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Etiological Patterns and Microbiological Spectrum of Deep Neck Space Abscesses in Rural versus Urban Populations: A Comparative Study

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ABSTRACT

Background: Deep neck space abscesses (DNSA) are potentially life-threatening infections with varied etiologies and microbiological profiles. Socioeconomic status, access to healthcare, and community setting may influence disease causation and outcomes. **Objective:** To compare etiological factors and microbiological spectrum of deep neck space abscesses between rural and urban populations. **Methods & Materials:** This observational comparative study was conducted on 72 patients diagnosed with deep neck space abscesses. Patients were categorized into rural (n=38) and urban (n=34) groups based on residence. Etiological factors such as odontogenic infections, upper respiratory tract infections (URTI), tuberculosis, trauma and unknown causes were analyzed. Pus samples were subjected to microbiological culture and sensitivity testing. Data were analyzed using descriptive statistics and comparative tests. **Results:** Odontogenic infection was the most common etiology overall (44.4%), significantly higher in rural patients (52.6%) compared to urban patients (35.3%). Tuberculosis-related abscesses were more frequent in rural populations (18.4% vs 5.9%). URTI was the predominant cause in urban patients (32.4%). Staphylococcus aureus was the most common isolate followed by Streptococcus species and anaerobes. Polymicrobial growth was more common in odontogenic infections. **Conclusion:** Etiological patterns and microbiological profiles of DNSA differ significantly between rural and urban populations. Poor oral hygiene and delayed presentation contribute to higher odontogenic and tubercular infections in rural settings. Early diagnosis and targeted antimicrobial therapy based on community-specific patterns can reduce morbidity.

Keywords: *Deep Neck Space Abscess, Odontogenic Infection, Rural Population, Urban Population, Tuberculosis, Microbiological Spectrum.*

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INTRODUCTION

Deep neck space abscesses (DNSA) are potentially life-threatening infections that involve the fascial spaces of the neck. These infections can rapidly progress to airway compromise, mediastinitis, septicemia, and other serious complications if not diagnosed and managed promptly [1]. Despite advancements in diagnostic imaging and antibiotic therapy, DNSA continues to pose significant morbidity and mortality, particularly in developing countries where access to healthcare may be limited [2]. Historically, the primary etiologies of DNSA were tonsillar and pharyngeal infections. However, in recent decades, odontogenic infections have emerged as the predominant cause, particularly in adults [3,4]. Other etiologies include upper respiratory tract infections (URTI), trauma, foreign bodies, and tubercular involvement of cervical lymph nodes [5]. Tuberculosis, though less common in developed countries, remains a significant contributor to chronic deep neck infections in endemic regions [6]. The etiological profile varies according to age, comorbidities, socioeconomic status, and geographic location, emphasizing the importance of context-specific studies. Community setting is a critical determinant in the epidemiology and outcomes of DNSA. Rural populations often present late due to limited healthcare access, reliance on traditional medicine, low literacy and financial constraints [7]. Consequently, rural patients may develop more advanced or polymicrobial infections, including odontogenic and tubercular abscesses. In contrast, urban populations typically have earlier access to medical care, resulting in prompt diagnosis and treatment. Nevertheless, urban residents may still be predisposed to infections due to lifestyle-related oral health problems or recurrent URTIs [8]. Microbiologically, DNSA commonly involves aerobic Gram-positive cocci such as Staphylococcus aureus and Streptococcus species, as well as anaerobes, especially in odontogenic infections [9]. Polymicrobial infections are frequently observed in advanced cases, underscoring the importance of culture-guided therapy. Knowledge of local microbial patterns is critical for empirical antibiotic selection and minimizing treatment failure [10]. Despite the recognized differences in community health profiles, there is limited comparative data on the etiological and microbiological spectrum of DNSA in rural versus urban populations. Understanding these differences is vital for guiding empirical therapy, prioritizing preventive strategies and improving clinical outcomes. This study aims to analyze the etiological factors, site distribution, and microbiological spectrum of deep neck space abscesses in rural and urban populations. By highlighting community-specific differences, the findings can inform targeted management strategies and public health interventions to reduce the burden of DNSA.

METHODS & MATERIALS

This observational comparative study was conducted in the National Institute of ENT, Tejgaon, Dhaka, Bangladesh from January 2024 to June 2024. A total of 72 patients diagnosed with deep neck space abscesses

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were included in the study after obtaining informed consent. Ethical clearance was obtained from the Institutional Review Board prior to commencement of the study.

Study Population and Grouping

Patients of all age groups and both sexes with clinically and radiologically confirmed deep neck space abscesses were enrolled. Diagnosis was established based on clinical findings supported by ultrasonography and/or contrast-enhanced computed tomography of the neck. Patients were categorized into two groups according to their place of residence: rural population (n=38) and urban population (n=34).

Inclusion and Exclusion Criteria

Inclusion criteria comprised patients presenting with abscesses involving deep cervical fascial spaces such as submandibular, parapharyngeal, retropharyngeal, peritonsillar, or multiple neck spaces. Patients with superficial neck abscesses, postoperative neck infections, abscesses secondary to head and neck malignancy or those with incomplete clinical or microbiological data were excluded from the study.

