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Prevalence and Risk Factors of Skin Disorders among Diabetic Patients

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Abstract

Introduction: *Diabetes mellitus is a chronic metabolic disorder characterised by hyperglycaemia and is associated with various complications, including skin disorders. Diabetic patients often present with a range of skin manifestations, which can serve as indicators of underlying metabolic imbalances and disease severity. This study aims to evaluate the prevalence and risk factors of skin disorders among diabetic patients at a tertiary care center.*

Methods: *A cross-sectional study was conducted among 338 patients of type 2 diabetes mellitus at Santosh Hospital, Ghaziabad, India. Participants underwent detailed medical history assessments, physical examinations, and laboratory investigations. Dermatological evaluations, including culture and biopsy, were performed when indicated. Data were analysed using the Statistical Package for Social Sciences (SPSS).*

Results: *The results revealed that cutaneous infections were the most common skin manifestation, observed in 42% of patients, followed by skin disorders related to microangiopathy (10.4%) and neuropathy (15.1%). Poor glycaemic control, as indicated by high HbA1c levels, was significantly associated with an increased risk of skin disorders. Additionally, the duration of diabetes was positively correlated with the severity of skin manifestations.*

Conclusion: *Skin disorders are prevalent among diabetic patients, with infections being the most common manifestation. These findings underscore the importance of regular dermatological screening in diabetic patients, particularly those with poor glycaemic control, to enable early diagnosis and management of skin complications, potentially preventing further systemic complications.*

Key words: *Diabetes mellitus, skin disorders, acanthosis nigricans, cutaneous infections.*

Introduction:

Diabetes mellitus (DM), the most common endocrine disorder, poses a significant burden on the health care system as well as on society[1]. The rising incidence of diabetes mellitus and it's varied local and systemic manifestations make it one of the main health issues facing the world today. Approximately 500 million people worldwide suffer from diabetes, accounting for almost 10.5% of the adult population. In 2021, 536.6 million individuals (10.5%) globally were anticipated to have diabetes among those aged 20 to 79 years. This number is projected to rise to over 780 million people (12.2%) by 2045, according to the latest estimates. In comparison to rural areas (8.3%) and low-income countries, a higher prevalence has been noted in metropolitan areas (12.1%) and high-income nations. The dermatologist can play a crucial role in identifying such patients because diabetes can present with a wide range of symptoms, the most common of which are cutaneous in nature[2,3,4].

It has been proposed that oxidative stress, inflammation, and advanced glycation end products may cause early aeging of the skin, the development of diabetic dermopathy, and scleroderma diabeticorum[5]. In a comparable manner hormonal effects, insulin resistance, imbalances in growth factors and cytokines, and acrochordons and inflammatory dermatitis can cause skin lesions such as acanthosis nigricans and inflammatory dermatitis[5,6].

Prolonged diabetes can cause the body to irreversibly modify how it functions, which can lead to a number of problems. For individuals with diabetes mellitus, abnormal glucose, amino acid, and lipid metabolism directly results in physical symptoms[7]. During the long course of their illness, at least 30% of DM patients experience various cutaneous problems. These problems offer insight into the patient's past and present metabolic state[8]. Numerous studies have shown that during the long course of their condition, 30 - 82% of DM patients develop various cutaneous disorders. Maintaining the body's metabolic balance can help with treatment and possibly avoid some of these symptoms. However, a lot

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of glycaemic control drugs also cause adverse skin reactions . Even those without a history of DM who exhibit cutaneous symptoms linked to the disease should have their condition looked into[9]. There is a significant prevalence of diabetic morbidity; nevertheless, there is a paucity of specific information on cutaneous complications associated with DM.

The aim of this study was to assess the prevalence and pattern of skin disorders among diabetic patients at Santosh Hospital, Ghaziabad.

Material and Methods

This was a cross-sectional study conducted in the Departments of Medicine and Dermatology at Santosh Hospital, Uttar Pradesh. Approval was obtained from the ethics committee. 338 subjects diagnosed with type 2 diabetes mellitus showing dermatological manifestations were included in the study.

