



Risk factors, clinical characteristics, and outcomes of lower limb cellulitis in a tertiary hospital in Iran

Manizhe Jozpanahi¹, Ahmadreza Mobaien^{1*}, Azar Biat², Elham Sadr¹, Afsaneh Karami¹

1. Department of Infectious Diseases, Zanjan University of Medical Sciences, Zanjan, Iran

2. Faculty of Medicine, Zanjan University of Medical Sciences, Zanjan, Iran

ABSTRACT

Article info:

Received: 18 Jul 2025
Accepted: 28 Sep 2025

Keywords:

Cellulitis
Risk factor
Lower limb
Cross-sectional study
Trauma

Lower limb cellulitis is a frequent bacterial infection associated with substantial morbidity, yet epidemiological data from Iran remain limited. This retrospective cross-sectional study analyzed the medical records of 120 patients admitted to a tertiary hospital in Zanjan, Iran, with lower limb cellulitis between July and December 2023. The mean age was 53.3 years, and 65.0% of the participants were male. The average duration of hospitalization was 6.3 ± 5.4 days. Hypertension (28.3%) and diabetes mellitus (17.5%) were the most common comorbidities. Trauma was the leading precipitating factor, reported in 50.0% of cases, and was significantly more frequent among males ($p=0.007$). Abscess formation occurred in 29.2% of patients and was strongly associated with trauma ($p=0.001$) and previous cellulitis ($p=0.046$). Hypertension and diabetes were more common among female patients, although their older mean age may partially confound this. A history of deep vein thrombosis and recurrent cellulitis was associated with prolonged hospitalization. These findings highlight trauma as the predominant risk factor for cellulitis in this population, with comorbid diabetes further worsening clinical outcomes. The results underscore the need for preventive strategies, including patient education on wound care, strict control of chronic diseases, and targeted interventions for high-risk groups such as diabetic patients and manual laborers. Despite providing valuable regional insight, the study is limited by its retrospective single-center design, reliance on univariate analysis, small subgroup sizes, and potential data inconsistencies. Future prospective, multi-center studies are warranted to validate and expand these observations.

*Corresponding Author(s):

Ahmadreza Mobaien, MD

Address: Department of Infectious Diseases, Zanjan University of Medical Sciences, Zanjan, Iran

Tel: +98 912 6191730

E-mail: Mobaien@zums.ac.ir



Copyright © 2025: Author(s)

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International license (<https://creativecommons.org/licenses/by-nc/4.0/>).
Noncommercial uses of the work are permitted, provided the original work is properly cited.

1. Introduction

Cellulitis represents an acute bacterial infection characterized by its spread through subcutaneous tissue, resulting in inflammation. An extensive assessment, including a comprehensive patient history and examination, is crucial for precise diagnosis [1,2]. The condition typically arises when pathogenic bacteria, most commonly beta-hemolytic streptococci or *Staphylococcus aureus*, breach the epidermis and invade the subcutaneous layers [3]. While less frequent, gram-negative or fungal organisms can also be causative agents [4]. The clinical presentation is characterized by localized inflammation (manifesting as pain, swelling, erythema, and warmth) and may be accompanied by a systemic inflammatory response [5].

Prolonged delays in diagnosis and treatment may result in grave, potentially lethal outcomes, including abscess development, necrotizing fasciitis, septicemia, and gangrene. Cellulitis imposes a significant burden of illness and mortality. The reported incidence varies from 1.5 to 24.6 per 1,000 patient-years, with as many as 25% of patients needing hospitalization for treatment [6]. Recurrence is a common problem, affecting 16% to 53% of patients within three years of an initial episode [7,8]. The risk of recurrence increases with each subsequent episode, which often occurs at shorter intervals [9]. Furthermore, these recurrent episodes are typically more severe and are associated with longer hospital stays [10]. A variety of local and systemic factors contribute to the development and recurrence of cellulitis. The incidence is known to increase with age [11]. Key predisposing factors include local conditions that compromise skin integrity, such as chronic edema, venous insufficiency, and obesity [9,12,13]. A previous episode of cellulitis is itself a major predictor of future occurrences, with studies showing that 35% to 47% of patients have a prior history of the condition [14]. Systemic comorbidities, including diabetes, cancer, and peripheral vascular disease, are also recognized as significant risk factors. While the aforementioned risk factors are well-established, their prevalence and interplay can vary significantly across different populations due to genetic, environmental, and differences in healthcare systems. Nonetheless, there is a significant lack of current evidence elucidating the unique epidemiological characteristics and causative variables for lower limb cellulitis within the Iranian setting. This knowledge deficiency constrains the capacity to formulate customized, evidence-based, preventative, and management strategies for this area. This study aims to investigate the principal risk factors, clinical characteristics, and outcomes of patients hospitalized with lower limb cellulitis in Zanjan, Iran.

