

Correlation between Glycemic Control and Diabetic Dermopathy Severity in Type 2 Diabetes Mellitus: A Cross-Sectional Study

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Abstract:

Background: Diabetic dermopathy (DD) is a common cutaneous manifestation of diabetes mellitus (DM), characterized by atrophic, hyperpigmented lesions, primarily on the lower extremities. Chronic hyperglycemia, microangiopathy, and impaired wound healing are thought to contribute to the pathogenesis of DD.

Aim and objectives: To investigate the correlation between glycemic control, as measured by HbA1c levels, and the severity of diabetic dermopathy in patients with type 2 diabetes mellitus (T2DM).

Materials and Methods: A cross-sectional observational study was conducted with 150 patients diagnosed with T2DM. Demographic and clinical data, including HbA1c levels, were collected. Based on the number and size of lesions, the severity of DD was classified into mild, moderate, and severe categories. Statistical analyses were performed using Pearson's correlation and ANOVA to assess the correlation between HbA1c levels and DD severity.

Results: The mean age of the participants was 58.3 ± 8.9 years, and the average HbA1c level was $8.4 \pm 1.2\%$. DD severity was categorized as mild in 38.7% of patients, moderate in 43.3%, and severe in 18.0%. A significant positive correlation was observed between HbA1c levels and DD severity ($r = 0.68$, $p < 0.001$). Patients with severe DD had a higher mean HbA1c ($9.2 \pm 1.1\%$) than those with mild DD ($7.6 \pm 0.8\%$). Additionally, patients with severe DD were more likely to have other microvascular complications, such as neuropathy and retinopathy.

Conclusion: This study found a strong correlation between higher HbA1c levels and increased severity of diabetic dermopathy. Poor glycemic control was associated with more severe manifestations of DD, suggesting that tighter glucose management could mitigate the progression of skin complications in patients with diabetes.

Keywords: Diabetic dermopathy, type 2 diabetes mellitus, HbA1c, glycemic control, diabetic skin complications, microvascular complications

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Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia, which leads to a wide range of complications affecting various organs, including the skin.¹ One of the most common skin manifestations observed in diabetic patients is diabetic dermopathy (DD), a condition marked by the appearance of small, round, brownish, and atrophic lesions, predominantly on the shins. [1, 2] Although DD is generally considered benign and asymptomatic, its prevalence is significantly higher among individuals with poorly controlled diabetes and long-standing hyperglycemia. [1, 2]

The aetiology of DD is not fully understood, but it is believed to be related to underlying diabetic microangiopathy and impaired wound healing.³ These lesions are thought to result from trauma or

local vascular insufficiency in the context of chronic hyperglycemia. [4] Additionally, DD has been linked to other microvascular complications of diabetes, such as retinopathy, nephropathy, and neuropathy, indicating a possible shared pathophysiological mechanism. [3, 4]

Glycemic control, typically assessed by measuring glycated haemoglobin (HbA1c), is a crucial marker of diabetes management. [5] HbA1c reflects the average blood glucose levels over the past two to three months, providing insight into the effectiveness of diabetes treatment. [6] Higher HbA1c levels indicate poorer glucose control, which is associated with an increased risk of diabetic complications. [7] Given the vascular basis of both diabetes complications and DD, investigating the relationship between HbA1c

levels and the severity or progression of DD is essential to understanding whether better blood glucose control could mitigate the development or worsening of this skin condition. [5-7]

This study aimed to explore the correlation between HbA1c levels and diabetic dermopathy in patients with type 2 diabetes mellitus (T2DM), hypothesizing that tighter glycemic control may be associated with reduced severity or progression of DD. Understanding this relationship could provide insight into the role of glucose management in preventing dermatological complications in diabetes.

