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How Does Diabetes Influence the Severity and Microbiological Profile of Odontogenic Maxillofacial Infections? An Observational Study

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Abstract

Background: Odontogenic maxillofacial infections are common yet serious conditions that can lead to life-threatening complications. Diabetes mellitus (DM) is known to exacerbate the severity of such infections due to its impact on immune function and wound healing. This study aimed to compare the severity, microbiological profile, and clinical outcomes of odontogenic infections in diabetic and non- diabetic patients in Dhaka, Bangladesh.

Methods: A retrospective observational study was conducted at the Department of Oral and Maxillofacial Surgery, Military Dental Center, Dhaka Cantonment. Seventy patients diagnosed with odontogenic infections requiring hospitalization were included, divided into diabetic (n=35) and non-diabetic (n=35) groups. Data on demographics, infection characteristics, microbiological findings, antibiotic susceptibility, and hospital stay duration were analyzed using SPSS version 26. The Chi-square test, independent t-test, and logistic regression were employed to assess statistical significance.

Results: The mean age of participants was 47.95±6.71 years, with a significant difference between groups (p=0.001). Male predominance was noted (70%). Diabetic patients exhibited significantly higher rates of multiple-space infections (31.43% vs. 11.43%; p=0.041) and prolonged hospital stays (18.32±4.78 days vs. 6.24±2.12 days; p<0.001). Microbiological analysis revealed Streptococcus viridans as the predominant organism in non-diabetic patients (31.43%), whereas Klebsiella pneumoniae was more frequent in diabetics (25.71%). Logistic regression analysis identified age, multiple-space infections, and bacterial isolates as significant predictors of prolonged hospitalization.

Conclusion: Diabetic patients with odontogenic infections experience more severe infections, longer hospital stays, and distinct microbiological patterns compared to non- diabetics. These findings emphasize the need for early diagnosis, aggressive management, and tailored antibiotic therapy in diabetic individuals to mitigate complications. Future research should focus on larger, multi-center studies to validate these findings and develop standardized treatment protocols.

Keywords: Odontogenic infection, Diabetes mellitus, Maxillofacial infection, Klebsiella pneumoniae, Streptococcus viridans, Hospital stay, Multiple-space infections.

Abbreviation

DM – Diabetes Mellitus

Non-DM – Non-Diabetic

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OMI – Odontogenic Maxillofacial Infection

BMI – Body Mass Index

SPSS – Statistical Package for the Social Sciences

SD – Standard Deviation

IDF – International Diabetes Federation

HbA1c – Glycated Hemoglobin

OMFS – Oral and Maxillofacial Surgery

Introduction

Odontogenic maxillofacial infections represent a significant clinical concern due to their potential for rapid progression and life-threatening complications.[1] These infections, originating from dental structures or their supporting tissues, can extend into the fascial spaces of the head and neck, leading to severe outcomes such as airway obstruction, sepsis, and mediastinitis.[2] Despite advancements in antibiotic therapies and surgical interventions, odontogenic infections remain prevalent, necessitating prompt diagnosis and effective management strategies.[3] The severity and spread of these infections depend on several factors, including the virulence of causative microorganisms, host immune response, and the timeliness of medical intervention.[4]

One critical factor influencing the progression and management of odontogenic infections is the presence of systemic conditions such as diabetes mellitus (DM).[5] Diabetes mellitus, characterized by chronic hyperglycemia due to impaired insulin secretion or action, compromises the host's immune defense mechanisms.[6] Diabetic patients exhibit reduced neutrophil function, including impaired chemotaxis, phagocytosis, and microbial killing abilities.[7] These immune dysfunctions contribute to an increased susceptibility to infections and complicate their clinical management.[8] Moreover, hyperglycemia impairs the wound-healing process, further complicating treatment outcomes in diabetic individuals.[9] The prevalence of diabetes mellitus is rising globally, with significant public health implications, especially in developing countries like Bangladesh.[10] According to the International Diabetes Federation, the number of individuals with diabetes in Bangladesh has been steadily increasing, posing a substantial burden on the healthcare system.[11] The interplay between diabetes and infectious diseases is well documented, with diabetic patients experiencing higher rates of infection-related morbidity and mortality.[12] In the context of odontogenic maxillofacial infections, this association warrants focused research to understand the unique clinical challenges posed by diabetic patients.[13]