Inclusion criteria

- All patients/cases of diabetes mellitus with significant dermatological manifestations.
- All age groups and both sexes

Exclusion criteria

- Patients with gestational diabetes mellitus.
- Patients with Type 1 diabetes mellitus
- Critically ill patients.
- Any drug reactions
- Patients unable to give an informed consent

After obtaining informed consent from the subjects, they were evaluated and selected after detailed medical history, physical examination, systemic examination. Basic anthropometric measurements such as weight, height and waist circumference were calculated. Routine investigations including fasting and post-prandial blood sugar, lipid profile, complete blood count, renal function tests, liver function tests to rule-out any underlying diseases were done.

Results

Data collected was entered into Microsoft Excel and analysed through Statistical Package for Social Sciences, version 23 (SPSS Inc., Chicago, IL). Results for continuous variables are presented as mean ± standard deviation, whereas results for categorical variables are presented as number (percentage). Any possible association was calculated using chi square test or student's-t test. $p < 0.05$ was considered as the cut-off value of significance. The data was analysed and is summarised in Table II-VII, with explanations thereafter.

Table I: Distribution of cases by age, duration of diabetes, and blood sugar levels

A. Distribution of cases based on age category			
Age (Years)	**No. of Cases (n = 338)**	**Percentage**	**Mean ± SD**
21 - 30	32	9.5	46.28 ± 12.58
31 - 40	86	25.4	
41 - 50	88	26.0	
51 - 60	90	26.6	
61 - 70	21	6.2	
71 - 80	14	4.1	
>80	7	2.1	
B. Distribution of cases based on duration of diabetes mellitus			
<1 year	76	22.4	6.23 ± 3.82
1 - 5 years	124	36.6	
5 - 10 years	103	30.5	
>10 years	35	10.5	
C. Distribution of the cases based on fasting blood sugar			
<120 mg/dL	76	22.5	134.64 ± 25.32
121 - 160 mg/dL	208	61.5	
>160 mg/dL	54	16	
D. Distribution of the cases based on post-prandial blood sugar			
70 - 140 mg/dL	19	5.6	188.92 ± 33.50
141 - 200 mg/dL	213	63	
>200 mg/dL	106	31.4	

Table II: Distribution of cases based on systemic illnesses

Associated illness	**Cases**
Hypertension	140
Heart disease	28
Bronchial asthma	5
Hypothyroidism	5
Dyslipidemia	14
Total	199

Table III: Distribution of cases based on types of cutaneous manifestations

Skin Manifestation	Cases	Percentage
Cutaneous Infections	142	42
Skin Manifestation Associated with Microangiopathy	35	10.4
Neuropathic and ischaemic diabetic skin disease	51	15.1
Skin Manifestation more commonly associated with diabetes mellitus*	214	63.3
Non-specific manifestations	137	40.5

**See Table IV*

Table IV: Distribution based on skin manifestations commonly associated with diabetes mellitus

Skin Manifestation	Cases
Pruritus	29
Acrochordons	55
Psoriasis	14
Vitiligo	8
Acanthosis nigricans	80
Progressive pigmented purpura	5
Perforating folliculitis	6
Lichen planus	5
Cherry angiomas	6
Macular amyloidosis	4
Alopecia universalis	2
Total	214

Table V: Distribution of cases based on non-specific manifestations

Dermatoses	Cases
Eczema	57
Seborrheic keratoses	17
Dermatosis papulosa nigra	11
Melasma	16
Contact dermatitis	5
Drug reactions	4
Scabies	7
Sebaceous cyst	1
Polymorphous light eruption	2
Keloid	5
Parapsoriasis	1
Seborrheic dermatitis	1
Pemphigus	2
Senile comedones	4
Lichen simplex chronicus	4
Total	137

Fig. 1: *Showing logistic regression coefficients.*

Table VI: Distribution and comparison of cutaneous manifestations in controlled and uncontrolled diabetes

