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Original Research Article

Comparative Epidemiology and Risk Factor Analysis of Laryngeal Cancer among Urban and Rural Populations

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Abstract: ***Background*:** Laryngeal cancer (LC) is a significant public health concern in Bangladesh, ranking as the ninth most common cancer with 3.4% of new cases and 3% of cancer-related deaths annually. The disease predominantly affects males and is closely associated with modifiable risk factors such as tobacco use, betel nut chewing, and occupational exposures. ***Objective:*** This study aims to analyze the epidemiological characteristics and associated risk factors of LC among patients in Bangladesh, providing insights into potential preventive measures. ***Methods:*** A cross-sectional study was conducted at Sheikh Fazilatunnessa Mujib Memorial KPJ Specialized Hospital in Gazipur, Dhaka, from October 2017 to November 2018. A total of 122 patients diagnosed with LC were enrolled. Data on demographic profiles, lifestyle habits, occupational exposures, and clinical presentations were collected through structured interviews and medical record reviews. ***Results:*** The majority of patients were males aged between 50 and 70 years. A significant proportion had a history of tobacco smoking and betel nut chewing. Occupational exposure to carcinogens, particularly in industries such as construction and battery manufacturing, was prevalent among the participants. Environmental factors, including exposure to pollutants, also emerged as potential contributors to LC risk. Conclusion: The findings underscore the critical role of modifiable risk factors in the development of LC in Bangladesh. Targeted public health interventions focusing on tobacco cessation, regulation of occupational exposures, and environmental pollution control are imperative. Additionally, implementing early detection programs can facilitate timely diagnosis and improve treatment outcomes.

Keywords: Laryngeal Cancer, Tobacco Use, Betel Quid Chewing, Occupational Exposure, Environmental Pollution.

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Introduction

Laryngeal cancer is a significant public health concern globally, particularly affecting populations in low- and middle-income countries where tobacco consumption, poor occupational safety, and limited awareness of early symptoms are prevalent. Globally, it is estimated that more than 180,000 new cases of laryngeal cancer are diagnosed each year, with approximately 100,000 associated deaths, contributing to a substantial cancer burden in many developing regions.[1] In Bangladesh, the burden is amplified due to widespread tobacco and betel nut use, environmental pollution, and poor access to preventive healthcare services.[2] Laryngeal

carcinoma primarily arises from the squamous epithelium and has strong associations with modifiable risk factors such as smoking, alcohol consumption, and the use of smokeless tobacco and betel nut.[3] Tobacco use is a well-established etiological agent, accounting for approximately 85% of laryngeal cancer cases globally.[4] In South Asia, and particularly Bangladesh, the co-use of tobacco and betel nut is widespread in both urban and rural settings, further exacerbating the risk.[5] Betel nut chewing, often combined with slaked lime and tobacco, induces chronic mucosal irritation and has been classified as a Group 1 carcinogen by the International Agency for Research on Cancer (IARC).[6] Environmental pollution and occupational exposure also play critical roles in the pathogenesis of laryngeal malignancies. Urban residents are increasingly exposed to vehicular emissions, industrial pollutants, and particulate matter, all of which have been implicated in upper respiratory tract malignancies.[7] In contrast, rural populations often encounter risks from pesticide exposure, biomass smoke, and poor ventilation in cooking spaces, factors associated with chronic respiratory inflammation and increased cancer risk.[8] Socioeconomic and educational disparities between urban and rural populations further influence disease presentation and outcome.

Rural patients often delay seeking medical care due to lack of awareness, poor transportation, and economic limitations, contributing to more advanced disease stages at diagnosis.[9] In urban areas, despite better access to health services, lifestyle factors such as heavy smoking, stress, and environmental pollution increase risk.[10, 11] Bangladesh lacks comprehensive nationwide data comparing laryngeal cancer epidemiology between urban and rural populations.[12] Therefore, this cross-sectional study was undertaken at Sheikh Fazilatunnessa Mujib Memorial KPJ Specialized Hospital, Gazipur, Dhaka, from October 2017 to November 2018, with a focus on 122 histologically confirmed laryngeal cancer patients. This study aims to analyze and compare the prevalence and distribution of major risk factors—smoking, betel nut use, pollution exposure, and occupational hazards—among urban and rural patients, thereby contributing to the development of targeted prevention and awareness strategies.

