Assessing risk of skin lesions among people with diabetes: a case-control study from Uttarakhand, India

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Background: Diabetes mellitus is a non-communicable disease that affects all the body's organ systems, including the dermatologic system. Skin lesions can cause discomfort, harm one's quality of life (QOL), and increase treatment costs. The objective of conducting this study was to compare the proportion of dermatologic comorbidities, the direct cost of treatment, and the QOL between cases and controls.

Methods: The study was conducted in a medical college hospital in the hilly region of Uttarakhand using a case-control design. Cases were recruited from the Outpatient Department (OPD) and controls from the hospital. Comparisons were made for the presence of skin diseases between 195 patients with diabetes and an equal number of age and gender-matched non-diabetics. The independent t-test was used to compare QOL and treatment cost between the two groups.

Results: The risk of skin diseases was 5.3 times higher in cases than in controls. The proportion of skin diseases in cases was 36.4% versus 9.7% in controls.

Limitations: There is a probability that the QOL scores could be lower and the treatment cost higher than that observed.

Conclusion: The proportion of skin disorders and the mean direct cost of treatment was reported to be significantly higher among cases.

Keywords: Diabetes mellitus, dermatologic system, skin disorders, direct cost

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INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder known to affect almost all the organ systems of the body and is characterized by hyperglycemia. Over the last few decades, diabetes has shown a rising trend, and the number of diabetics is projected to rise to 629 million by the year 2045 [1]. Diabetes presents with symptoms of hyperglycemia such as thirst, polyuria, and weight loss. It is notorious for impacting other body systems in the form of comorbidities, including skin diseases. The severity of the clinical features of skin diseases ranges from mild pain and discomfort to life-threatening conditions following the spread of infection.

On one side, skin diseases are sometimes the first presenting clinical features after the development of diabetes. On the other side, they are the only clue to undiagnosed or uncontrolled diabetic states and comprise the most common component of diabetes care. Prevalence of skin diseases among people with diabetes has shown wide variability (17% to 74%) in different studies [2-8].

Skin diseases frequently occur, as comorbidities, in diabetic patients and are a cause of constant distress to them, thereby affecting their quality of

life (QOL). The deterioration in QOL among people with diabetes and skin diseases may include physical and psychosocial discomfort. Physical discomfort often presents in the form of pain, itching, or the ugly appearance of a body part, while psychosocial discomfort presents in the form of embarrassment, self-consciousness, anxiety, or stress. The presence of skin diseases among people with diabetes can also simultaneously increase the cost of treatment. There are limited studies from India and none from Uttarakhand reporting these attributes of skin disorders in diabetic patients. Therefore, the objective of this study was to compare the proportion of dermatologic comorbidities, the direct cost of treatment, and QOL between cases and controls.

PARTICIPANTS AND METHODS

Study Design and Study population

The present study was conducted in a medical college hospital that provides tertiary care to people in the Srinagar tehsil of Uttarakhand. A case-control study design was implemented.

Selection of cases and controls

Patients with a diagnosis of type 2 diabetes mellitus (DM) for the last six months and with an age of ≥30 years were eligible to be recruited as cases after providing informed consent. They were recruited from our outpatient department. Patients' attendants/caregivers with a negative history of diabetes, further confirmed by a capillary random blood sugar testing, were eligible for recruitment as controls. Cases and controls were pair-matched for age and gender. The period of study was from April 2015 to August 2018.

Sample size

Considering the ratio of cases versus controls (r) in the study as 1, alpha error for testing the hypothesis as 0.05%, power as 80%, and the proportion of skin disorders in cases (p_1) and controls (p_2) as 47.5% and 33.2%, respectively, we obtained a sample size (n) of 182 in each group [9,10]. Finally, we collected data from 392 patients to account for any incomplete data at the time of analysis.

Sampling Procedure

Consecutive sampling was done to recruit both cases and controls as per the inclusion criteria. Pair matching for age (within the range of 2 years) and gender was done.

