The Impact of Diabetes Mellitus on the incidence and severity of cellulitis

Jayapriya Murugavel[1], Dr. A.N. Uma[2*], Dr. S. Raj[3], Sourav Das[4], Yuvasri Pandurangan[5], Akila Mohan[6], Lavanya B[7]

1 Intern student, Department of Physician Associate, School of Allied Health Sciences, Sri Balaji Vidyapeeth (Deemed to be University), Puducherry, India

2 Professor of Medical Genetics & Principal, School of Allied Health Sciences, Sri Balaji Vidyapeeth (Deemed to be University), Puducherry, India

3 Associate Professor, Department of General Surgery, Mahatma Gandhi Medical College & Research Institute, Sri Balaji Vidyapeeth (Deemed to be University), Puducherry, India

4 Assistant Professor, Department of Microbiology, School of Allied Health Sciences, Sri Balaji Vidyapeeth (Deemed to be University), Puducherry, India

5 Tutor, Department of Physician Associate, School of Allied Health Sciences, Sri Balaji Vidyapeeth (Deemed to be University), Puducherry, India

6 Tutor, Department of Respiratory Therapy, School of Allied Health Sciences, Sri Balaji Vidyapeeth (Deemed to be University), Puducherry, India

7 Assistant Professor, Department of Community Medicine, Shri Sathya Sai Medical College and Research Institute, Sri Balaji Vidyapeeth, (Deemed to be University), Chengalpattu District, Tamil Nadu, India.

*Corresponding Author: Dr. A. N. Uma

THE IMPACT OF DIABETES MELLITUS ON THE INCIDENCE AND SEVERITY OF CELLULITIS

ABSTRACT

Background:

Cellulitis is an acute bacterial infection of the dermis and subcutaneous tissue, characterized by erythema, swelling, and tenderness. Diabetes mellitus is a major risk factor that predisposes individuals to recurrent and severe cellulitis due to impaired immunity, poor circulation, and delayed wound healing. This study was undertaken to evaluate the impact of diabetes on the incidence and severity of cellulitis.

Methods:

An observational study was conducted in the Department of General Surgery, Mahatma Gandhi Medical College and Research Institute, Puducherry, from January 2025 to June 2025. Thirty patients diagnosed with cellulitis, both diabetic and non-diabetic, were included. Data regarding age, sex, comorbidities, staging of cellulitis, investigations (including HbA1C), treatment, and outcomes were collected. Severity was assessed and compared between diabetic and non-diabetic groups. Descriptive statistics and comparative analysis were used to interpret the data.

Results:

Out of 30 patients, 15 had diabetes mellitus. Moderate cellulitis was more common among diabetic patients (33.3%), with 16.7% presenting with severe disease. In contrast, non-diabetic patients predominantly exhibited mild cellulitis (30%) and moderate severity (20%). Males were more frequently affected than females, and the age group 36–40 years showed the highest prevalence. Treatment outcomes indicated that women had a comparatively faster recovery, while men required longer durations of therapy.

Conclusion:

The findings confirm that diabetes mellitus significantly increases the risk and severity of cellulitis, resulting in higher morbidity and prolonged recovery. Early recognition, strict glycemic control, and proper wound care are essential to reduce complications. Preventive strategies and patient education play a crucial role in minimizing the burden of cellulitis among diabetic individuals.

Keywords:

Diabetes mellitus, cellulitis, incidence, severity, wound care, infection.

INTRODUCTION

Cellulitis is a common bacterial infection of the skin and soft tissues, most often caused by Streptococcus and Staphylococcus species. It presents with redness, swelling, warmth, and pain, and while it can affect any body region, the lower extremities are most frequently involved. In severe cases, cellulitis may progress to systemic complications such as abscess formation, deep tissue involvement, or sepsis (1).

Diabetes mellitus is one of the most significant risk factors for cellulitis. Chronic hyperglycemia impairs immune responses, delays wound healing, and contributes to microvascular and skin changes that increase susceptibility to infection. As a result, individuals with diabetes are not only more likely to develop cellulitis but also tend to experience more severe disease, longer healing times, extended hospital stays, and higher complication rates (2).