Previous studies have highlighted that diabetic patients with odontogenic infections tend to have more extensive space involvement, prolonged hospital stays, and higher rates of complications compared to non-diabetic individuals.[14] Studies by Lin et al.[15] and Rao et al.[16] demonstrated that diabetic patients are more prone to multi-space infections and show a higher prevalence of *Klebsiella pneumoniae* as a causative organism.[17] These findings suggest that diabetes mellitus not only predisposes individuals to odontogenic infections but also influences the microbiological profile and severity of these infections.[18] Recent research has further demonstrated clinical and microbiological variations in odontogenic infections based on glycemic control.[19] Poorly controlled diabetic patients tend to experience more aggressive infections requiring longer hospital stays and intensive management.[20] However, despite these insights, there remains a paucity of region-specific data, particularly in Bangladesh, where both the prevalence of diabetes and the burden of odontogenic infections are substantial.[21] Understanding the epidemiological and clinical differences of odontogenic infections in diabetic and non-diabetic populations is crucial for developing targeted prevention and management strategies.[22] Such knowledge can inform clinical guidelines, optimize healthcare resource allocation, and ultimately improve patient outcomes.[23] The aim of his study was to compare the severity, microbiological profiles, and clinical outcomes of odontogenic maxillofacial infections between diabetic and non-diabetic patients in Dhaka, Bangladesh.

Study Design and Study Setting

A comparative observational study was carried out at the Department of Oral and Maxillofacial Surgery, Military Dental Center, Dhaka Cantonment, Bangladesh. The study duration extended from July 2021 to June 2022. Hospital records of eligible patients were retrospectively reviewed to obtain relevant clinical and microbiological information.

Study Population

A total of 70 hospitalized patients diagnosed with odontogenic maxillofacial infections were included in the study. The participants were equally divided into two groups: diabetic patients (n = 35) and non-diabetic patients (n = 35). Diabetes mellitus was identified based on documented medical history or fasting blood glucose levels greater than 7.2 mmol/L.

Inclusion and Exclusion Criteria

Patients aged between 20 and 80 years who presented with odontogenic infections involving deep fascial spaces and required hospital admission were included in the study. Patients were excluded if they had infections of non-odontogenic origin, incomplete medical records, immunocompromising conditions other than diabetes, or if they declined to provide informed consent.

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Data Collection

Data were collected using a structured and standardized data collection form. Information regarding patient demographics, medical history, clinical presentation, involved fascial spaces, microbiological findings, antibiotic sensitivity patterns, and duration of hospital stay was recorded. Pus samples were obtained for culture and sensitivity testing, which were performed using standard microbiological procedures to identify causative organisms and determine their antibiotic susceptibility profiles.

Ethical Considerations

This study was conducted after obtaining ethical approval from the Research Review Committee of the Department of Oral and Maxillofacial Surgery, Military Dental Center, Dhaka Cantonment, Bangladesh. The research protocol adhered to the ethical principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants prior to inclusion in the study. Patient confidentiality and privacy were strictly maintained by anonymizing personal identifiers and securely storing all collected data.

Statistical Analysis

Data analysis was performed using Statistical Package for the Social Sciences (SPSS) version 26. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequencies and percentages. The Chi-square test and Fisher's exact test were applied to compare categorical variables between groups, and independent t-tests were used for continuous variables. Logistic regression analysis was conducted to determine independent predictors of prolonged hospital stay. A p-value of less than 0.05 was considered statistically significant.

Result

Odontogenic infections in the maxillofacial region pose a significant clinical challenge, particularly in patients with underlying systemic conditions such as diabetes mellitus. This section presents a comparative analysis of the demographic characteristics, clinical features, microbiological findings, and hospital stay outcomes between diabetic and non-diabetic patients. Understanding these differences is crucial for optimizing treatment strategies and improving patient outcomes.