Dermatoses	Number of Patient (N)	HbA1c (<7%) (75)	HbA1c (>7%) (263)	p-value
Cutaneous infections	142	30	112	0.689
Skin manifestation associated with microangiopathy	35	12	23	**0.001**
Neuropathic and ischaemic diabetic skin disease	51	16	35	0.087
Skin manifestations more commonly associated with diabetes	214	50	164	0.495
Non-specific manifestations	137	33	104	0.488

Table VII: Logistic regression coefficients

Predictor	Coefficient
Age (years)	0.062413921
Sex, M = 1, F = 2	-0.250683044
Duration (Years)	0.2723622576078667
Family History Yes = 1, No = 2	-0.093979814
RBS (mg/dL)	0.4262537542514903
FBS (mg/dL)	0.079301319
PP (mg/dL)	-0.401034697
HbA1c (%)	-0.021041913

The majority of diabetic patients with skin manifestations were in the age groups of 21 - 30 years (9.5%), 31 - 40

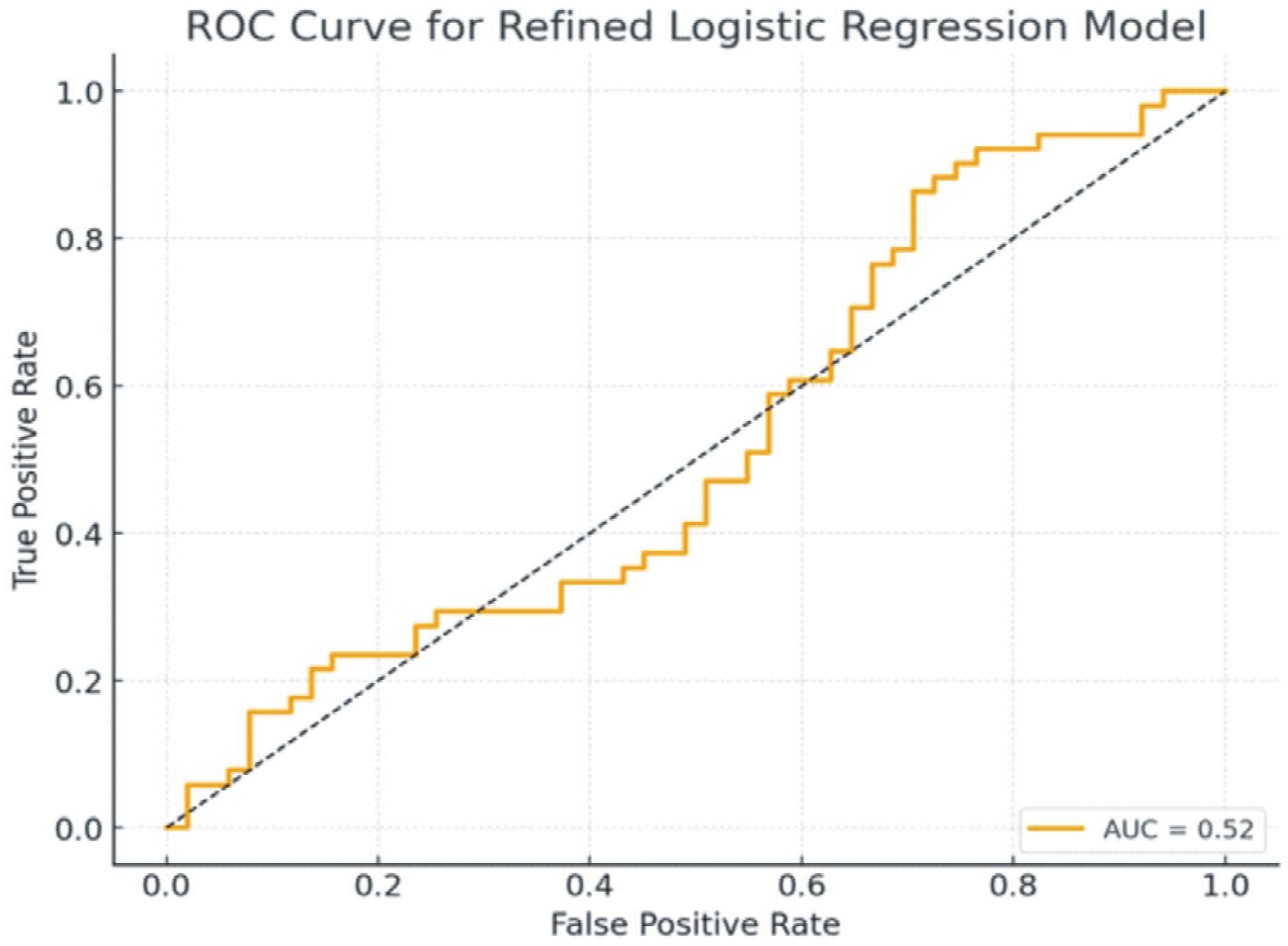

Fig. 2: *ROC curve for refined logistic regression model.*

years (25.4%), 41 - 50 years (26%), and 51 - 60 years (26.6%) (Table I). The mean age was 46.28 ± 12.58 years, indicating that middle-aged individuals are more prone to skin disorders. Regarding the duration of diabetes, 36.6% of patients had diabetes for 1 - 5 years, while 30.5% had diabetes for 5 - 10 years, suggesting that cutaneous manifestations tend to appear relatively early in the disease course. Most patients (61.5%) had fasting blood sugar levels in the range of 121 - 160 mg/dL, and 63% had post-prandial blood sugar levels between 141 - 200 mg/dL, with a mean post-prandial blood sugar level of 188.92 ± 33.50 mg/dL. This highlights the prevalence of inadequate glycaemic control among the study population.

Among the diabetic patients with skin disorders, a significant proportion (60%) also had associated systemic illnesses (Table II). Hypertension was the most common co-morbidity, present in 140 patients. Other notable associated conditions included heart disease (28 cases), chronic renal failure (10 cases-excluded in biostatistics), and dyslipidaemia (14 cases). These findings underscore the multifactorial nature of diabetes-related complications, where co-morbid conditions may exacerbate skin manifestations.