2. Materials and Methods

2.1 Study Design and Setting

This retrospective, cross-sectional study aimed to

investigate the risk factors, clinical features, and outcomes associated with lower limb cellulitis. The research was conducted at Valiasr Hospital, a tertiary care facility affiliated with a university in Zanjan, Iran. Data were gathered from patients admitted in the latter half of 2023.

2.2 Study Population and Eligibility Criteria

A total of 120 patients were included in the study, as detailed in the patient selection flowchart (Figure 1), using a census-based sampling method that comprised all eligible patients admitted during the study period. The primary inclusion criterion was a clinical diagnosis of lower limb cellulitis, defined by the acute onset of skin erythema, edema, warmth, and tenderness. Exclusion criteria included an incomplete medical record for primary outcome variables and a final diagnosis of a non-infectious condition mimicking infection, such as stasis dermatitis, deep vein thrombosis (DVT) without cellulitis, or gout.

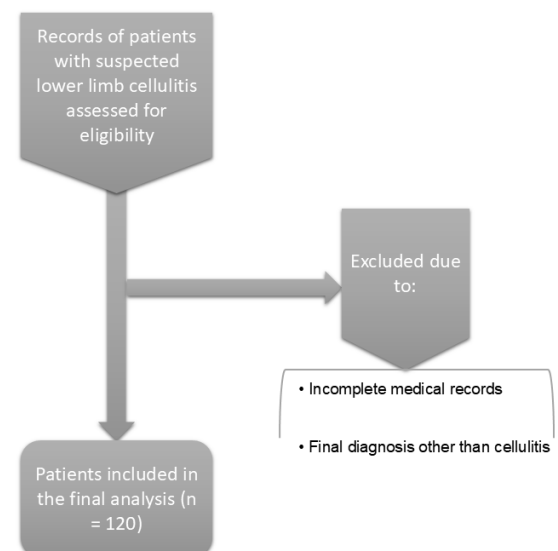


Figure 1. Flow diagram of the patient selection process

2.3 Data Collection and Variables

Trained research staff used a standardized data collection form to extract data for this study from hospital medical records retrospectively. We collected data on the age and sex of the patients, as well as pertinent comorbidities (such as diabetes, ischemic heart disease, and hypertension), and significant clinical risk factors. Clinical risk factors included prior cellulitis episodes, any documented wound manipulation, and a history of trauma (defined as any reported cut, abrasion, or physical injury to the limb prior to symptom onset). The primary outcomes and laboratory data collected included the length of hospital stay, the development of an abscess, and the presence of leukocytosis. For this study, key variables were operationally defined.

Leukocytosis was described as a white blood cell (WBC) count greater than 11,000 cells/ μ L. Abscess formation was confirmed either by the presence of a fluctuant mass on clinical examination or by imaging evidence from ultrasonography.

2.4 Statistical Analysis

Data were analyzed using SPSS software, version 26 (IBM Corp., Armonk, NY, USA). The normality of continuous data was assessed using the Kolmogorov-Smirnov test. Variables that followed a normal distribution were analyzed using parametric tests. In contrast, variables that did not follow a normal distribution, such as the length of hospital stay, were assessed using non-parametric methods. Based on the results of this test, the independent sample t-test was used for normally distributed variables. In contrast, the Mann-Whitney U test was applied for variables that were not normally distributed. Descriptive statistics were presented as mean $\pm$ standard deviation (SD) for normally distributed continuous variables and as frequency (percentage) for categorical variables. The Chi-square test was used for associations between categorical variables; Fisher's exact test was applied when the expected count in any cell was less than 5. A p-value of less than 0.05 was considered statistically significant.