The rising global prevalence of diabetes underscores the importance of understanding its relationship with cellulitis. Poor glycemic control, vascular dysfunction, neuropathy, and impaired leukocyte activity all play roles in the pathogenesis and recurrence of cellulitis in diabetic patients. Early recognition, prompt treatment, and preventive measures are therefore essential to reducing morbidity, complications, and healthcare costs. This article highlights the complex interplay between diabetes and cellulitis and emphasizes the need for targeted strategies to improve outcomes in this high-risk group (3).

Cellulitis is an acute bacterial infection of the dermis and subcutaneous tissue, typically presenting as a poorly demarcated, erythematous, warm, and tender area with associated edema. Unlike abscesses, cellulitis does not involve purulent discharge. It often arises as a complication of wounds, ulcers, dermatoses, or breaches in skin integrity caused by trauma, surgery, fungal infections, or intravenous catheters (4).

The condition is most frequently caused by beta-hemolytic streptococci, particularly Streptococcus pyogenes (group A), and Staphylococcus aureus, including methicillin-sensitive strains. Certain populations—such as immunocompromised patients, individuals colonized with methicillin-resistant S. aureus (MRSA), animal bite victims, and those with comorbidities like diabetes mellitus—are at increased risk of infections from additional or atypical organisms (5). Polymicrobial infections are not uncommon and may involve anaerobes such as Prevotella species, Bacteroides fragilis group, or Clostridium species. Notably, Haemophilus influenzae type b remains a major cause of periorbital and orbital cellulitis (6).

Cellulitis is pyogenic and potentially spreadable, characterized by localized pain, swelling, erythema, and warmth. The affected region, commonly the lower limb, blends indistinctly into surrounding skin. In contrast, erysipelas, a superficial variant with extensive lymphatic involvement, displays a raised, well-defined border and a distinctive "peau d'orange" appearance. S. pyogenes-induced cellulitis is notable for its rapid, diffuse spread, often accompanied by fever and lymphangitis (7).

Recurrent streptococcal cellulitis is frequently associated with chronic venous stasis, previous saphenous vein harvesting, or chronic lymphedema due to conditions such as elephantiasis, Milroy's disease, or lymph node dissection following mastectomy. Infections in intravenous drug users are commonly caused by staphylococcal and streptococcal species, though unusual organisms may also be implicated depending on the substance used (8). Cellulitis affects all age groups, but is more prevalent among the elderly, immunocompromised, and diabetic patients. Increasingly, cases are being reported in neonates and young children, underscoring the broad spectrum of susceptibility across populations (9).

Individuals with impaired immune function, including those with diabetes, HIV/AIDS, cancer, or those taking immunosuppressive medications, are at increased risk. In diabetes, chronic hyperglycemia compromises immune responses, impairs wound healing, and alters skin integrity, thereby facilitating bacterial proliferation and increasing susceptibility to cellulitis. Maintaining proper skin hygiene—such as keeping interdigital spaces dry, cleaning minor cuts with soap and water, and applying moisturizers to prevent cracks is particularly important in these high-risk groups (9). Venous insufficiency is another significant risk factor. Poor venous return leads to blood pooling in the lower extremities, causing edema, skin irritation, and, in severe cases, open ulcers. These lesions create portals for bacteria to invade the deep layers of the skin, further increasing cellulitis risk in patients with diabetes and vascular compromise (10)

Figure 1: Cellulitis with Diabetic Mellitus

Type 2 diabetes mellitus (T2DM) specifically predisposes patients to cellulitis through multiple mechanisms, including insulin resistance, hyperglycemia, immune dysfunction, and skin barrier compromise. If untreated, cellulitis can progress to severe systemic illness, compounding complications already associated with T2DM, such as cardiovascular, renal, and ocular damage (11). Cellulitis can present as superficial or deep soft tissue infections, ranging from simple subcutaneous inflammation to abscess formation requiring surgical intervention. Diabetic patients are particularly prone to complicated infections and have a higher risk of morbidity and mortality. Observational studies consistently report a twofold increase in mortality among diabetics with soft tissue infections (12). Early recognition, prompt antimicrobial therapy, and, when indicated, surgical source control are essential to improving outcomes.