Cutaneous infections were the most prevalent skin disorder, affecting 42 % of patients (Table III). Skin manifestations commonly associated with diabetes, such as acanthosis nigricans and acrochordons, were present in 63.3% of cases. Non-specific skin manifestations, like eczema and melasma, accounted for 40.5% of cases. The prevalence of neuropathic and ischaemic diabetic skin diseases was 15.1%, while skin manifestations linked to microangiopathy, such as diabetic dermopathy, were seen in 10.4% of patients. This distribution highlights the broad spectrum of skin disorders that can arise in diabetic patients, often reflecting underlying pathophysiological changes related to diabetes.

Acanthosis nigricans was the most common specific skin disorder (Table IV), observed in 80 patients, followed by acrochordons (55 cases) and pruritus (29 cases). Other less common conditions included psoriasis (14 cases), vitiligo (8 cases), and cherry angiomas (6 cases). These findings indicate that hyperinsulinaemia and insulin resistance, common in type 2 diabetes, may be important contributors to these dermatological conditions. The variety of manifestations also emphasizes the need for dermatological screening in diabetic care.

Among the non-specific manifestations, eczema was the most frequently reported condition (Table V), affecting 57 patients. Other common conditions included seborrheic keratoses (17 cases), melasma (16 cases), and scabies (7 cases). The occurrence of these conditions suggests that diabetic patients may be more susceptible to general skin disorders, possibly due to altered immune responses or poor skin barrier function.

The comparison between controlled (HbA1c <7%) and uncontrolled diabetes (HbA1c >7%) revealed that uncontrolled diabetes was significantly associated with a higher incidence of skin manifestations (Table VI). Specifically, patients with poor glycaemic control had a significantly higher prevalence of microangiopathy-related skin conditions ($p = 0.001$) and neuropathic and ischaemic diabetic skin disease ($p = 0.087$). Cutaneous infections and non-specific skin manifestations were also more common in the uncontrolled group, though not statistically significant. This reinforces the importance of maintaining good glycaemic control to reduce the risk of cutaneous complications in diabetic patients.