A pre-designed pre-tested interview schedule was applied to record basic information, history, and examination to confirm the presence of skin diseases and the cost involved in treating the skin diseases. Comorbidities related to skin diseases were first assessed by the Principal Investigator (PI) and further confirmed by clinical and laboratory examination by a dermatologist. All the skin diseases were classified into two groups: non-infectious and infectious. We used the Hindi version of the World Health Organization-Quality of life BREF (WHOQOL-BREF) questionnaire for measuring QOL. This tool contains 26 questions, is a validated instrument, and reports four health domains as its outcomes: physical, psychological, social, and environmental health [11]. The addition of direct medical and non-medical costs was done to estimate the overall direct cost of treatment. The operational definition of direct medical costs included the cost of consultation and any other fees, including those of emergency department visits, laboratory investigations, drugs, and other medical items. The non-medical direct costs included expenses related to transportation for consultation, any relocation expenses due to ailment, and expenses involved in making dietary modifications or changes in possessions such as a house or car or other items. It also included the cost of monitoring visits.

The mean age of cases was 56.8 ± 12.4 years, while that for controls was 54.4 ± 12.3 years. Age and gender distribution of both the groups were similar as they were matched for these variables ($P > 0.05$). Both cases and controls were also comparable with respect to marital status, religion, caste, educational status, and family size ($P > 0.05$), but not for socioeconomic status, income, occupation, and history of diabetes in the family ($P < 0.05$).

Statistical Analysis

Data analysis was done using SPSS 23.0. The chi-squared test was used to compare proportions, while the t-test was used to compare means between the two groups. Statistical significance was reported

with a P-value below 0.05. Risk estimates were reported using the odds ratio (OR) and its 95% confidence intervals (95% CI).

Ethical considerations

We obtained permission from the Institutional Review Board (IRB) of IIHMR University, where the Ph.D. thesis was registered, and from the IEC of the institute, where the study was conducted. We also obtained permission from the WHO office to use the WHOQOL-BREF questionnaire. Written informed consent was obtained from all the study participants before the interview.

RESULTS

It was observed that 36.4% of cases had a skin disorder as a comorbidity compared with 9.7% of controls. Non-infectious skin diseases were almost thrice that of infectious ones among both cases and controls. Cases had 5.3 times higher odds of having skin diseases than controls ($P < 0.001$). The risk of non-infectious skin lesions was higher (OR 6.1) than infectious skin lesions (OR 5.9) (Table 1).

In our study, the most common non-infectious skin lesion reported amongst cases was xerosis (7.7%), with the risk being seven times more than among controls. Acanthosis nigricans and other non-infectious skin lesions such as lichen planus, lipodystrophy, and macular amyloidosis were reported only among cases. The risk of bacterial skin lesions (OR 8.5) and fungal skin lesions (OR 7.1) was relatively higher among cases; the risk of other infectious skin lesions was also more than five times higher. Other infectious skin lesions such as foot ulcers, boils, and erythrasma were reported only among cases (Table 2).

Table 1. Risk of skin diseases among cases and controls

Comorbidities of skin	Cases (195) No. (%)	Controls (195) No. (%)	OR	Confidence interval	*P*-value
Non-infectious skin lesions	61 (31.3)	14 (7.2)	6.1	3.3-11.5	< 0.001
Infectious skin lesions	21 (10.8)	5 (2.6)	5.9	2.1 -16.2	< 0.001
Both types of skin lesions	11 (5.6)	0 (0)	-	-	-
None*	124 (63.6)	176 (90.3)	-	-	-
Total	71 (36.4)	19 (9.7)	5.3	3.0 -9.2	< 0.001