Clinically, cellulitis is characterized by poorly demarcated erythema, warmth, edema, and tenderness. Additional features may include red streaking along lymphatic pathways, blistering, peeling, fever, chills, and malaise. The lower extremities are affected in approximately 70–80% of cases, and cellulitis is also observed following interventions such as breast cancer surgery (13). Complications may include systemic spread and abscess formation if not managed promptly. Overall, cellulitis represents a common and potentially serious infection, with severity and recurrence significantly influenced by underlying conditions such as diabetes, venous insufficiency, and immunosuppression. Proper hygiene, vigilant monitoring, and timely intervention are critical to preventing and managing this infection (14).

METHODS AND METHODOLOGY

This was a six-month observational study conducted in the Department of General Surgery, Mahatma Gandhi Medical College and Research Institute (MGMCRI), Puducherry, between January 2025 and June 2025. The study focused on patients admitted with cellulitis, both diabetic and non-diabetic, to assess and compare disease severity and outcomes.

A total of 30 patients admitted with cellulitis were included in the study. Among them, 15 were known diabetics and 15 were non-diabetic controls. Eligible participants were between 25 and 50 years of age and had a confirmed clinical diagnosis of cellulitis. Patients below 25 years of age, those with immunosuppression, and individuals undergoing active cancer therapy were excluded.

Demographic details, clinical history, and comorbidities were documented using a structured proforma. Clinical parameters recorded included site of infection, extent of erythema, edema, systemic features, and stage of cellulitis. Laboratory investigations, particularly fasting blood glucose and HbA1C, were performed to establish diabetic status and assess glycemic control. The severity of cellulitis was graded based on clinical presentation. Treatment modalities—conservative medical management, surgical intervention, physiotherapy, and nutritional support—were recorded along with recovery patterns.

The primary outcome of interest was the severity of cellulitis in diabetic versus non-diabetic patients. Secondary outcomes included differences in age and sex distribution, duration of hospital stay, and treatment response.

STATISTICAL ANALYSIS

All data were entered into a spreadsheet and analysed using Statistical Package for the Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY). Continuous variables were checked for normality using the Shapiro–Wilk test. Normally distributed continuous data are presented as mean ± standard deviation (SD) and were compared between two groups using the independent samples t-test. Non-normal continuous data are presented as median (interquartile range) and were compared using the Mann–Whitney U test.

Categorical variables are reported as frequencies and percentages. The primary comparison — severity of cellulitis (categorical: mild / moderate / severe) between diabetic and non-diabetic patients — was evaluated using a Pearson Chi-square test for independence. If any cell in a contingency table had an expected frequency <5 (violation of Chi-square assumptions), Fisher's exact test or an exact (Monte Carlo) method was planned as the alternative. For binary outcomes (for example severe vs non-severe), 2×2 contingency tables were analysed with Fisher's exact test and odds ratios (OR) with 95% confidence intervals (CI) were calculated. Where zero cell counts occurred, the Haldane–Anscombe continuity correction (+0.5 to each cell) was used to estimate OR and 95% CI.

All tests were two-tailed. A p-value < 0.05 was considered statistically significant. Where appropriate, effect sizes (odds ratios) are reported to aid interpretation. Because the sample size was modest (n = 30), emphasis was placed on effect size and exact tests rather than p-values alone, and results are presented with explicit caution regarding precision and generalizability.

RESULT

Among the 30 patients studied, the distribution of cellulitis severity showed a marked difference between diabetic and non-diabetic groups. In the diabetic group (n = 15), 10 patients (33.3%) presented with moderate cellulitis, while 5 patients (16.7%) developed severe cellulitis. Notably, no mild cases were recorded in diabetics. In contrast, the non-diabetic group (n = 15) predominantly presented with mild cellulitis in 9 patients (30%), with the remaining cases distributed as moderate infections, and none progressing to severe cellulitis.