3. Results

The study cohort consisted of 120 patients, with a mean age of 53.27 ± 18.76 years; the majority (65.0%)

were male. The most common underlying comorbidities were hypertension (28.3%) and diabetes mellitus (17.5%). A history of trauma was identified as the leading precipitating factor, reported in half of the patients (50.0%). Key clinical findings at presentation included leukocytosis (35.0%). Overall, abscess formation occurred in nearly one-third of patients (29.2%). See Table 1 for a summary of demographic, clinical, and risk factor profiles.

Analysis of risk factors revealed significant gender-based differences (Table 2). A history of trauma was significantly more frequent in male patients (59.0% vs. 33.3%, $p=0.007$), whereas hypertension and diabetes were more prevalent in females ($p=0.003$ and $p=0.002$, respectively). Furthermore, older age was significantly associated with the presence of hypertension ($p<0.001$), diabetes ($p=0.047$), and a prior history of cellulitis ($p=0.021$). The relatively narrow standard deviation observed for the mean age of patients with trauma should be interpreted with caution, as also noted in the Limitations section.

Table 3 illustrates the association between selected risk factors and clinical outcomes, including abscess formation and length of hospital stay. A history of trauma and a previous episode of cellulitis were significant predictors of abscess formation ($p=0.001$ and $p=0.046$, respectively). A longer hospital stay was significantly associated with a history of deep vein thrombosis (DVT) ($p=0.009$) and prior cellulitis ($p=0.038$). No significant associations were found between the investigated risk factors and the presence of leukocytosis or radiological changes ($p>0.05$).

Table 1. Baseline Characteristics of Patients with Lower Limb Cellulitis (N=120)

Category	Variable	Value
Demographics	Age, mean $\pm$ SD (years)	53.27 $\pm$ 18.76
	Gender	Male: 78 (65.0%) / Female: 42 (35.0%)
Comorbidities	Length of hospital stay, mean $\pm$ SD (days)	6.31 $\pm$ 5.39
	Hypertension	34 (28.3%)
	Diabetes mellitus	21 (17.5%)
	Ischemic heart disease (IHD)	7 (5.8%)
Risk Factors	History of trauma	60 (50.0%)
	Previous cellulitis	8 (6.7%)
	Wound manipulation	20 (16.7%)
Clinical Findings	Abscess formation	35 (29.2%)
	Leukocytosis	42 (35.0%)
	Radiological changes	2 (1.7%)

Table 2. Comparison of Risk Factors According to Patient Gender and Age (N = 120)

Risk factor	Male (n=78)	Female (n=42)	P-value (Gender)	Mean Age with Factor (years)	Mean Age without Factor (years)
Hypertension	15 (19.2%)	19 (45.2%)	0.003	64.50 $\pm$ 16.53	48.83 $\pm$ 17.78 < 0.001
Diabetes Mellitus	7 (9.0%)	14 (33.3%)	0.002	58.86 $\pm$ 12.22	52.08 $\pm$ 19.71 0.047
History of Trauma	46 (59.0%)	14 (33.3%)	0.007	50.93 $\pm$ 7.50	55.60 $\pm$ 6.68 0.174
Previous Cellulitis	7 (9.0%)	1 (2.4%)	0.258	62.00 $\pm$ 8.63	52.64 $\pm$ 19.15 0.021

P-values for gender comparisons were calculated using the Chi-square test. P-values for age comparisons were calculated using the independent sample t-test or Mann-Whitney U test, as appropriate.

Table 3. Association of Key Risk Factors with Clinical Outcomes

Risk Factor	Abscess Formation n (%)	P-value	Mean Length of Stay (days)	P-value
History of trauma	26/60 (43.3%)	0.001	6.23 ± 5.82	0.880
No history of trauma	9/60 (15.0%)		6.38 ± 4.97	
Previous cellulitis	5/8 (62.5%)	0.046	10.13 ± 6.74	0.038
No previous cellulitis	30/112 (26.8%)		6.04 ± 5.21	
Deep vein thrombosis	0/3 (0.0%)	0.555	14.33 ± 7.09	0.009
No DVT	35/117 (29.9%)		6.10 ± 5.22	

P-values for the association with abscess formation were calculated using the Chi-square test or Fisher's exact test. P-values for the association with length of hospital stay were calculated using the independent sample t-test or Mann-Whitney U test, as appropriate.