Data Collection

Detailed demographic and clinical data were recorded using a structured proforma. Information regarding presenting symptoms, duration of illness, comorbid conditions, site of abscess, and suspected etiological factors was documented. Etiology was categorized as odontogenic infection, upper respiratory tract infection, tuberculosis, trauma or foreign body and unknown origin. Tuberculosis was diagnosed based on clinical suspicion supported by radiological findings, microbiological evidence, or histopathological confirmation.

Microbiological Evaluation

Pus samples obtained during needle aspiration or surgical incision and drainage were sent for Gram staining, aerobic and anaerobic culture and antibiotic sensitivity testing. Ziehl–Neelsen staining and mycobacterial culture were performed when tuberculosis was suspected.

Management Protocol

All patients received empirical broad-spectrum intravenous antibiotics on admission, which were later modified based on culture and sensitivity results. Surgical drainage was performed when indicated. Supportive care including airway management was provided as required.

Statistical Analysis

Data were analyzed using statistical software. Categorical variables were expressed as frequencies and percentages. Comparative analysis between rural and urban groups was performed using the Chi-square test, with a p-value of <0.05 considered statistically significant.

RESULTS

Demographic Characteristics

A total of 72 patients with deep neck space abscesses were included in this study, comprising 38 rural and 34 urban residents. The age of patients ranged from 5 to 68 years, with a mean age of 33.8 ± 12.2 years. The majority of patients were in the third and fourth decades of life. Male patients predominated in both groups, accounting for 65.3% of the total study population, while females comprised 34.7%. There were no statistically significant differences in age or sex distribution between rural and urban groups, indicating comparable baseline demographics (*Table I*).

Table I

Demographic Distribution of Patients (*n* = 72).

Variable	Rural (n=38)	Urban (n=34)	Total (n=72)
Mean age (years)	34.6 ± 12.8	32.9 ± 11.6	33.8 ± 12.2
Male	25 (65.8%)	22 (64.7%)	47 (65.3%)
Female	13 (34.2%)	12 (35.3%)	25 (34.7%)

Etiological Patterns

The etiological distribution of deep neck space abscesses showed notable differences between rural and urban populations. Overall, odontogenic infections were the most common cause, observed in 44.4% of cases. Rural patients exhibited a higher prevalence of odontogenic infections (52.6%) compared to urban patients (35.3%). Upper respiratory tract infections (URTI) were the second most frequent cause and predominated in urban patients (32.4%) versus rural patients (18.4%). Tuberculosis-related abscesses accounted for 12.5% of total cases and were significantly more common in rural patients (18.4%) than in urban patients (5.9%). Trauma or foreign body-related abscesses were observed in a minority of cases (8.3%) with no significant difference between the groups. Cases with unknown etiology represented 9.7% of the total more frequently in urban patients (14.6%) than rural (5.3%) *Table II*.

Table II

Etiological Factors in Rural and Urban Populations.

Etiology	Rural (n=38)	Urban (n=34)	Total (n=72)
Odontogenic infection	20 (52.6%)	12 (35.3%)	32 (44.4%)
Upper respiratory tract infection	7 (18.4%)	11 (32.4%)	18 (25.0%)
Tuberculosis	7 (18.4%)	2 (5.9%)	9 (12.5%)
Trauma / foreign body	2 (5.3%)	4 (11.8%)	6 (8.3%)
Unknown origin	2 (5.3%)	5 (14.6%)	7 (9.7%)

Site of Abscess

Submandibular space involvement was the most frequent overall, observed in 36.1% of patients, and was particularly common among rural patients (42.1%), correlating with the high prevalence of odontogenic infections. Parapharyngeal abscesses accounted for 23.6% of cases, slightly more frequent in urban patients (26.5%) than rural (21.1%). Retropharyngeal abscesses were present in 18.1% of patients, with a marginally higher incidence in urban populations (20.6% vs 15.8%). Peritonsillar abscesses occurred in 13.9% of cases, more often in urban patients (17.6%) than rural (10.5%). Multiple deep neck space involvement was observed in 8.3% of patients, predominantly in rural individuals (10.5%) reflecting delayed presentation (*Table III*).

Table III

Distribution of Deep Neck Space Involvement.

Site of Abscess	Rural (n=38)	Urban (n=34)	Total (n=72)
Submandibular	16 (42.1%)	10 (29.4%)	26 (36.1%)
Parapharyngeal	8 (21.1%)	9 (26.5%)	17 (23.6%)
Retropharyngeal	6 (15.8%)	7 (20.6%)	13 (18.1%)

Peritonsillar	4 (10.5%)	6 (17.6%)	10 (13.9%)
Multiple spaces	4 (10.5%)	2 (5.9%)	6 (8.3%)

Microbiological Findings

Microbiological analysis revealed that Staphylococcus aureus was the most commonly isolated pathogen, accounting for 27.8% of cases, followed by Streptococcus species (22.2%). Anaerobic organisms were isolated in 18.1% of patients, predominantly associated with odontogenic infections in rural populations. Klebsiella pneumoniae and Pseudomonas aeruginosa were less common, comprising 9.7% and 6.9% of isolates, respectively. Mycobacterium tuberculosis was identified in 12.5% of cases, almost exclusively in rural patients presenting with chronic abscesses. Only 2.8% of cases yielded sterile cultures (*Table IV*).