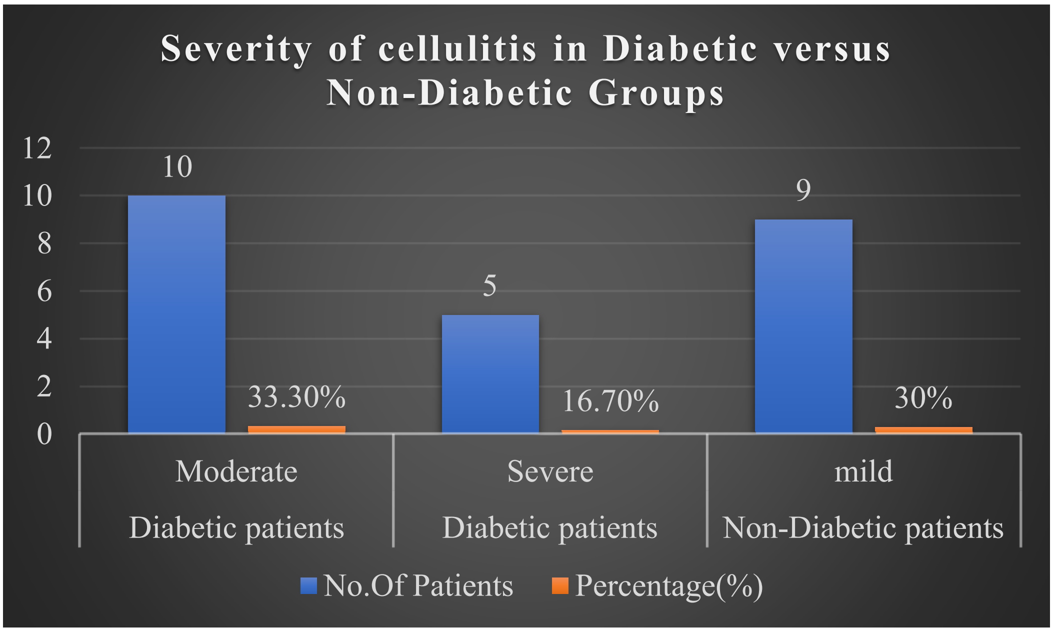

Figure 2: Severity of cellulitis in Diabetic versus Non-Diabetic Groups

In this study, the distribution of cellulitis severity differed markedly between diabetic and non-diabetic patients. Among diabetics, 33.3% (10 patients) presented with moderate cellulitis and 16.7% (5 patients) with severe cellulitis. Importantly, no mild cases were observed in this group. By contrast, in the non-diabetic group, 30% (9 patients) presented with mild cellulitis, while the remaining cases were of moderate severity, and none progressed to severe cellulitis.

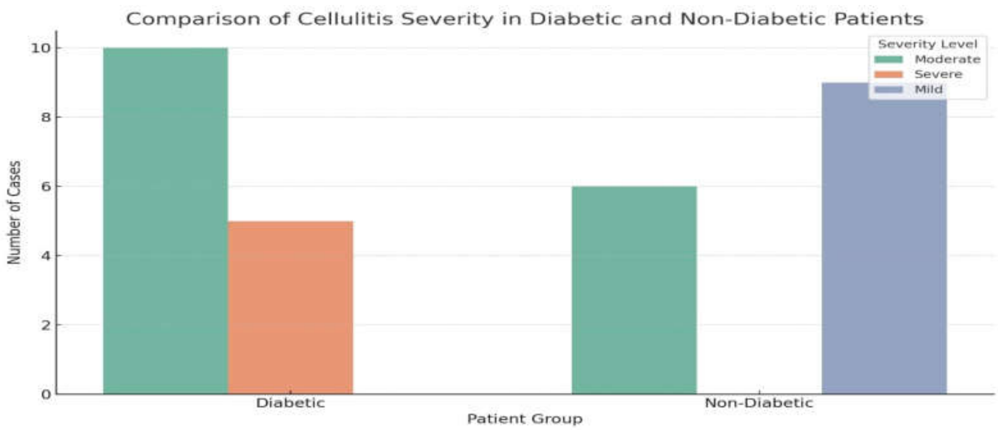

Figure 3: Comparison of Cellulitis Severity between Diabetic and Non-Diabetic Groups

The chart illustrates treatment outcomes by sex, represented in terms of the number of patients. The analysis suggests that women generally respond to treatment more quickly, achieving cure within a shorter period when compared to men. Although male patients also demonstrate positive treatment outcomes, the process of reaching full recovery appears to take relatively longer. This difference highlights a potential variation in treatment response between sexes, where women show earlier improvement, while men require additional time to achieve the same outcome.