*Reference category for OR. P-value of < 0.05 is considered significant

Table 2. Description of various types of skin diseases among cases and controls

Comorbidities of skin	Cases No. (%) *	Controls No. (%)*	OR	95% Confidence Interval	*P*-value
Non-infectious skin lesions#	61 (31.2)	14 (7.1)	6.1	3.3-11.5	< 0.001
Xerosis	15 (7.7)	3 (1.5)	7.1	2.0-25.0	< 0.001
Dermopathy	12 (9.7)	4 (2.1)	4.2	1.3-13.5	< 0.001
Psoriasis	9 (4.6)	3 (1.5)	4.2	1.1-16.0	0.01
Acanthosis nigricans	9 (4.6)	0	-	-	-
Thickening of skin	6 (3.1)	3 (1.5)	2.8	0.7-11.5	0.07
Hyperpigmentation	5 (2.6)	2 (1.0)	3.55	0.7-18.6	0.07
Lichen planus	3 (1.0)	0	-	-	-
Lipodystrophy	2 (1.0)	0	-	-	-
Macular amyloidosis	1 (1.0)	0	-	-	-
Skin tag	1 (1.0)	2 (1.0)	0.7	0.06-7.9	0.39
Infectious skin lesions#	21 (10.7)	5 (2.6)	5.9	2.1-16.2	< 0.001
Fungal infection (mycosis)	15 (7.7)	3 (1.5)	7.1	2.0-25.0	< 0.001
Bacterial infection	6 (3.1)	1 (0.5)	8.5	1.0-71.6	0.02
Candidiasis	4 (2.1)	1 (0.5)	5.6	0.6-51.4	0.06
Foot ulcers	4 (2.1)	0	-	-	-
Tinea	4 (2.1)	1 (0.5)	5.6	0.6-51.4	0.06
Boils	2 (1.0)	0	-	-	-
Folliculitis	3 (1.5)	2 (1.0)	2.1	0.3-12.9	0.20
Erythrasma	1 (0.5)	0	-	-	-

*Denominator for figures in parenthesis is 195, #Multiple response

The overall QOL score was significantly lower among cases than that among controls. Domain wise, QOL scores were also significantly lower in each domain in cases compared with controls (Table 3).

We observed that the six-monthly direct cost was INR 4116.9 among cases with skin diseases compared to INR 1630.9 among controls; however, this difference in direct cost was not significant. It was also observed that 62.7% of the overall expenditure among cases was on medications, compared with 58.2% among controls. Significant differences in the cost of medicines and other expenses were reported (Table 4).

DISCUSSION

The objectives of the current study were to compare the proportion of skin diseases, mean direct cost of treatment, and QOL scores between cases and controls. We identified 18 different types of cutaneous manifestations. Some of these conditions were reported exclusively among cases and may be indicators of DM. Thirty-six percent of cases had a cutaneous manifestation. Most other studies have reported a higher prevalence of skin disorders among cases [6,12,13]. Phuleri *et al.* observed skin lesions in 90.4% of cases [5]. The differences in prevalence could be due to the duration of the disease and the status of control achieved. Nonetheless, we observed a significantly higher risk of skin disorder among cases

The types of skin diseases reported among diabetic patients vary widely. Some studies report infectious skin lesions as the most common, while others report a higher prevalence of non-infectious skin lesions, as reported in the present research [5,14-17]. Variability has also been reported with respect to the classification of skin lesions. While some authors classify skin diseases into infectious and non-infectious, others classify them based on microvascular, neurological, drug-induced, or infectious pathophysiology. Our results match those of Kumar *et al.* and others who reported the presence of more than one skin disease among cases [18]. Our results are comparable to another case-control study by Banavasi S Girisha *et al.*, who reported that diabetics had a significantly higher proportion of infectious (fungal) and non-infectious skin lesions (xerosis); however, no significant difference was reported with reference to bacterial infections [19]. The proportion of psoriasis among cases (4.6%) reported in our study was higher than in another study by Girisha *et al.* (2.75%), possibly due to the smaller sample size in our study [19].