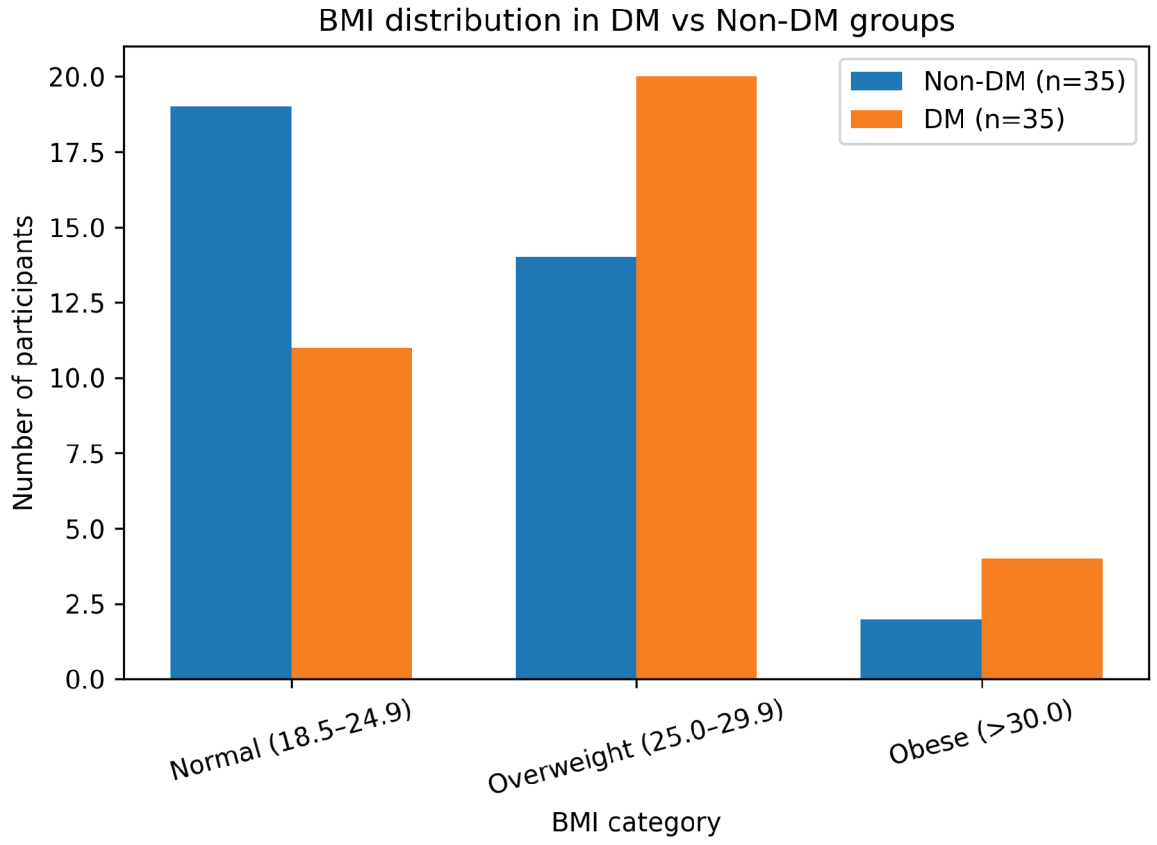

Figure 1: Distribution of the study subjects by BMI (N=70)

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In figure-1, the study population comprised 70 patients, divided into two groups: diabetic (n=35) and non-diabetic (n=35). The mean age of participants was 47.95±6.71 years, with a significant difference between the two groups (p=0.001). Males constituted 70% of the study population, with a male-to- female ratio of 2.3:1. The majority of patients were businessmen (44.3%), followed by service holders (25.7%) and housewives (18.6%). A substantial proportion (41.4%) had a monthly income between 10,000-20,000 BDT.

Table 1 Distribution of the study subjects by Spaces involved in diabetic and nondiabetic patients. resembles Analysis of maxillofacial space involvement revealed that the submandibular space was the most frequently affected in both groups (31.43% in non-diabetics and 22.86% in diabetics). Multiple-space infections were significantly more common in diabetic patients (31.43%) compared to non-diabetics (11.43%) (p=0.041). Other frequently involved spaces included the buccal (17.14% in non-diabetics, 20% in diabetics) and submental (2.86% in non-diabetics, 5.71% in diabetics) regions.

Table 1: Distribution of the study subjects by Spaces involved in diabetic and nondiabetic patients (N=70)

Involved spaces	Non-DM (n=35)		DM (n=35)		p-value
	n	%	n	%	
Submandibular	11	31.43	8	22.86	0.42
Buccal	6	17.14	7	20	0.758
Submental	1	2.86	2	5.71	0.555
Submasseteric	2	5.71	1	2.83	0.555
Pterygomandibular	4	11.43	3	8.57	0.69
Ludwig's angina	2	5.71	1	2.86	0.555
Canine	2	5.71	0	0	0.151
Sublingual	1	2.86	1	2.86	1
Temporal	2	5.71	1	2.86	0.555
Multiple spaces	4	11.43	11	31.43	0.041*
Total	35	100	35	100	

Table 2 shows Isolated organisms from diabetic and nondiabetic patients. Pus culture and sensitivity tests identified six bacterial species as the primary pathogens. Streptococcus viridans was the most commonly isolated organism in non-diabetic patients (31.43%), while Klebsiella pneumoniae (25.71%) and Streptococcus viridians (22.86%) were predominant in diabetics. Other isolated organisms included Staphylococcus aureus, Pseudomonas spp., Enterococcus, and Escherichia coli. Antibiotic susceptibility tests indicated high sensitivity to amoxicillin, cefotaxime, and imipenem, while resistance was noted against clindamycin and amikacin.