Materials and Methods

Study Design and Population: This cross-sectional observational study was conducted over six months at a tertiary care hospital. The study population consisted of patients diagnosed with T2DM attending the outpatient diabetes clinic. Inclusion criteria were patients aged 30–70, diagnosed with T2DM for at least five years, and having visible signs of DD. Patients with chronic skin diseases unrelated to diabetes, such as psoriasis or eczema, those on long-term corticosteroid therapy, and individuals with type 1 diabetes or gestational diabetes, were excluded from the study.

Sample Size: One hundred fifty patients were enrolled in the study based on the availability of diabetic patients with visible DD lesions during the study period. All participants provided informed consent before inclusion, and the institution's ethical review board approved the study.

Demographic and Clinical Data: Demographic data, including age, gender, body mass index (BMI), duration of diabetes, and family history, were collected from the patient's medical records and through interviews. Additionally, clinical data such as blood pressure, lipid profile, and history of diabetic complications (e.g., retinopathy, neuropathy, nephropathy) were recorded.

HbA1c Measurement: Glycemic control was assessed by measuring glycated haemoglobin (HbA1c) levels. Blood samples were collected from each participant, and HbA1c levels were measured using high-performance liquid chromatography (HPLC). The results were categorized into three groups:

- Good glycemic control (HbA1c < 7%)

- Moderate glycemic control (HbA1c 7–8%)
- Poor glycemic control (HbA1c > 8%)

Diabetic Dermopathy Evaluation

Each participant was examined for diabetic dermopathy by a trained dermatologist. DD was defined as the presence of round or oval, hyperpigmented, atrophic lesions on the anterior aspect of the lower legs. The severity of DD was assessed using a modified scoring system based on the number, size, and extent of lesions. Patients were categorized into three groups based on DD severity:

- Mild (1–4 lesions)
- Moderate (5–10 lesions)
- Severe (>10 lesions)

Statistical Analysis: The data were analyzed using SPSS version 25. Descriptive statistics were used to summarize demographic and clinical characteristics of the study population. Continuous variables like age and HbA1c levels were presented as means \pm standard deviation (SD), while categorical variables were expressed as frequencies and percentages. The relationship between HbA1c levels and DD severity was analyzed using Pearson's correlation coefficient for continuous variables and chi-square tests for categorical variables. A one-way ANOVA compared the mean HbA1c levels between the mild, moderate, and severe DD groups. A p-value of < 0.05 was considered statistically significant.

Results

Demographic and Clinical Characteristics of the Study Population: A total of 150 patients with T2DM were included in the study. The mean age of the participants was 58.3 ± 8.9 years, with 90 (60%) being male and 60 (40%) female. The average duration of diabetes was 10.2 ± 4.3 years. The mean HbA1c level across the study population was $8.4 \pm 1.2\%$, indicating generally poor glycemic control among the participants. Additionally, 55% of the patients had hypertension, and 42% had a history of diabetic complications such as neuropathy or retinopathy.

Table 1: Demographic and Clinical Characteristics of Study Participants

Variable	Total (n = 150)	Mild DD (n = 58)	Moderate DD (n = 65)	Severe DD (n = 27)
Age (years)	58.3 ± 8.9	56.2 ± 9.1	58.9 ± 8.6	61.3 ± 8.2
Gender				
Male	90 (60%)	35 (60%)	38 (58.5%)	17 (63%)
Female	60 (40%)	23 (40%)	27 (41.5%)	10 (37%)
Duration of Diabetes (years)	10.2 ± 4.3	9.1 ± 3.8	10.3 ± 4.1	12.1 ± 4.5

HbA1c (%)	8.4 ± 1.2	7.6 ± 0.8	8.5 ± 0.9	9.2 ± 1.1
Hypertension	83 (55%)	27 (46%)	36 (55.4%)	20 (74%)
Diabetic Complications	63 (42%)	15 (25%)	29 (44.6%)	19 (70%)

Correlation between HbA1c Levels and Diabetic Dermopathy Severity: Out of the 150 patients, all had visible signs of diabetic dermopathy (DD). The severity of DD was classified as mild in 58 (38.7%) patients, moderate in 65 (43.3%) patients, and severe in 27 (18.0%) patients. The mean HbA1c level was significantly higher in patients with more severe DD ($p < 0.001$).