4. Discussion

This study provides a detailed clinical snapshot of lower limb cellulitis at a tertiary center in Iran, identifying a history of trauma as the overwhelming precipitating factor, particularly among males. Our findings also underscore the significant burden of underlying metabolic comorbidities, such as diabetes and hypertension, which are crucial contributors to the disease profile in this patient population.

The discovery that a traumatic incident preceded half of the cellulitis cases underscores the vital role of skin barrier disturbance in the pathogenesis of this infection, a notion supported by multiple investigations [11,15]. This prevalence is consistent with reports from other regions, including a study in Malaysia [16] and a systematic review of African populations [17], which also identify trauma as a primary risk factor. In our population, trauma was substantially more prevalent among men. This gap may indicate geographical and cultural influences, such as a greater involvement of males in manual work, agriculture, or other professions associated with a heightened risk of minor skin injuries. This suggests that public health initiatives focusing on occupational safety and timely wound treatment may be particularly effective among males.

Our research further supports the robust correlation between cellulitis and systemic comorbidities, a relationship that has been thoroughly established in the existing literature. Diabetes mellitus, observed in 17.5% of our population, constitutes a significant risk factor. Its function has been proven by extensive cohort studies [18] and explained by mechanisms such as hyperglycemia-induced impairment of cellular immunity and phagocyte function, as well as diabetes-related neuropathy [19,20]. Our results are also consistent with other studies that have identified diabetes as a significant risk factor for cellulitis [15,21]. An interesting finding in our cohort was that both hypertension and diabetes were significantly more prevalent in female patients. This may be partially confounded by the fact that women in these subgroups were, on average, older. Since our analysis relied solely on univariate methods, the independent contribution of age versus sex could not be determined with certainty.

The significant association between a history of trauma and later abscess formation (29.2% of all patients) indicates that the original injury may result in a greater bacterial inoculum or more virulent infections. Moreover, a history of previous cellulitis predicted both

abscess development and an extended hospital stay, underscoring that recurring infections tend to be more severe and complex to treat. This discovery is notable, despite its contradiction with specific research, including one conducted in Japan [22], which found that deep vein thrombosis (DVT), rather than a history of cellulitis, was not a significant predictor for readmission, highlighting potential regional differences in patient profiles.

In conclusion, our findings paint a clear picture of cellulitis in our setting, driven primarily by trauma in males and exacerbated by a high burden of comorbidities. Clinically, this underscores the importance of two key strategies: proactive patient education on wound care and rigorous management of systemic diseases. Future prospective, multi-center studies are needed to build upon these findings and create a more comprehensive national profile of cellulitis in Iran.

This study has several limitations. First, its retrospective single-center design restricts causal inference and generalizability. Second, reliance on medical records may have introduced information bias, particularly for variables such as trauma history or prior cellulitis. Third, only univariate statistical tests were used; the absence of multivariate models limited the ability to adjust for confounders such as age and sex. Fourth, the sample size of some subgroups (e.g., patients with DVT or prior cellulitis) was very small, reducing statistical power. Fifth, the reported variability in the mean age of trauma subgroups appeared unexpectedly narrow, which may reflect data entry issues or sampling error and therefore should be interpreted with caution. Finally, essential factors such as BMI, smoking status, and socioeconomic indicators were not available in the records and could not be analyzed.

This study highlights trauma as the main precipitating factor for lower limb cellulitis in our region, especially among middle-aged men, while comorbidities such as diabetes significantly worsen outcomes. Clinically, these findings underscore the importance of thorough risk assessment, patient education on wound care, and meticulous control of chronic diseases to prevent complications, such as abscess formation and prolonged hospitalization. From a public health perspective, targeted preventive measures—including diabetic foot care programs and occupational safety campaigns for manual laborers—are strongly warranted. Although the study provides valuable regional insights, further

prospective, multi-center research is needed to validate these findings, examine additional risk factors such as obesity and smoking, and explore microbial causes and cost-effective preventive strategies.