Cases reported having significantly lower total and domain-wise QOL scores, highlighting the impact of skin disease on various aspects of health rather than just physical health. QOL is reportedly impaired in chronic skin disorders, irrespective of diabetes status [20]; it is also harmed in diabetics with foot ulcers [21] as well as in onchomycosis [22].

Most of the earlier studies have estimated the direct cost of treatment among type 2 DM with

Table 3. Domain-wise comparison of quality of life scores between cases and controls with skin diseases

Domains of quality of life	Cases with skin lesions (71) (Mean ± SD)	Controls with skin lesions (19) (Mean ± SD)	*t* value	*P*-value
Physical	22.5 ± 5.1	25.4 ± 3.3	2.9	< 0.001
Psychological	23.6 ± 4.6	26.8 ± 4.1	2.6	< 0.001
Social relationships	11.8 ± 2.6	12.7 ± 1.3	1.9	0.05
Environment	31.8 ± 5.7	35.4 ± 4.5	2.5	0.01
Total	90.0 ± 16.2	100.5 ± 11.4	2.6	< 0.001

Table 4. Comparison of the six-monthly direct cost of treatment between cases and controls with skin diseases

Characteristic	Cases with dermatology comorbidity (71)	Controls with dermatology comorbidity (19)	*t* value	*P*-value
Consultation	414.7 ± 1018.6	210.4 ± 568.5	0.84	0.40
Medications	2584.9 ± 4929.2	836.3 ± 1667.2	2.50	0.01
Tests	465.7 ± 814.6	450.0 ± 755.9	0.07	0.93
Other expenses	660.9 ± 1580.6	134.2 ± 456.7	2.44	0.01
Total	4116.9 ± 6517.3	1630.9 ± 2799.8	1.62	0.10

skin diseases considering a single dermatological disease such as diabetic foot, foot ulcer, or foot complications. However, the current study provides a comprehensive comparison of the direct cost between the two groups, considering all types of skin diseases. The present study demonstrated that the direct cost of treatment of skin diseases among cases was significantly higher than in controls. These findings were similar to that reported by Shobhana *et al.*, who observed a significantly higher six-month cost expenditure among diabetics with foot complications (Rs. 15450/-) than those without foot complications (Rs. 4373/-). The proportionate cost of medication, relative to other direct cost components, was found to be higher in the present study, similar to that reported in other studies [23-25].

Limitation

There is a probability that the QOL scores could be lower and the cost of treatment obtained could be higher than what was observed since few study participants also had co-existent comorbidities of other systems. The present study's findings are still relevant and provide important results of comparison with a control group, which is also a unique aspect of this study.

CONCLUSION

The prevalence of skin diseases among cases was relatively higher compared with controls, significantly impacting the direct cost and QOL. These findings imply the need for measures to identify skin comorbidities early in the course of diabetes and manage them promptly, thereby reducing the cost of treatment and improving patients' QOL.