- **Mild DD:** Mean HbA1c = 7.6 ± 0.8%

Table 2: Correlation between HbA1c Levels and Severity of Diabetic Dermopathy

Severity of Diabetic Dermopathy	Mean HbA1c (%) ± SD	p-value (ANOVA)
Mild DD (n = 58)	7.6 ± 0.8	< 0.001
Moderate DD (n = 65)	8.5 ± 0.9	
Severe DD (n = 27)	9.2 ± 1.1	

Prevalence of Diabetic Complications About DD Severity: Patients with more severe DD were also more likely to have other diabetes-related complications such as neuropathy, nephropathy, and retinopathy. Among patients with severe DD, 85% had at least one microvascular complication, compared to 45% in the mild DD group ($p < 0.01$).

Table 3: Prevalence of Microvascular Complications of DD Severity

Complication	Mild DD (n = 58)	Moderate DD (n = 65)	Severe DD (n = 27)	p-value (Chi-square)
Neuropathy	10 (17.2%)	22 (33.8%)	16 (59.2%)	< 0.01
Retinopathy	5 (8.6%)	12 (18.5%)	10 (37.0%)	< 0.05
Nephropathy	4 (6.9%)	9 (13.8%)	7 (25.9%)	< 0.05

Discussion

The present study explored the correlation between glycemic control, as measured by HbA1c levels, and the severity of DD in patients with T2DM. The findings demonstrate a strong positive correlation between higher HbA1c levels and increased severity of DD, highlighting the potential role of chronic hyperglycemia in the development and progression of this skin condition. These results are consistent with previous research, further reinforcing the link between poor glycemic control and the manifestation of diabetic skin complications.

Our findings align with those of Praveen et al., who reported that higher HbA1c levels were associated with increased prevalence and severity of diabetic dermopathy. Their study, which examined 103 patients with T2DM, found that patients with HbA1c levels > 8% had significantly more severe DD than those with better glycemic control. Similarly, a study by Romano et al. also indicated that elevated HbA1c levels correlated with the number and size of DD lesions, supporting the idea that sustained hyperglycemia exacerbates microvascular damage in the skin. These findings are consistent with our study, where patients with HbA1c > 8% had more extensive and severe DD.

- **Moderate DD:** Mean HbA1c = 8.5 ± 0.9%
- **Severe DD:** Mean HbA1c = 9.2 ± 1.1%

A positive correlation ($r = 0.68$, $p < 0.001$) was found between HbA1c levels and the severity of DD, indicating that poorer glycemic control is associated with more severe manifestations of diabetic dermopathy.

The pathophysiological mechanisms behind this correlation may be linked to the microvascular changes seen in diabetes. [3] Chronic hyperglycemia accumulates advanced glycation end products (AGEs), which damage blood vessels and impair skin microcirculation. This results in reduced blood supply to the skin, contributing to the atrophic and hyperpigmented lesions characteristic of DD. [4-5] Previous studies have noted that patients with other microvascular complications, such as retinopathy and nephropathy, often present with DD, suggesting a shared underlying mechanism. [10] Our study supports this observation, as patients with severe DD were more likely to have concomitant microvascular complications.

Moreover, our study found that patients with moderate to severe DD had significantly longer durations of diabetes, which aligns with the work of Mendes et al., [2], who observed that the duration of diabetes is a critical factor in developing skin complications. They proposed that prolonged exposure to hyperglycemia accelerates vascular and neurological damage, further complicating skin health in people with diabetes.