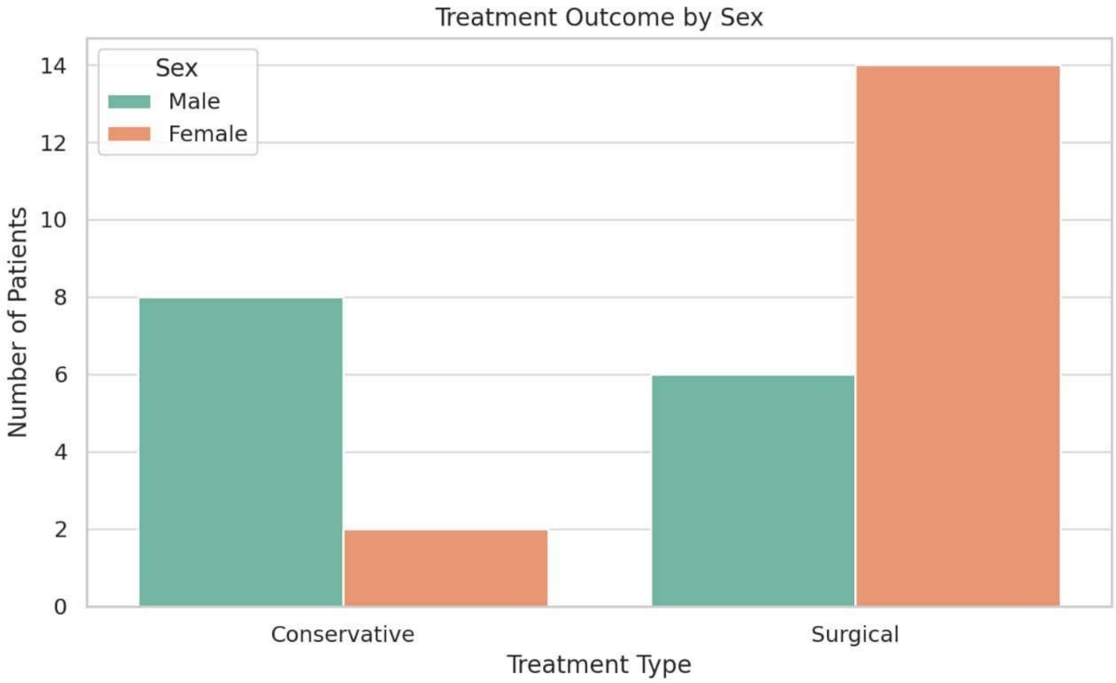

Figure 4: Treatment outcome of the patients according to the gender

The chart illustrates the severity of cellulitis by age group and number of patients. The findings show that severe cases are most commonly observed in individuals aged 36–40 years. Moderate cases are more frequent among those aged 46–50 years, while mild cases are predominantly seen in the 25–30 Year age group. This distribution highlights the variation in severity of cellulitis across different age categories