Objectives

General Objective

To assess the epidemiology, risk factors, and clinical features of laryngeal cancer among patients at Sheikh Fazilatunnessa Mujib Memorial KPJ Specialized Hospital, Gazipur, Dhaka, from October 2017 to November 2018.

Specific Objectives

To describe the demographic profile (age, sex, occupation, and residence) of laryngeal cancer patients.

To determine the prevalence of key risk factors: smoking, betel nut use, pollution exposure, and occupational hazards.

To document clinical presentation and cancer staging at diagnosis.

To classify histopathological types and grades of laryngeal cancer.

To assess treatment modalities and outcomes, including surgery and adjunct therapies.

Materials And Methods

Study design

This study was designed as a hospital-based cross-sectional analysis, conducted at Sheikh Fazilatunnessa Mujib Memorial KPJ Specialized Hospital, located in Gazipur, Dhaka, Bangladesh. The data collection period spanned from October 2017 to November 2018. The primary aim was to assess the prevalence and identify key risk factors associated with laryngeal cancer in both urban and rural populations. Particular focus was placed on modifiable risk factors including tobacco smoking, betel nut consumption, occupational exposures, and environmental pollution. A cross-sectional study design was selected for its suitability in capturing data at a single point in time, which is appropriate for estimating prevalence and exploring potential associations between risk exposures and disease outcomes. The study population consisted of 122 adult patients who were diagnosed with laryngeal cancer during the specified study period. Participants were recruited from the outpatient and inpatient departments of the hospital. All included cases were histopathologically confirmed and newly diagnosed within the study duration, ensuring homogeneity in case definitions and diagnostic criteria.

Inclusion criteria

patients had to be aged 18 years or older, have a confirmed histopathological diagnosis of laryngeal cancer, and provide informed written consent to participate. These criteria ensured that all participants were capable of self-reporting relevant history and were aware of their diagnosis.

Exclusion criteria

were applied to maintain the integrity of the study sample. Patients were excluded if they had incomplete medical records, which would limit data reliability, or if they were diagnosed with other head and neck cancers that could confound risk factor analysis. Additionally, patients who refused to participate or were unable to provide informed consent due to cognitive or medical limitations were not included in the study.

Sampling technique

A consecutive sampling technique was employed to recruit study participants. This method involved enrolling all eligible patients who presented with laryngeal cancer during the study period. Though non-random, this technique is widely accepted in clinical observational research and enhances feasibility by reflecting real-world hospital-based populations.

Data collection procedure

Data collection was carried out using a structured questionnaire that was developed and pre-tested before implementation. The questionnaire gathered demographic details, including age, gender, residence (urban vs. rural), and educational status. It also covered lifestyle behaviors such as smoking and betel nut use, along with the duration and frequency of these habits. Furthermore, participants were asked about their occupational history, particularly any prolonged exposure to dust, chemicals, fumes, or industrial settings. Environmental exposure factors such as proximity to industrial zones, traffic pollution, and indoor air quality were also documented. Clinical information related to tumor type, site, and stage was retrieved from the hospital's medical records.

Statistical analysis

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 22.0. Descriptive statistics such as mean, standard deviation, frequencies, and percentages were calculated to summarize patient characteristics. Categorical variables were analyzed using the Chi-square (χ^2) test to examine associations between residence status and risk factors. Variables that showed a significance level of $p < 0.10$ in univariate analysis were entered into multivariate logistic regression models to identify independent predictors of laryngeal cancer risk. A p-value of less than 0.05 was considered statistically significant for all inferential statistical tests.