Table 2: Isolated organisms from diabetic and nondiabetic patients (N=70)

Isolated organism	Non-DM (n=35)		DM (n=35)	p-value
	n	%	n	%
Enterococcus	3	8.57	4	11.43
Escherichia coli	0	0	2	5.71
Klebsiella pneumoniae	3	8.57	9	25.71
Streptococcus spp.	11	31.43	8	22.86
Staphylococcus aureus	6	17.14	1	2.86
Pseudomonas	3	8.57	6	17.14
No growth/Gram-positive	9	25.71	5	14.29
Total	35	100	35	100

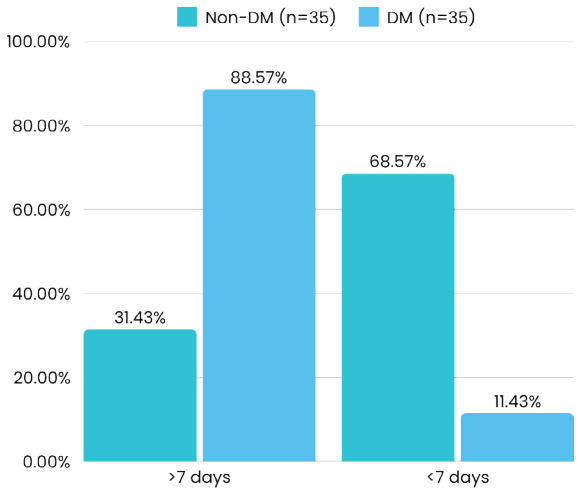

Figure 2: Hospital Stay and Clinical Outcomes of the Patients (N=70)

Figure 1: Bar chart distribution of outcome of hospital stay.

Figure 1 illustrates hospital Stay and clinical outcomes of the patients. The mean duration of hospitalization was significantly longer in diabetic patients (18.32±4.78 days) than in non-diabetics (6.24±2.12 days) (p<0.001). Among diabetics, 88.57% required hospitalization for more than seven days, compared to only 31.43% of non-diabetics. Logistic regression analysis identified age, presence of multiple-space infections, and bacterial isolates as significant predictors of prolonged hospital stay (p<0.05).

Table 3 resembles comparison of hospital stay in diabetic and nondiabetic patients. The mean hospital stay duration was 18.32±4.78 days in diabetics and 6.24±2.12 days in non-diabetics. 88.57% diabetics had hospital stay for more than 7 days. Only 31.43% non-diabetes needed hospital stay for more than a week. The difference between the groups was statistically significant (p<0.001).

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Table 4 demonstrates multiple logistic regressions of prediction of hospital stay among the respondents. Age, medical history and isolates bacteria are the significant predictors of duration of hospital stay (p>0.05).

Table 3: Comparison of hospital stay in diabetic and nondiabetic patients (N=70)

	Non-DM		DM		p-value
Hospital stay (days)	(n=35)		(n=35)		
	n.	%	n.	%	
>7 days	11	31.43	31	88.57	
<7 days	24	68.57	4	11.43	
Total	35	100	35	100	
Mean±SD	6.24±2.12		18.32±4.78		<0.001*

Table 4: Multiple logistic regressions of prediction of hospital stay among the respondents (N=70)

	Likelihood Ratio Tests		
Effect	Chi-Square	df	Sig.
Intercept	0	0	.
Age	10.637	4	.031*
BMI	0	2	1
Medical History	6.204	1	.013*
Abscess Location	22.937	9	0.006
Bacteria Isolations	18.782	6	**.005***

Discussion

Odontogenic maxillofacial infections continue to pose a significant challenge in oral and maxillofacial surgery because of their potential for rapid progression and serious complications. The present study demonstrates clear differences in disease severity, microbiological profile, and clinical outcomes between diabetic and non-diabetic patients, emphasizing the influence of diabetes mellitus on infection behavior. A key finding of this study is the significantly higher frequency of multiple-space involvement among diabetic patients. This observation is consistent with previous reports indicating that diabetes predisposes individuals to more extensive deep neck and fascial space infections of odontogenic origin[24,25]. Diabetic patients are particularly susceptible to aggressive spread due to impaired neutrophil function, compromised microcirculation, and delayed tissue repair, which collectively reduce the host's ability to localize infection[26]. These pathophysiological mechanisms likely explain the increased severity and wider anatomical involvement observed in diabetic individuals.