Importantly, our results emphasize the need for stringent glycemic control to mitigate the potential

progression of DD. The mean HbA1c level was significantly higher in patients with severe DD than those with mild DD, suggesting that better glucose management may reduce the risk of severe skin complications. This finding is supported by a study by Lima et al. (2019), who reported that intensive glyceemic control resulted in a lower incidence of new DD lesions over a follow-up period of one year . [11]

Although the present study adds to the growing body of literature linking poor glyceemic control with diabetic dermatopathy, there are limitations. The cross-sectional design limits the ability to infer causality, and the study was conducted in a single tertiary care centre, which may limit the generalizability of the findings. Additionally, the subjective assessment of DD severity based on visual inspection, though performed by a trained dermatologist, may introduce variability. Future longitudinal studies are needed to clarify further the temporal relationship between HbA1c levels and the progression of DD.

Conclusion

This study demonstrates a significant association between higher HbA1c levels and increased severity of diabetic dermatopathy in patients with type 2 diabetes mellitus. These findings underscore the importance of maintaining optimal glyceemic control to prevent the worsening of skin complications in diabetic patients. Further research, particularly long-term studies, is needed to explore the potential benefits of tight glucose regulation in preventing and progressing diabetic dermatopathy.

References

1. Labib A, Rosen J, Yosipovitch G. Skin manifestations of diabetes mellitus. In: Feingold KR, Anawalt B, Blackman MR, et al., editors. Endotext [Internet]. South Dartmouth (MA): MDText.com, Inc.; 2000- [updated 2022 Apr 21; cited 2024 Oct 15]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK481900/>
2. Mendes AL, Miot HA, Haddad V Jr. Diabetes mellitus and the skin. *An Bras Dermatol*. 2017; 92(1):8-20. doi: 10.1590/abd1806-4841.20175 514.
3. Naik PP, Farrukh SN. Clinical significance of diabetic dermatopathy. *Diabetes Metab Syndr Obes*. 2020; 13:4823-7. doi:10.2147/DMSO.S2 86887.
4. Pal RS, Wal P, Pal Y, Wal A. Recent insights on diabetic dermatopathy. *Open Dermatol J*. 2019;13(1):8-12. doi:10.2174/187437220191 3010008.
5. Sherwani SI, Khan HA, Ekhzaimy A, Masood A, Sakharkar MK. Significance of HbA1c test in diagnosis and prognosis of diabetic patients. *Biomark Insights*. 2016; 11:95-104. doi: 10.41 37/BMI.S38440.
6. Sherwani SI, Khan HA, Ekhzaimy A, Masood A, Sakharkar MK. Significance of HbA1c test in diagnosis and prognosis of diabetic patients. *Biomark Insights*. 2016;11. S38440. doi:10.41 37/bmi.s38440.
7. Eyth E, Naik R. Hemoglobin A1C. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan- [updated 2023 Mar 13; cited 2024 Oct 15]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK549 816/>
8. Praveen P, Mandal N, Sen S, Banerjee S, Dey P, Mandal S. Cutaneous manifestations of diabetes mellitus: correlation with HbA1C level— a cross-sectional observational study from a tertiary care center in Eastern India. *Ann Med Sci Res*. 2023;2(3):144. doi: 10.4103/amsr. amsr_57_22.
9. Romano G, Moretti G, Di Benedetto A, Giofrè C, Di Cesare E, Russo G, et al. Skin lesions in diabetes mellitus: prevalence and clinical correlations. *Diabetes Res Clin Pract*. 1998;39(2): 101-6. doi: 10.1016/s0168-8227(97)00119-8.
10. Mirhoseini M, Saleh N, Momeni A, Deris F, Asadi-Samani M. A study on the association of diabetic dermatopathy with nephropathy and retinopathy in patients with type 2 diabetes mellitus. *J Nephropathol*. 2016;5(4):139-43. doi: 10. 15171/jnp.2016.26.
11. Lima AL, Illing T, Schliemann S, Elsner P. Cutaneous manifestations of diabetes mellitus: a review. *Am J Clin Dermatol*. 2017;18 (4): 541-53. doi: 10.1007/s40257-017-0275-z.