Table IV

Microbiological Spectrum of Isolated Organisms.

Organism	Rural (n=38)	Urban (n=34)	Total (n=72)
Staphylococcus aureus	12 (31.6%)	8 (23.5%)	20 (27.8%)
Streptococcus species	9 (23.7%)	7 (20.6%)	16 (22.2%)
Anaerobic organisms	8 (21.1%)	5 (14.7%)	13 (18.1%)
Klebsiella pneumoniae	4 (10.5%)	3 (8.8%)	7 (9.7%)
Pseudomonas aeruginosa	3 (7.9%)	2 (5.9%)	5 (6.9%)
Mycobacterium tuberculosis	7 (18.4%)	2 (5.9%)	9 (12.5%)
No growth	1 (2.6%)	1 (2.9%)	2 (2.8%)

Growth Pattern

Regarding the nature of microbial growth, monomicrobial infections predominated in 61.1% of cases, particularly in urban patients (67.6%), where URTI-related abscesses were more frequent. Polymicrobial growth was more common in rural populations (42.1%), often linked to odontogenic abscesses. Sterile cultures were rare, observed in only 2.8% of patients (*Table V*).

Table V

Nature of Microbial Growth.

Growth Pattern	Rural (n=38)	Urban (n=34)	Total (n=72)
Monomicrobial	21 (55.3%)	23 (67.6%)	44 (61.1%)
Polymicrobial	16 (42.1%)	10 (29.4%)	26 (36.1%)
Sterile	1 (2.6%)	1 (2.9%)	2 (2.8%)

DISCUSSION

This study highlights distinct differences in the etiological and microbiological profile of deep neck space abscesses between rural and urban populations. Odontogenic infections were the most frequent cause overall, accounting for 44.4% of cases and were significantly more common in rural patients. This finding aligns with previous studies reporting a predominance of dental origin in deep neck infections, particularly in developing countries [3,11]. The higher prevalence in rural areas may be attributed to poor oral hygiene, limited dental care access, delayed presentation and lack of awareness regarding early intervention [7]. Upper respiratory tract infections were more prevalent among urban patients, consistent with studies suggesting that peritonsillar and parapharyngeal spaces are commonly involved in URTI-related abscesses [12]. Earlier presentation and accessibility to medical care in urban settings may reduce the progression to submandibular or multiple-space involvement. Tuberculosis-related abscesses were observed predominantly in rural patients, reflecting ongoing endemicity and delayed diagnosis in these communities [6,13]. Chronicity, lack of healthcare access, and underdiagnosis contribute to the higher rural burden. These findings underscore the need for heightened clinical suspicion and routine microbiological or histopathological evaluation in chronic or recurrent deep neck abscesses, particularly in endemic regions. The microbiological profile was consistent with global literature. Staphylococcus aureus was the most frequently isolated organism, followed by Streptococcus species and anaerobes. Polymicrobial growth was more common in rural patients, especially in odontogenic infections, reflecting more advanced disease at presentation [9,14]. Monomicrobial infections predominated in urban patients, likely due to earlier healthcare access and less severe disease. The presence of anaerobes emphasizes the importance of empiric coverage for both aerobic and anaerobic organisms in initial therapy, particularly for odontogenic abscesses,[15] the site of abscess was influenced by etiology. Submandibular space involvement correlated with odontogenic infections, while parapharyngeal and retropharyngeal abscesses were more often associated with URTI. Multiple-space involvement was more common in rural patients, suggesting delayed presentation and disease progression. These findings align with previous reports highlighting the relationship between etiology, site involvement and disease severity [4,12]. Overall, these results indicate that community setting significantly impacts the etiology, microbiology, and presentation of DNSA. Early diagnosis, community-specific empirical therapy and preventive measures, such as improving oral hygiene and tuberculosis screening in rural populations are essential to reduce morbidity and improve outcomes.

CONCLUSION

Deep neck space abscesses show distinct etiological and microbiological variations between rural and urban populations. Odontogenic and tubercular infections are more prevalent in rural settings, while URTI-related abscesses are common in urban areas. Awareness of community-specific patterns can aid in early diagnosis, appropriate empirical therapy, and prevention strategies.

LIMITATIONS

- Single-center study
- Relatively small sample size
- Anaerobic culture facilities were limited

RECOMMENDATIONS

- Strengthening rural dental healthcare services
- Early screening for tuberculosis in chronic neck infections
- Community-specific antibiotic protocols

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CONFLICT OF INTEREST
The authors declare that there is no conflict of interest regarding the publication of this study.

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