Authors' contributions

MJ: conceived the main research idea, supervised all stages of the project, and reviewed and approved the final manuscript. AM: participated in the methodology and the scientific review and editing of the manuscript. AB: contributed to the conceptualization, methodology, data collection, formal analysis, and the writing of the original draft. ES and AK: contributed to the data collection phase of the project. All authors have read and approved the final version of the manuscript for submission.

Conflict of interest

No potential conflict of interest was reported by the authors.

Ethical declarations

Patient confidentiality was strictly maintained throughout the study. Due to the retrospective design and the use of de-identified data from medical records, informed consent was waived. The study protocol was approved by the Institutional Ethics Committee of Zanjan University of Medical Sciences (approved code: IR.ZUMS.REC.1402.293).

Financial support

Self-funded.

References

- [1] Gunderson CG. Cellulitis: definition, etiology, and clinical features. *Am J Med.* 2011;124(12):1113-22. DOI: [10.1016/j.amjmed.2011.06.028](https://doi.org/10.1016/j.amjmed.2011.06.028) PMID: [22014791](https://pubmed.ncbi.nlm.nih.gov/22014791/)
- [2] Elsayed SM, Elbana HA. Risk Factors Associated with Occurrence of Cellulitis in Critically Ill Patients with Fulminant Hepatic Failure. *Menoufia Nursing Journal.* 2022;7(2):135-47. DOI: [10.21608/menj.2022.315243](https://doi.org/10.21608/menj.2022.315243)
- [3] Dalal A, Eskin-Schwartz M, Mimouni D, Ray S, Days W, Hodak E, et al. Interventions for the prevention of recurrent erysipelas and cellulitis. *Cochrane Database Syst Rev.* 2017;6:CD009758. DOI: [10.1002/14651858.CD009758.pub2](https://doi.org/10.1002/14651858.CD009758.pub2)
- [4] Yoshida S, Koshima I, Imai H, Roh S, Mese T, Uchiki T, et al. Lymphaticovenous Anastomosis for Age-Related Lymphedema. *J Clin Med.* 2021;10:5129. DOI: [10.3390/jcm10215129](https://doi.org/10.3390/jcm10215129)
- [5] Raff AB, Kroshinsky D. Cellulitis: a review. *JAMA.* 2016;316(3):325-37. DOI: [10.1001/jama.2016.8825](https://doi.org/10.1001/jama.2016.8825)
- [6] Bartholomeeusen S, Vandenbroucke J, Truysers C, Buntinx F. Epidemiology and comorbidity of erysipelas in primary care. *Dermatology.* 2007;215:118-22. DOI: [10.1159/000104262](https://doi.org/10.1159/000104262)
- [7] Tay EY, Fook-Chong S, Oh CC, Thirumoorthy T, Pang SM, Lee HY. Cellulitis Recurrence Score: A tool for predicting recurrence of lower limb cellulitis. *Journal of the American Academy of Dermatology.* 2015;72(1):140-5. DOI: [10.1016/j.jaad.2014.08.043](https://doi.org/10.1016/j.jaad.2014.08.043)
- [8] Thomas KS, Crook AM, Nunn AJ, Foster KA, Mason JM, Chalmers JR, et al. Penicillin to prevent recurrent leg cellulitis. *N Engl J Med.* 2013;368(18):1695-703. DOI: [10.1056/NEJMoa1206300](https://doi.org/10.1056/NEJMoa1206300) PMID: [23635049](https://pubmed.ncbi.nlm.nih.gov/23635049/)
- [9] McNamara DR, Tleyjeh IM, Berbari EF, Lahr BD, Martinez J, Mirzoyev SA, et al. A predictive model of recurrent lower extremity cellulitis in a population-based cohort. *Arch Intern Med.* 2007;167(7):709-15. DOI: [10.1001/archinte.167.7.709](https://doi.org/10.1001/archinte.167.7.709) PMID: [17420430](https://pubmed.ncbi.nlm.nih.gov/17420430/)
