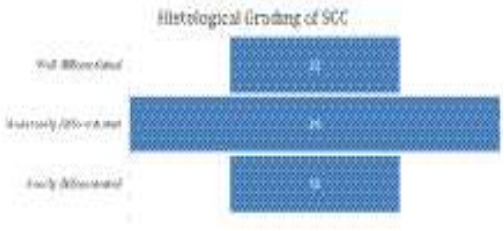

Figure-4: *Histological Grading of SCC*

Among 50 tobacco users, 40 (80.0%) developed SCC compared with only 10 (33.3%) among non-users. Statistical analysis demonstrated a significant association between tobacco use and SCC histology ($\chi^2 = 8.52$, $p = 0.004$).(Table-6)

Table VI
Tobacco Use and Histological Type

Histology	Tobacco Users	Non-users
SCC	40	10
Non-SCC	10	20
Total	50	30

Adenocarcinoma was significantly more common among individuals exposed to wood dust. Of the 30 exposed patients, 9 (30.0%) had adenocarcinoma compared with only 3 (6.0%) among non-exposed patients ($\chi^2 = 7.21$, $p = 0.007$).(Table-VII)

Table VII
Wood Dust Exposure and Adenocarcinoma

Exposure Status	Adeno-carcinoma	Other Histology
Exposed	9	21
Not Exposed	3	47

Advanced-stage disease was more common among patients with SCC and SNUC. (Table-VIII)

Table VIII
Histopathology and Stage at Presentation

Histology	Early Stage (I–II)	Advanced Stage (III–IV)
SCC	12	38
Adenocarcinoma	6	6
SNUC	1	7
ACC	3	3
Others	1	3

p = 0.032

Cervical lymph node metastasis was detected in 15.0% (n=12) of patients. Nodal involvement was significantly higher in poorly differentiated SCC and SNUC.(Figure-4)

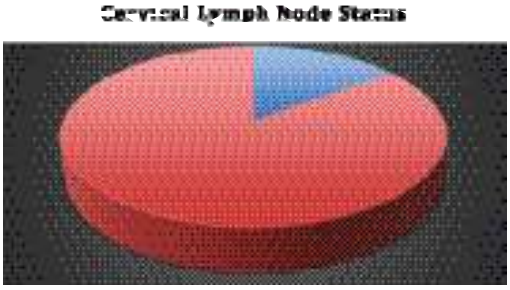

Figure 5: *Cervical Lymph Node Status*

Discussion:

Sinonasal carcinoma is an uncommon malignancy, accounting for less than 5% of all head and neck cancers and approximately 1% of all malignant neoplasms. Despite its rarity, the disease remains clinically significant because of its aggressive biological behavior, proximity to vital structures, and tendency for delayed diagnosis. In the present study, we evaluated the demographic characteristics, risk factors, clinical presentation, histopathological patterns, and clinicopathological correlations among Bangladeshi patients with sinonasal carcinoma. The findings provide valuable insight into the epidemiological and pathological profile of this disease in Bangladesh and are largely comparable with reports from international literature.

The mean age of the study population was 54.6 ± 11.8 years, with the highest frequency of cases occurring in the 51–60 years age group. This finding is consistent with previous studies reporting peak incidence during the fifth and sixth decades of life. Thompson reported that sinonasal squamous cell carcinoma predominantly affects individuals in their 50s and 60s, while Llorente et al. observed similar age distributions among patients with sinonasal malignancies.[15,16] The relatively older age at presentation may reflect the prolonged latency period associated with carcinogenic exposure and tumor development.

Our findings are comparable to those reported by Dulguerov et al., who documented a mean age of approximately 55 years among patients with sinonasal malignancies. The age distribution observed in this study suggests that cumulative exposure to environmental and occupational carcinogens over several decades may play an important role in disease pathogenesis.