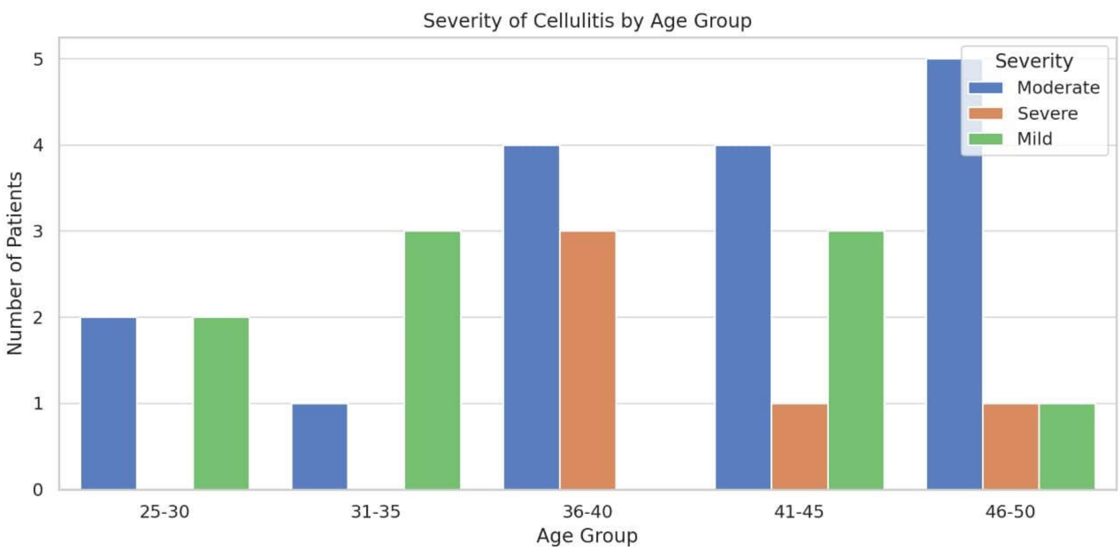

Figure 5: severity of cellulitis according to the age categories

DISCUSSION

Diabetes mellitus (DM) significantly alters both the natural history and clinical presentation of cellulitis. A comparison between diabetic and non-diabetic cases highlights several key differences. The incidence of cellulitis is markedly higher among individuals with diabetes. This increased susceptibility is attributed to hyperglycemia-induced immune dysfunction, peripheral neuropathy, and impaired microvascular circulation. In contrast, non-diabetic patients typically develop cellulitis secondary to external trauma or superficial skin infections, with fewer systemic risk factors involved.

Cellulitis in diabetic patients tends to present with greater severity. They frequently exhibit larger erythematous areas, deeper tissue involvement, and slower response to antibiotic therapy. This often necessitates longer hospital stays, more frequent surgical interventions, and results in a higher recurrence rate, particularly in the lower extremities. Non-diabetic patients, unless immunocompromised, generally experience localized infections that resolve more predictably with antibiotics alone (8).

Zacay G et al, (2021) study examines the association between blood glucose regulation and the development of cellulitis, a common bacterial skin infection. Poor glycemic control, particularly in patients with diabetes, may impair immune function and wound healing, thereby increasing susceptibility to cellulitis and worsening clinical outcomes. Understanding this relationship highlights the importance of tight glycemic management in reducing infection risk and improving patient care (3).

Milo R et al (2022) reported preseptal cellulitis is an infection limited to the eyelid and surrounding soft tissues anterior to the orbital septum, usually arising from local trauma, insect bites, or adjacent infections such as sinusitis. It typically presents with eyelid swelling, redness, and tenderness but without vision changes or restricted eye movements. Orbital cellulitis, in contrast, is a serious infection involving tissues posterior to the orbital septum, often secondary to sinus infections. It presents with more severe symptoms, including painful or restricted eye movements, proptosis, decreased vision, and systemic signs of infection. Distinguishing between the two is critical, as preseptal cellulitis is usually managed with oral antibiotics, whereas orbital cellulitis requires urgent hospitalization, intravenous antibiotics, and sometimes surgical intervention to prevent complications such as vision loss or intracranial spread (7).

Ganapathy V et al, (2021) reported orbital cellulitis is an acute, potentially sight- and life-threatening infection involving the tissues posterior to the orbital septum. It commonly arises as a complication of paranasal sinus infections, particularly ethmoid sinusitis, but may also result from trauma, surgery, or hematogenous spread. From an epidemiological perspective, orbital cellulitis is more frequent in children and adolescents, though it can affect all age groups (9). The widespread use of antibiotics has reduced its incidence, yet it continues to pose significant risks, especially in regions with limited healthcare access. Management involves prompt hospital admission, intravenous broad-spectrum antibiotics, and close monitoring for complications such as abscess formation, cavernous sinus thrombosis, or vision loss. Imaging, especially CT or MRI of the orbit and sinuses, is often required to assess the extent of infection. In cases of orbital abscess or poor response to medical therapy, surgical drainage may be necessary. Multidisciplinary care with ophthalmology, otolaryngology, and infectious disease specialists is crucial (4).

Cellulitis in diabetic individuals is often polymicrobial, involving gram-negative bacteria and anaerobes, especially in the presence of ulcers or necrotic tissue. In non-diabetic patients, the infection is more commonly caused by Streptococcus pyogenes or Staphylococcus aureus (MSSA/MRSA).