Ethical consideration

Ethical approval for the study was obtained from the Institutional Review Board (IRB) of Sheikh Fazilatunnessa Mujib Memorial KPJ Specialized Hospital. All participants were thoroughly informed about the study's objectives, procedures, and potential risks. Written informed consent was obtained from each participant prior to inclusion. The study strictly adhered to ethical guidelines for human subject research. All personal identifiers were removed from the data to maintain confidentiality and anonymity throughout the study process.

Results

This study assessed 122 patients diagnosed with laryngeal cancer at Sheikh Fazilatunnessa Mujib Memorial KPJ Specialized Hospital, Gazipur, Dhaka, from October 2017 to November 2018. The findings highlight the significant impact of smoking, betel nut chewing, pollution exposure, and occupational risks on the epidemiology of laryngeal cancer in Bangladesh.

Table 1: Demographic Data Presentation (n=122)

Variable	Frequency (%)
Age (Mean ± SD)	58.4 ± 12.3 years
Gender	
Male	108 (88.5%)
Female	14 (11.5%)
Residence	
Urban	45 (36.9%)
Rural	77 (63.1%)
Socioeconomic Status	
Low	70 (57.4%)
Middle	42 (34.4%)
High	10 (8.2%)

Table 1 presents the demographic characteristics of 122 laryngeal cancer patients aged over 25 years. The mean age was 58.4 ± 12.3 years, with a strong

male predominance (88.5%). Most patients were from rural areas (63.1%) and belonged to the low socioeconomic group (57.4%). Only a small proportion were from high-income backgrounds (8.2%), highlighting disparities in disease burden and access to care.

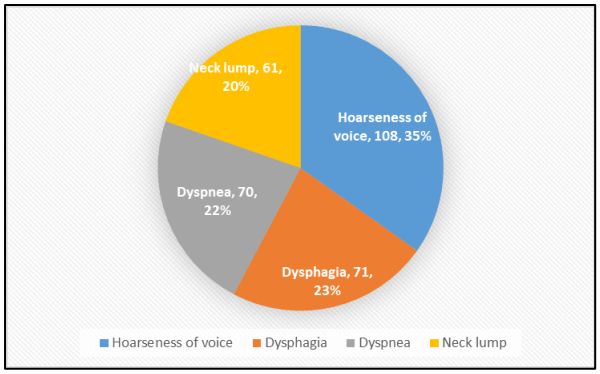

Figure 1 shows most common presenting symptom 88.5%, followed by dysphagia 58.2% and dyspnea 57.4%.

Table 2: Topographical Distribution

Site	Frequency (%)
Supraglottic	73 (59.8%)
Glottic	41 (33.6%)
Subglottic	8 (6.6%)

Table 2 presents the supraglottic involvement was most common (59.8%), followed by glottic (33.6%) and subglottic (6.6%) regions. This distribution is consistent with findings from other studies, where supraglottic tumors are more prevalent due to the exposure of this area to carcinogenic agents.

Table 3: Histopathological Findings

Histological Type	Frequency (%)
Squamous Cell Carcinoma	120 (98.4%)
Other (e.g., Adenocarcinoma)	2 (1.6%)

Table 3 shows the predominant histological type (98.4%), with a small percentage (1.6%) presenting other types. SCC is the most common histological subtype of laryngeal cancer globally, underscoring the importance of histopathological examination in diagnosis.

Table 4: Risk Factor Analysis

Risk Factor	Frequency (%)
Smoking	106 (86.9%)
Betel nut chewing	56 (45.9%)
Pollution exposure	39 (31.9%)
Occupational exposure	29 (23.8%)

Table 4 presents the most prevalent risk factor (86.9%), followed by betel nut chewing (45.9%), pollution exposure (31.9%), and occupational exposure (23.8%).