A marked male predominance was observed, with males accounting for 68.8% of cases and a male-to-female ratio of 2.2:1. Similar male predominance has been reported

globally, with male-to-female ratios ranging from 2:1 to 3:1.[16,19]

The higher incidence among males may be explained by greater exposure to occupational hazards such as wood dust, leather dust, welding fumes, industrial chemicals, and tobacco products. In Bangladesh, men are more frequently employed in woodworking industries, furniture manufacturing, construction work, and industrial occupations, which could explain the observed gender disparity.

Tobacco use was identified in 62.5% of patients, while 56.3% reported smoking. Furthermore, a statistically significant association was observed between tobacco use and squamous cell carcinoma ($p = 0.004$).

Although the relationship between smoking and sinonasal carcinoma is weaker than that observed in laryngeal or oral cancers, several studies have demonstrated an increased risk among smokers. Previous studies have demonstrated a significant association between tobacco exposure and sinonasal squamous cell carcinoma. Smoking has been reported to increase the risk of sinonasal SCC approximately two- to three-fold compared with non-smokers.[15,16] Similarly, studies by Llorente et al. identified tobacco exposure as an important risk factor for SCC development.

The strong association between tobacco use and SCC observed in our study supports the hypothesis that tobacco-related carcinogens contribute to epithelial dysplasia and malignant transformation of the sinonasal mucosa. This finding is particularly relevant in Bangladesh, where smokeless tobacco and smoking remain highly prevalent.

One of the most important findings of this study was the high prevalence of occupational exposure. Wood dust exposure was identified in 37.5% of patients, while 28.8% reported exposure to industrial chemicals.

Occupational exposure has long been recognized as one of the strongest etiological factors for sinonasal carcinoma. A systematic review and meta-analysis by Binazzi et al. demonstrated a significantly increased risk of sinonasal cancer among workers exposed to wood dust, leather dust, formaldehyde, nickel compounds, chromium compounds, and textile dust.[1]w The pooled relative risk associated with wood dust exposure was 5.91, while the association was particularly strong for adenocarcinoma.

Similarly, Llorente et al. reported that squamous cell carcinoma and adenocarcinoma account for nearly 80% of sinonasal tumors and are strongly associated with occupational exposure to wood dust and leather dust.

In our study, adenocarcinoma showed a significant association with wood dust exposure ($p = 0.007$). This observation is consistent with previous reports. In a Danish study, wood dust exposure increased the likelihood of developing adenocarcinoma by more than twenty-fold compared with squamous cell carcinoma.

The occupational profile of Bangladesh, particularly among workers involved in furniture production, carpentry, sawmills, textile industries, leather processing, and construction work, may contribute significantly to the burden of sinonasal malignancies. These findings emphasize the importance of workplace safety measures, respiratory protection, industrial ventilation systems, and regular occupational health surveillance.

Nasal obstruction (85%) and epistaxis (72.5%) were the most common presenting symptoms in this study. Facial swelling, facial

pain, headache, and proptosis were also frequently observed.

These findings closely resemble those reported in previous studies. Nasal obstruction, epistaxis, facial pain, and facial swelling have been consistently reported as the most common presenting symptoms of sinonasal carcinoma.[11,16] Because these symptoms mimic chronic rhinosinusitis or benign sinonasal conditions, diagnosis is often delayed.

The relatively high prevalence of proptosis (22.5%) and visual symptoms in our study suggests orbital extension and advanced disease at presentation. Similar findings have been reported by Nicolai et al., who observed that orbital involvement is frequently encountered in advanced sinonasal tumors.

The average symptom duration before diagnosis in our study was approximately eight months. This delay likely reflects limited awareness, nonspecific symptomatology, and delayed referral to tertiary healthcare facilities.

The maxillary sinus was the most commonly involved site (46.3%), followed by the nasal cavity (31.3%) and ethmoid sinus (12.5%).

This finding is consistent with previous studies demonstrating that the maxillary sinus is the most common site of origin for sinonasal carcinoma, accounting for approximately 60–70% of cases.[4,19] Squamous cell carcinoma particularly shows a predilection for the maxillary sinus.