Older age groups were more likely to experience infections, likely due to age-related changes in immunity and skin integrity. Poor glycaemic control, indicated by elevated FBS, PP, RBS, and HbA1c, was strongly associated with increased infection risk. Longer diabetes duration also raised risk, possibly due to complications like neuropathy. Sex may influence risk through hormonal and behavioural factors (Table VII). Positive co-efficients for predictors like age and glycaemic markers suggest that an increase in these factors raises the likelihood of infections (Fig. 1). The coefficients highlight how tightly controlled sugar levels may mitigate risk (Fig. 2) ROC analysis for a Refined Logistic Regression Model Showed limited predictive ability of models, indicating either additional factors need exploration, or that skin infections are influenced by a mix of multiple, complex factors.

Discussion

Cutaneous diseases in individuals with diabetes mellitus may occur prior to or coincide with the diagnosis of diabetes. A number of these lesions, such as diabetic dermopathy, diabetic bullae, and necrobiosis lipoidica, have a strong correlation with diabetes mellitus. Conversely, certain additional skin abnormalities linked to infection have been seen in diabetics[2,7]. Skin alterations might even be noticed before diabetes manifests. Long-term diabetic patients experience more severe skin diseases. The multiple metabolic problems associated with diabetes, such as persistent hyperglycaemia that causes glycosylation of diverse skin tissue components, are ultimately responsible for the alterations in skin[7].

In the present study, majority of the subjects belonged to the 4th and 5th decade with 26% and 26.6% respectively with mean age was 46.28 ± 12.58 years (Table I). Similar results were obtained in a study of Ramesh *et al*[10] and Sani *et al*[5] with 46% and 47% of their subjects, respectively belonging to the age group of 41 - 60 years. A mean age of

55.85 ± 13.04 years was seen in a study by Azizian *et al*[9].

Chronicity of diabetes plays an important role in cutaneous manifestations. In the present study, 36.6% of patients were presented with diabetes for a period of 1 - 5 years and 30.5% patients for 6 - 10 years (Table I). In a study by Sani *et al*[5], it was observed that 72% individuals had diabetes for <10 years while 24% had diabetes for 11 - 20 years. Azizian *et al*[9] observed a mean duration of diabetes to be 8.06 ± 7.16 years in their study.

In the current study, most patients had fasting blood sugar levels in the range of 121 - 160 mg/dL (62%) with a mean of 134.64 ± 25.32 mg/dL while mean PPBS was observed to be 188.92 ± 33.50 mg/dL. In a study by Azizian *et al*[9], the mean FBS was found to be 155.64 ± 53.16 mg/dL. 60% of subjects presented with associated systemic co-morbidity, out of which hypertension was observed in 40% cases. Ischaemic heart disease was seen in 8% and dyslipidaemia in 4% of subjects (Table II). In a study by Azizian *et al*[9], hypothyroidism was seen in majority (12.4%) cases.

Cutaneous infections were seen in 42% of cases (Table III). Although there is little evidence to support the widespread belief, people with diabetes are thought to be more susceptible to infections. Patients with poor metabolic control appear to be at higher risk for this; however, it is frequently unclear if these infections are the result of or a cause of the poor metabolic control. 20 - 50% of patients get cutaneous infections, which frequently co-exist with modest blood glucose control. Peripheral vascular diseases, peripheral neuropathy, immune response suppression, and problems with microvascular circulation; all increase the risk of infection[9].

The four types of cutaneous manifestations seen in diabetes are: infections (bacterial, fungal), manifestations of diabetic complications (microangiopathy, macroangiopathy, neuropathy), reactions to diabetic treatment (sulphonylureas or insulin), and lesions with strong-to-weak association with diabetes (necrobiosis lipiodica, diabetic dermopathy, diabetic bullae, yellow skin, eruptive xanthomas, perforating disorders, acanthosis nigricans, oral leucoplakia, lichen planus)[9]. Among the various dermatoses studied, acanthosis nigricans was most commonly seen in 37.3% subjects, followed by acrochordons (25.7%), infections (8.6%), psoriasis (6.5%) and vitiligo (3.7%) (Table IV).