Microbiological findings revealed a predominance of *Klebsiella pneumoniae* in diabetic patients, whereas *Streptococcus viridans* was more frequently isolated from non-diabetic patients. Similar microbial patterns have been reported in earlier studies, where Gram-negative organisms were significantly more common in diabetic populations[27,28]. Chronic hyperglycemia alters host–microbial interactions and favors the growth of opportunistic pathogens such as *Klebsiella* species, contributing to more severe infections and treatment challenges[29]. In contrast, the predominance of viridans streptococci in non-diabetic patients reflects the typical oral flora associated with odontogenic infections in immunocompetent hosts[30]. The antibiotic susceptibility pattern observed in this study supports the continued effectiveness of broad-spectrum agents such as amoxicillin and cefotaxime in managing odontogenic infections. These findings align with prior research demonstrating reliable sensitivity of common odontogenic pathogens to beta-lactam antibiotics, while highlighting emerging resistance to agents such as clindamycin and amikacin[31]. This underscores the importance of culture-guided antibiotic therapy, particularly in diabetic patients with severe or refractory infections. Hospitalization duration was significantly prolonged among diabetic patients compared to non-diabetic individuals. This finding is consistent with previous studies reporting extended hospital stays in diabetic patients due to delayed wound healing, poor glycemic control, and higher rates of infection-related complications[32]. Additionally, diabetic patients are more prone to developing serious complications such as airway compromise, descending mediastinitis, and secondary infections, all of which contribute to prolonged recovery and increased healthcare burden[33].

The increased severity and complexity of odontogenic infections in diabetic patients highlight the need for an aggressive and multidisciplinary treatment approach. Early surgical intervention, appropriate antimicrobial therapy, and strict glycemic control are critical components of effective management. Previous studies have demonstrated that optimal blood glucose regulation significantly reduces complication rates and improves treatment outcomes in maxillofacial infections[34]. Therefore, early identification of diabetic status and close collaboration between surgical and medical teams are essential to minimize morbidity. Overall, the findings of this study reinforce the concept that diabetes mellitus significantly alters the clinical course of odontogenic maxillofacial infections. Enhanced clinical vigilance, early diagnosis, and individualized treatment strategies are necessary to improve outcomes in this high-risk population.

Limitation of the Study

This study has several limitations that should be considered when interpreting the findings. First, the relatively small sample size and single-center design may limit the generalizability of the results to broader populations. Second, glycemic control parameters such as HbA1c levels were not consistently available, restricting assessment of

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the relationship between infection severity and long-term diabetic control. Third, the study did not evaluate long-term follow-up outcomes after discharge, which could provide insight into recurrence and late complications. Finally, variations in antibiotic use prior to hospital admission may have influenced microbiological culture results.

Conclusion

Diabetes mellitus significantly influences the clinical severity and outcomes of odontogenic maxillofacial infections. Diabetic patients demonstrate more extensive space involvement, altered microbial patterns, and prolonged hospitalization compared with non-diabetic individuals. These findings underscore the role of impaired immunity and delayed healing in worsening infection outcomes. Early diagnosis, strict glycemic control, and aggressive multidisciplinary management are essential to reduce morbidity in this high-risk population.

diabetic patients tend to develop more aggressive infections that require extended hospitalization and more intensive medical interventions. These findings are consistent with global research emphasizing the importance of stringent glycemic control and early medical intervention in preventing severe odontogenic infections in diabetic individuals. To improve patient outcomes, a multidisciplinary approach is recommended, incorporating routine dental check-ups, early identification of odontogenic infections, and aggressive antimicrobial therapy tailored to the microbial spectrum observed in diabetic patients. Furthermore, public health initiatives should focus on educating diabetic patients about oral hygiene and the potential risks associated with odontogenic infections. Overall, this study contributes valuable insights into the clinical and microbiological distinctions between diabetic and non-diabetic patients with odontogenic infections. Future research should focus on larger, multi-center studies to further validate these findings and develop standardized treatment protocols aimed at reducing morbidity and improving clinical outcomes in this vulnerable population.

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