The immune response in diabetics is compromised due to impaired neutrophil function, reduced chemotaxis, and diminished phagocytosis. By contrast, non-diabetic patients, unless otherwise immunosuppressed, mount a more effective innate immune response, limiting the severity and progression of cellulitis. Management of cellulitis in diabetic patients typically requires prolonged antibiotic therapy, strict glycemic control, and multidisciplinary care involving wound specialists and endocrinologists. Non-diabetic patients usually respond well to shorter antibiotic regimens, with minimal need for adjunctive measures.

Diabetic patients are at a substantially higher risk of developing chronic wounds, recurrent cellulitis, and, in severe cases, limb amputation—particularly when diabetic foot ulcers are present. Non-diabetic individuals generally experience fewer complications, with relapses most often linked to external reinjury rather than systemic predisposition.

CONCLUSION

Evidence indicates that diabetes mellitus substantially worsens the clinical course of cellulitis. Impaired immune defense, compromised tissue perfusion, and delayed wound healing collectively heighten the risk of severe infection. As a result, diabetic patients are more prone to complications such as deep tissue abscesses, osteomyelitis, and systemic sepsis. Recurrent cellulitis is notably more common among individuals with diabetes, particularly affecting the lower limbs. Contributing factors include inadequate foot hygiene, unrecognized injuries due to peripheral neuropathy, and the presence of chronic ulcers. These conditions create a cycle of reinfection that is difficult to control without targeted preventive strategies and ongoing management.

ABBREVIATIONS

DM	-	Diabetes mellitus
T1DM	-	Type 1 diabetes mellitus
T2DM	-	Type 2 diabetes mellitus
MODY	-	Maturity onset diabetes of the young
ABSSSI	-	Acute bacterial skin and skin structural infection
UTI	-	Urinary tract infection
HIV	-	Human immunodeficiency virus
URTI	-	Upper respiratory tract infection
MRSA	-	Methicillin resistance staphylococcus aureus

REFERENCES

1. Chambers HF. Skin and Soft Tissue Infections. Infect Dis Clin North Am. 2021 Mar;35(1):xiii–xiv.
2. Bystritsky RJ. Cellulitis. Infect Dis Clin North Am. 2021 Mar;35(1):49–60.
3. Zacay G, Hershkowitz Sikron F, Heymann AD. Glycemic Control and Risk of Cellulitis. Diabetes Care. 2021 Feb 1;44(2):367–72.
4. Zhou Z, Wang H, Tan S, Zhang H, Zhu Y. The alterations of innate immunity and enhanced severity of infections in diabetes mellitus. Immunology. 2024 Mar 17;171(3):313–23.
5. Rrapi R, Chand S, Kroshinsky D. Cellulitis. Medical Clinics of North America. 2021 Jul;105(4):723–35.
6. Rrapi R, Chand S, Kroshinsky D. Cellulitis. Medical Clinics of North America. 2021 Jul;105(4):723–35.
7. Milo RB. Preseptal Cellulitis Versus Orbital Cellulitis. Adv Emerg Nurs J. 2022 Jul;44(3):199–205.
8. Weiland AJ, Rohde RS. Cellulitis. In: Acute Management of Hand Injuries. Boca Raton: CRC Press; 2024. p. 129–32.
9. Ganapathy V, Anosike B, Nakamura M. The Epidemiology And Management Of Orbital Cellulitis. In: Section on Hospital Medicine Program. American Academy of Pediatrics; 2021. p. 587–8.
10. Wang A, Hibdon M, Desaraju C, Liu-Young G. Treatment and Management of Shewanella algae Necrotizing Cellulitis. Cureus. 2024 Nov 14;
11. Kim EJ, Ha KH, Kim DJ, Choi YH. Diabetes and the Risk of Infection: A National Cohort Study. Diabetes Metab J. 2019;43(6):804.
12. Castater C, Bishop E, Santos A, Freedberg M, Kim P, Sciarretta C. Diabetic Soft Tissue Infections. Surgical Clinics of North America. 2023 Dec;103(6):1191–216.
13. Chuat C, Clerc O, Donzé J. Cellulite : recommandations de prise en charge. Rev Med Suisse. 2024;20(895):2131–4.
14. Gopalakrishnan S, KR S, Christina EP, Ramalakshmi V, RK K. Study of Subcutaneous Pressure in Lower Limb Cellulitis and its Correlation With Surgical Intervention. Cureus. 2024 Nov 5;