Acanthosis nigricans is an important prognostic indicator for the development of type 2 diabetes. Additionally, certain ethnic groups may have a hereditary tendency or enhanced skin sensitivity to hyperinsulinaemia[2]. Acrochordons, also known as skin tags, fibroepithelial polyps, and soft fibromas, are pedunculated protuberances of healthy skin on a slender stalk that are typically found on the groin, neck, axillae, and eyelids. About 25% of individuals have them, and as people age, their numbers and prevalence increase. Acrochordons have been linked to acanthosis nigricans, obesity, and family history; the link between hyperinsulinaemia and skin tags is well-established[2]. In a 2014 study by Furqan *et al*[11] on 100 diabetic patients with DM types 1 and 2, the most prevalent cutaneous findings were cutaneous infections and diabetic dermopathy.

In the present study, among the 137 patients who presented with non-specific manifestations (Table V), the majority had eczema (41.6%) followed by seborrheic keratosis (12.40%), melasma (11.67%), diabetic peripheral neuropathy (8.02%) and scabies (5.10%). According to Sani *et al*. Idiopathic guttate hypomelanosis was the most predominant finding in 61% cases[5].

Among the 338 diabetic patients with cutaneous manifestations, 75 patients had HbA1c <7% (good to moderate control) while 263 patients had poor control of diabetes (HbA1c >7%) (Table VI). When cutaneous manifestation patterns of the controlled and uncontrolled groups were compared, it was found that the uncontrolled group had a significantly greater incidence of cutaneous infections, metabolic disorders, and cutaneous reactions to diabetic treatment. There was a statistically significant ($p < 0.05$) increase in the incidence of non-specific symptoms in the controlled group. There was no statistically significant correlation found between the incidence of cutaneous diseases and metabolic glucose control in a study by Chatterjee *et al* that examined the prevalence and pattern of skin problems in 680 diabetic patients[12]. Long-term uncontrolled diabetes mellitus seems to increase the risk of infections and other cutaneous illnesses in addition to involvement of other target organs[9].

There are many different types of skin manifestations, and they frequently act as a diagnostic indication for underlying diabetes. When a patient exhibits several skin symptoms, it is important to determine whether they are diabetic. The first step in both prevention and treatment is identifying these skin abnormalities. Diabetes-related skin symptoms will grow more frequent as diabetes prevalences rises. As a result, physicians must become acquainted with the spectrum of cutaneous diseases seen in diabetes patients.

The analysis reveals that age, glycaemic control, diabetes duration, and sex are key predictors of cutaneous infections. Older age, poor glycaemic control (evidenced by elevated FBS, PP, and HbA1c), and longer diabetes duration significantly increase the risk of infection. Despite these insights, the predictive models showed limited accuracy (~53%) and AUC (~0.52), indicating that other factors might influence infection risk. The refined logistic regression co-efficients suggest that tighter blood sugar control can help mitigate risks. The findings point to a need for further

exploration of additional factors influencing skin infection susceptibility (Fig. 2). The study found that skin infections, particularly fungal (22%), were the most common cutaneous manifestation in diabetic patients, followed by bacterial infections (16%). Diabetic dermopathy, vitiligo, and insulin-related skin reactions were also prevalent. Skin manifestations were more common in type 2 diabetes and with longer disease duration[13].

Conclusion

The goal of this study was to understand the spectrum of cutaneous symptoms associated with diabetes mellitus. The most prevalent skin finding among diabetics was infections. Cutaneous signs may raise a clinician's suspicions for diabetes mellitus, which in turn helps to prevent systemic derangements by allowing for early start of treatment. A long-term blood glucose control program and proper skin care can lower the chance of developing some diabetic skin lesions. If treatment is not received, problems, such as open sores (ulcers) and, in extreme circumstances, gangrene or a potentially fatal infection may develop. In individuals who are generally healthy, some skin anomalies may suggest the need for an assessment. Skin manifestations in a diabetic may indicate the need for more aggressive diabetes control. Therefore, it is critical that the primary care physician be empowered to identify these, suggest a course of treatment, and, when necessary, refer the patient to a dermatologist for additional assessment.

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