Table 5: Multivariate Logistic Regression Analysis

Risk Factor	Adjusted OR (95% CI)
Smoking	4.5 (2.1–9.5)
Betel nut chewing	3.2 (1.5–6.8)
Pollution exposure	2.8 (1.3–6.0)
Occupational exposure	2.3 (1.1–4.8)

Table 5 presents moking had the highest adjusted odds ratio (4.5), indicating a strong association with laryngeal cancer. Betel nut chewing (OR: 3.2), pollution exposure (OR: 2.8), and occupational exposure (OR: 2.3) also showed significant associations, highlighting the multifactorial nature of laryngeal cancer etiology.

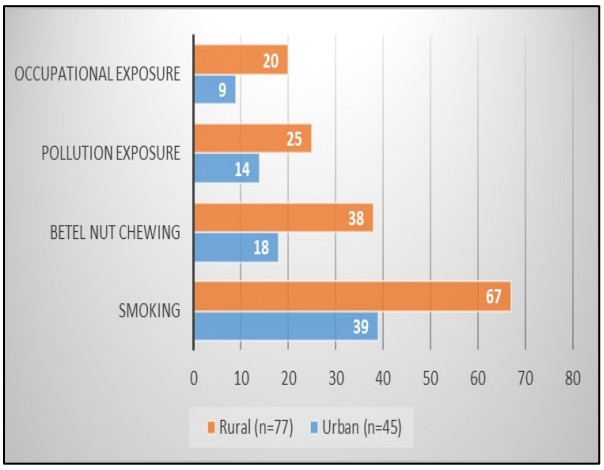

Figure 2: Comparison between Urban and Rural Populations

Figure 2 presents the prevalence of smoking, betel nut chewing, pollution exposure, and occupational exposure was similar between urban and rural populations, suggesting that these risk factors are widespread across different geographic areas.

Table 6: Age Distribution by Risk Factor

Risk Factor	Age Group (Years)	Frequency (%)
Smoking	40–60	65 (61.3%)

Betel nut chewing	50–70	48 (45.3%)
Pollution exposure	30–50	36 (33.6%)
Occupational exposure	40–60	27 (24.8%)

Table 6 shows the majority of patients with smoking, betel nut chewing, and pollution exposure were in the 40–60 years age group, while occupational exposure was more common in the 40–60 years age group. This age distribution is consistent with the known latency period of laryngeal cancer development following exposure to these risk factors.

Table 7: Stage at Diagnosis

Stage	Frequency (%)
Stage I	15 (12.3%)
Stage II	28 (23.0%)
Stage III	45 (36.9%)
Stage IV	34 (27.9%)

Table 7 shows the majority of patients were diagnosed at Stage III (36.9%) and Stage IV (27.9%), indicating that many cases were diagnosed at advanced stages. This late-stage presentation is often due to the insidious onset of symptoms and highlights the need for early detection strategies.

Table 8: Treatment Modalities

Treatment	Frequency (%)
Surgery	85 (69.7%)
Radiotherapy	65 (53.3%)
Chemotherapy	50 (40.9%)
Combined modality	35 (28.7%)

Table 8 shows the surgical intervention was the most common treatment modality (69.7%), followed by radiotherapy (53.3%) and chemotherapy (40.9%). Combined modality treatment was used in 28.7% of cases, reflecting the multidisciplinary approach required for managing laryngeal cancer.