- [10] Karppelein M, Syrjänen J, Siljander T, Vuopio-Varkila J, Kere J, Huhtala H, et al. Factors predisposing to acute and recurrent bacterial non-necrotizing cellulitis in hospitalized patients: a prospective case-control study. *Clinical Microbiology and Infection.* 2010;16(6):729-34. DOI: [10.1111/j.1469-0691.2009.02906.x](https://doi.org/10.1111/j.1469-0691.2009.02906.x)
- [11] Halpern J, Holder R, Langford NJ. Ethnicity and other risk factors for acute lower limb cellulitis: a UK-based prospective case-control study. *British Journal of Dermatology.* 2008;158(6):1288-92. DOI: [10.1111/j.1365-2133.2008.08489.x](https://doi.org/10.1111/j.1365-2133.2008.08489.x)
- [12] Scheinfeld NS. Obesity and dermatology. *Clin Dermatol.* 2004;22:303-9. DOI: [10.1016/j.clindermatol.2004.01.001](https://doi.org/10.1016/j.clindermatol.2004.01.001)
- [13] Li A, Wang N, Ge L, Xin H, Li W. Risk factors of recurrent erysipelas in adult Chinese patients: a prospective cohort study. *BMC Infect Dis.* 2021;21:1-7. DOI: [10.1186/s12879-020-05710-3](https://doi.org/10.1186/s12879-020-05710-3)
- [14] Karppelein M, Siljander T, Vuopio-Varkila J, Kere J, Huhtala H, Vuento R, et al. Factors predisposing to acute and recurrent bacterial non-necrotizing cellulitis in hospitalized patients: a prospective case-control study. *Clin Microbiol Infect.* 2010;16(6):729-34. DOI: [10.1111/j.1469-0691.2009.02906.x](https://doi.org/10.1111/j.1469-0691.2009.02906.x) PMID: [19694769](https://pubmed.ncbi.nlm.nih.gov/19694769/)
- [15] Mokni M, Dupuy A, Denguezli M, Dhaoui R, Bouassida S, Amri M, et al. Risk factors for erysipelas of the leg in Tunisia: a multicenter case-control study. *Dermatology.* 2006;212(2):108-12. DOI: [10.1159/000090649](https://doi.org/10.1159/000090649)
- [16] Norazirah MN, Khor IS, Adawiyah J, Tamil AM, Azmawati MN. The risk factors of lower limb cellulitis: A case-control study in a tertiary centre. *Malays Fam Physician.* 2020;15(1):23-29. PMID: [32284801](https://pubmed.ncbi.nlm.nih.gov/32284801/)
- [17] Tianyi FL, Mbanga CM, Danwang C, Agbor VN. Risk factors and complications of lower limb cellulitis in Africa: a systematic review. *BMJ Open.* 2018;8(7):e021175. DOI: [10.1136/bmjopen-2017-021175](https://doi.org/10.1136/bmjopen-2017-021175)
- [18] Shah BR, Hux JE. Quantifying the risk of infectious diseases for people with diabetes. *Diabetes care.* 2003;26(2):510-3. DOI: [10.2337/diacare.26.2.510](https://doi.org/10.2337/diacare.26.2.510)
- [19] Gupta S, Koirala J, Khardori R, Khardori N. Infections in diabetes mellitus and hyperglycemia. *Infectious disease clinics of North America.* 2007;21(3):617-38. DOI: [10.1016/j.idc.2007.07.003](https://doi.org/10.1016/j.idc.2007.07.003)
- [20] Oumeish OY. Skin disorders in patients with diabetes. *Clinics in dermatology.* 2008;26(3):235-42. DOI: [10.1016/j.clindermatol.2007.10.015](https://doi.org/10.1016/j.clindermatol.2007.10.015)
- [21] Cannon J, Dyer J, Carapetis J, Manning L. Epidemiology and risk factors for recurrent severe lower limb cellulitis: a longitudinal cohort study. *Clin Microbiol Infect.* 2018;24:1084-8. DOI: [10.1016/j.cmi.2018.01.023](https://doi.org/10.1016/j.cmi.2018.01.023)
- [22] Norimatsu Y, Ohno Y. Predictors for readmission due to cellulitis among Japanese patients. *J Dermatol.* 2021;48:681-4. DOI: [10.1111/1346-8138.15771](https://doi.org/10.1111/1346-8138.15771)