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REFERENCES

1. Karuranga S, Fernandes JR, Huang Y, et al. IDF diabetes: Global estimates for the prevalence of diabetes for 2015 and 2040, Diabetes Research and Clinical Practice. Elsevier. 2017;128:40-50.
2. Cvitanović H, Jančić E, Knežević E, et al. Skin changes in patients with diabetes mellitus in Karlovac county. Medicina Fluminensis. 2009;45(4):370-80.
3. Ghosh K, Das K, Ghosh S, et al. Prevalence of skin changes in diabetes mellitus and its correlation with internal diseases: a single center observational study. Indian J Dermatol. 2015;60(5):465-9.
4. Ragunatha S, Anitha B, Inamadar AC, et al. Cutaneous disorders in 500 diabetic patients attending diabetic clinic. Indian J Dermatol. 2011;56(2):160-4.
5. Phulari YJ, Kaushik V. Study of cutaneous manifestations of type 2 diabetes mellitus. Int J Res Dermatol. 2018;4(1):8-13.
6. Sasmaz S, Buyukbese MA, Cetinkaya A, et al. The prevalence of skin disorders in type-2 diabetic patients. Int J Dermatol. 2005;3(1):1-4.
7. Chatterjee N, Chattopadhyay C, Sengupta N, et al. An observational study of cutaneous manifestations in diabetes mellitus in a tertiary care Hospital of Eastern India. Indian J Endocrinol Metab. 2014;18(2):217-20.
8. Goyal A, Raina S, Kaushal SS, et al. Pattern of cutaneous manifestations in diabetes mellitus. Int J Dermatol. 2010;55(1):39-41.
9. Duff M, Demidova O, Blackburn S, et al. Cutaneous manifestations of diabetes mellitus. Clin Diabetes. 2015;33(1):40-8.
10. Dimri D, Reddy B V, Kumar Singh A. Profile of skin disorders in unreached hilly areas of North India. Dermatol Res Pract. 2016;2016:8608534.
11. Saxena S, Chandiramani K, Bhargava R. WHOQOL-Hindi: a questionnaire for assessing quality of life in health care settings in India. World Health Organization Quality of Life. Natl Med J India. 1998;11(4):160-5.
12. Romano G, Moretti G, Di Benedetto A, et al. Skin lesions in diabetes mellitus: prevalence and clinical correlations. Diabetes Res Clin Pract. 1998;39(2):101-6.
13. Bhat YJ, Gupta V, Kudyar RP. Cutaneous manifestations of diabetes mellitus. Int J Diab Dev Ctries. 2006;26(4):152-5.
14. Ghosh K, Das K, Ghosh S, et al. Prevalence of skin changes in diabetes mellitus and its correlation with internal diseases: a single center observational study. Indian J Dermatol. 2015;60(5):465-9.
15. Chatterjee N, Chattopadhyay C, Sengupta N, et al. An observational study of cutaneous manifestations in diabetes mellitus in a tertiary care Hospital of Eastern India. Indian J Endocrinol Metab. 2014;18(2):217-20.
16. Goyal A, Raina S, Kaushal SS, et al. Pattern of cutaneous manifestations in diabetes mellitus. Indian J Dermatol. 2010;55(1):39-41.
17. Mahmood T, ul Bari A, Agha H. Cutaneous manifestations of diabetes mellitus. J Pakistan Assoc Dermatologists. 2005;15(3):227-32.

18. Kumar AA, Ansari SH, Gupta V. A study on cutaneous manifestations in patients of type 2 diabetes mellitus in a tertiary care hospital. Int J Med Res Prof. 2016;2(1):125-7.
19. Girisha BS, Viswanathan N. Comparison of cutaneous manifestations of diabetic with nondiabetic patients: A case-control study. Clin Dermatol Rev. 2017;1(1):9.
20. Ejaz A, Rao SE, Manzoor A, et al. Quality of life assessment in chronic skin disorders. J Pakistan Assoc Dermatologists. 2015;25(2):86-9.
21. Nemcová J, Hlinková E, Farský I, et al. Quality of life in patients with diabetic foot ulcer in Visegrad countries. J Clin Nurs. 2017;26 (9-10):1245-56.
22. Elewski BE. Onychomycosis. Am J Clin Dermatol. 2000;1(1):19-26
23. Shobhana R, Rama Rao P, Lavanya A, et al. Cost burden to diabetic patients with foot complications–a study from southern India. J Assoc Physicians India. 2000;48(12):1147-50.
24. Nath B, Gupta SD, Kumari R. Dental problems among diabetics: A case control study from an Indian state. Indian J Dent Res. 2020;31(4):546-9.
25. Nath B, Gupta SD, Kumari R. Effect of comorbidities on direct cost among type 2 diabetes mellitus (T2DM) patients in tertiary care government hospital in Uttarakhand, India: A primary data analysis of out of pocket expenditure. Diabetes Metab Syndr. 2020;14(6):2153-9.