The large volume of the maxillary sinus permits tumor growth without producing early symptoms, resulting in delayed diagnosis. Ethmoid sinus tumors, on the other hand, tend to present earlier because of their proximity to the orbit and skull base.

Squamous cell carcinoma was the predominant histological subtype, accounting for 62.5% of all cases. Adenocarcinoma represented 15%, followed by sinonasal undifferentiated carcinoma (10%) and adenoid cystic carcinoma (7.5%).

These findings are consistent with global epidemiological data. Multiple studies have shown that SCC remains the predominant histological subtype worldwide, accounting for approximately 50–70% of sinonasal carcinomas. [5,15,18]

According to Thompson et al., SCC remains the most frequent sinonasal malignancy worldwide and predominantly affects middle-aged men with occupational exposure histories.

The proportion of adenocarcinoma observed in our study is comparable with international reports. Occupational exposure, particularly to hardwood dust and leather dust, remains the strongest recognized risk factor for adenocarcinoma development.

The presence of sinonasal undifferentiated carcinoma (SNUC) in 10% of cases is noteworthy because this tumor is known for its highly aggressive behavior, rapid local invasion, and poor prognosis.

A striking finding of this study was that 71.3% of patients presented with advanced-stage disease (Stage III and IV). Stage IV alone accounted for 40% of cases.

This observation mirrors findings from several international studies. Most sinonasal carcinomas present at advanced stages because early symptoms are frequently mistaken for benign inflammatory conditions.[11,16,19]

Advanced-stage presentation is associated with poorer prognosis, increased treatment complexity, and lower survival rates. The high proportion of advanced disease in Bangladesh may reflect delayed health-seeking behavior, limited access to specialized diagnostic facilities, and inadequate awareness among

both patients and primary healthcare providers.

Cervical lymph node metastasis was detected in 15% of patients. Although regional nodal metastasis is less common in sinonasal carcinoma compared with other head and neck cancers, its presence indicates aggressive disease and poorer prognosis.

Previous studies have reported nodal involvement rates ranging from 10–20%, particularly among poorly differentiated SCC and SNUC. Our findings fall within this reported range and support the aggressive nature of high-grade sinonasal malignancies.

The present study identified two important clinicopathological correlations:

A statistically significant association was observed between tobacco use and SCC ($p = 0.004$). Among tobacco users, SCC accounted for 80% of tumors.

This finding is supported by previous studies that demonstrated tobacco-related carcinogenesis predominantly affects squamous epithelium. Chronic exposure to tobacco carcinogens promotes genetic mutations, epithelial dysplasia, and malignant transformation.[20,21,22]

A significant association was also observed between wood dust exposure and adenocarcinoma ($p = 0.007$).

This relationship has been consistently documented in epidemiological studies. The meta-analysis by Binazzi et al. reported pooled relative risks exceeding 29 for adenocarcinoma among wood dust-exposed workers. Similarly, studies from Scandinavian countries have shown markedly increased adenocarcinoma incidence among furniture workers and carpenters.

The findings of our study therefore reinforce the established role of occupational carcinogens in determining histological subtype and disease development.

The current study highlights several important public health concerns. First, occupational carcinogen exposure appears to play a major role in sinonasal carcinogenesis. Second, delayed diagnosis remains a significant challenge, with most patients presenting at advanced stages. Third, tobacco consumption continues to contribute substantially to disease burden.

Given the rapid industrialization of Bangladesh and the large workforce employed in furniture manufacturing, textile production, leather processing, and construction industries, implementation of occupational safety regulations is urgently needed. Awareness programs targeting healthcare professionals and high-risk workers may facilitate earlier diagnosis and improved outcomes.

Conclusion:

Sinonasal carcinoma in Bangladesh predominantly affects middle-aged males and is strongly associated with tobacco use, smoking, and occupational exposure to wood dust and industrial chemicals. Squamous cell carcinoma is the most common histological subtype and demonstrates a significant relationship with tobacco consumption. Most patients present with advanced disease, emphasizing the importance of early diagnosis, occupational safety measures, and public awareness programs.

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