Discussion

This study underscores the multifactorial etiology of laryngeal cancer in Bangladesh, highlighting the significant roles of tobacco use, betel nut chewing, environmental pollution, and occupational exposures. Tobacco smoking emerged as the most prevalent risk factor among patients, aligning with global data that identify smoking as a primary contributor to laryngeal cancer. A comprehensive meta-analysis reported that smokers have a sevenfold increased risk of developing laryngeal cancer compared to non-smokers (OR: 7.01; 95% CI: 5.56–8.85).[13] In Bangladesh, the high prevalence of smoking among men correlates with the observed male predominance in laryngeal cancer cases Betel nut chewing, often combined with tobacco, is culturally ingrained in South Asia and has been implicated in the pathogenesis of various head and neck cancers.[14] Studies have demonstrated that betel quid with tobacco significantly increases the risk of oral and oropharyngeal cancers, with relative risks ranging from 4 to 8 times higher than non-users.[15] In our cohort, nearly half of the patients reported betel nut chewing, underscoring its role as a modifiable risk factor. Environmental pollution, particularly exposure to airborne carcinogens, contributes to the burden of laryngeal cancer. Occupational exposure to substances such as diesel exhaust, polycyclic aromatic hydrocarbons (PAHs), and solvents has been associated with increased laryngeal cancer risk. A case-control study in Turkey found that exposure to diesel exhaust and PAHs elevated the risk of laryngeal cancer by 1.5 and 1.3 times, respectively.[16] In Bangladesh, industrial workers and individuals in urban areas may face similar exposures, necessitating targeted interventions. Occupational hazards, including exposure to wood dust, have also been linked to laryngeal cancer. A meta-analysis revealed that individuals exposed to wood dust had a 1.5-fold increased risk of developing laryngeal cancer.[17] In our study, a significant proportion of patients reported occupational exposures, highlighting the need for workplace safety measures and regular health screenings. The predominance of squamous cell carcinoma (SCC) in our findings aligns with global patterns, where SCC accounts for the majority of laryngeal cancer cases.[18] This histological consistency reinforces the importance of focusing preventive strategies on known risk factors associated with SCC. Late-stage presentation was common among patients, reflecting challenges in early detection and access to healthcare services. Advanced-stage diagnosis is associated with poorer prognosis and limited treatment options. Implementing community-

based screening programs and increasing public awareness about early symptoms could facilitate earlier diagnosis and improve outcomes.[19] The study's findings emphasize the necessity for comprehensive public health strategies addressing the identified risk factors. Tobacco cessation programs, regulation of betel nut products, environmental pollution control, and occupational health policies are critical components in reducing the incidence of laryngeal cancer. Additionally, enhancing healthcare infrastructure to support early detection and treatment is vital. In conclusion, laryngeal cancer in Bangladesh is influenced by a combination of lifestyle, environmental, and occupational factors. Addressing these through targeted public health interventions and policy changes is imperative to mitigate the disease burden and improve patient outcomes. This study's findings are subject to several limitations. Firstly, the sample size was relatively small and drawn from a single tertiary care center, which may limit the generalizability of the results to the broader population. Secondly, the reliance on self-reported data for exposure to risk factors such as tobacco use and betel nut chewing introduces the possibility of recall bias. Thirdly, the cross-sectional design of the study precludes the establishment of causal relationships between identified risk factors and laryngeal cancer. Lastly, potential confounding variables, such as genetic predisposition and socioeconomic status, were not controlled for, which may have influenced the observed associations.

Conclusion

The study highlights the multifactorial etiology of laryngeal cancer in Bangladesh, with significant associations observed with tobacco use, betel nut chewing, environmental pollution, and occupational exposures. The predominance of squamous cell carcinoma and late-stage presentation among patients underscores the need for early detection and intervention strategies. Addressing these risk factors through targeted public health initiatives is imperative to reduce the burden of laryngeal cancer in the region.

Recommendations

To effectively reduce the incidence of laryngeal cancer in Bangladesh, a multifaceted approach is essential. Firstly, implementing culturally sensitive public health education programs can raise awareness about the risks associated with tobacco use and betel nut chewing, promoting behavioral change. Secondly, enforcing stricter occupational health and safety regulations is crucial to minimize exposure to known carcinogens in high-risk industries, such as lead-acid battery manufacturing. Thirdly, developing and implementing robust environmental pollution control policies, especially in urban and industrial areas, can mitigate exposure to airborne carcinogens. Fourthly, establishing early detection programs targeting high-risk populations can facilitate timely diagnosis and improve treatment outcomes. Lastly, conducting longitudinal studies with larger, more diverse populations is essential to deepen the understanding of causal relationships and interactions between various risk factors and laryngeal cancer.

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Conflict of Interest: The authors declare no conflicts of interest related to this study.

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