Content available at: https://www.ipinnovative.com/open-access-journals

Indian Journal of Clinical and Experimental Ophthalmology

Journal homepage: www.ijceo.org

Original Research Article

A comprehensive approach to the critical care management of dry eye syndrome in patients with diabetes mellitus

Sachitanand Singh[1], Aleena Saifi[2]*, Jyoti Mahawar[3], Mahima Pant[4], Niharika Negi[5], Renu Thakur[2]

[1]Dept. of Optometry, UIAHS, Chandigarh University, Punjab, India
[2]Chitkara School of Health Sciences, Chitkara University, Punjab, India
[3]NIMS University, Jaipur, Rajasthan, India
[4]Uttaranchal University, Dehradun, Uttarakhand, India
[5]Dept. of Optometry, Sparsh Himalaya University, Doiwala, Uttarakhand, India

Abstract

Background: Complaints of dry eye are common in diabetic patients with diabetes mellitus and can result in considerable discomfort and visual loss. The relationship between diabetes type, disease duration, and ocular surface remains unestablished.
Aim & Objective: The purpose of the current study was to examine the association between dry eye syndrome and diabetes mellitus and the impact of diabetes type and duration on the eyes.
Materials and Methods: A cross-sectional survey was carried out for a year with 155 diabetic patients, both type 1 and type 2. Information was obtained using diagnostic techniques, which included meibography, TBUT, and Schirmer's test. Descriptive and inferential analysis were used to relate features of diabetes to dry eye features.
Results: The study established that the prevalence of dry eye syndrome was higher in patients with long-standing diabetes and they experienced poor glycaemic control. The patients suffering from Type 2 diabetes mellitus appeared to have more severe symptoms than Type 1 diabetics, especially from the viewpoint of tear production and meibomian gland disorders.
Conclusion: Diabetes mellitus is a significant cause of dry eye syndrome, and the degree varies with diabetes type and its duration. Since this condition is progressive, having an earlier diagnosis and control system leads to a better quality of life prognosis.

Keywords: Dry eye syndrome, diabetes mellitus, meibography, tear break-up time, Schirmer's test, General ocular surface health.

Received: 19-01-2024; **Accepted:** 04-02-2025; **Available Online**: 09-06-2025

1. Introduction

Dry eye syndrome (DES) is an entity with multiple causes and signs that include feeling uncomfortable; visual impairment and unstable tear film.[1] However, this scenario is common now and affects more than millions of people worldwide. Although DM (Diabetes Mellitus) is but one of the numerous causative factors in DEM, it deserves mentioning considering its widespread prevalence in contributing to the initiation and complications associated with the disease.[2] The issue of the increasing prevalence of DM worldwide makes it a highly pressing one since alongside this increase there is a growing number of people with DES. This publication aims to provide insights into the complicated association between diabetes mellitus and non-pharmaceutical dry eye disease, their pathophysiology/aetiologies as well as their associated challenges in terms of clinical decision-making. Based on the IDF report there were nearly half a billion people who had developed diabetes in 2019 and it has been projected that by 2045 there will be nearly one billion.[3] There are even more than ten percent cases of diabetes mellitus in the world which

*Corresponding author: Aleena Saifi
Email: aleenasaifi.7@gmail.com

https://doi.org/10.18231/j.ijceo.2025.048

has become an epidemic and continues to grow.[4] Type one diabetes mellitus or type two diabetes mellitus is an example of a complication in the human body affecting the nervous system as well as the microvascular system. Researchers have taken much interest in these consequences, particularly their impact on organs such as the eye, kidneys, and heart. However, the ocular surface especially the cornea and conjunctiva has not been considered much about the issue of diabetes.[5] DM can cause significant disturbances on the ocular surface and make it worse for patients experiencing dry eye symptoms. Tear film generation, distribution, and drainage should be in a delicate balance to have comfortably clear vision. These delicate balances can be easily disturbed resulting in dry eye syndrome which consequently leads to a significant negative impact on the overall wellness of a person's quality of life. The paper discusses complex pathophysiological connections between diabetes and dry eye syndrome including chronic inflammation, neuropathy, and vessel dysfunction. In addition, this study considers the difficulties of establishing the diagnosis of dry eye symptoms among diabetics and suggests a framework for comprehensive critical care management. Diabetes-specific intervention to control blood sugar levels, and reduce systemic inflammation. Dry eye syndrome has implications related to the current epidemic of diabetes and therefore medical personnel dealing with this burden should understand how to treat the problem of dry eye syndrome. Itching, redness, burning, eye strain and stinging can accompany dry eye symptoms.[6-9] Blurry vision and grave sight are possible. If uncontainable, it will have an erosive effect on the cornea epithelium and lead long long-term pain and blindness. Dry eye etiologies are related to age, gender, environment, disease processes, medicine use, hormone shifts, and lifestyle choices.[10] Diabetes is a prolonged metabolic abnormality in which high blood sugar results from either insulin shortage or its deficient response to target cells. For this reason, type 1 diabetes involves the destruction of the pancreas' beta cells by an autoimmune procedure that makes a person dependent on taking insulin for the entirety of their life whereas type 2 diabetes develops in the maturity era.[11] Diabetes is common among people who are obese, inactive, and have unhealthy eating habits. In India, the prevalence of dry eye is 32% with a strong association between diabetes and dry eye.[12,13]

2. Materials and Methods

A cross-sectional study was then undertaken in an Outpatient Department of the Department of Ophthalmology. Determination of a sample size which was one of the crucial aspects of our study was based on the Cochran formula. Using a sample of 260, at a 95% confidence level, with an acceptable error rate of 5%, and assuming a maximum variance of 0.5 resulted in a sample size of 155. Rigorous recruitment of participants took place and every single one consented in writing explaining what were the risks/benefits related. Ethical considerations that were aligned with the principles of the Declaration of Helsinki. An ethical number issued for this study is EC/NEW/INST/2022/531/124.

$$\text{Sample size} = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1+\left(\frac{z^2 \times p(1-p)}{e^2 N}\right)}$$

This study employed careful screening of eligible participants, all of whom had to be diabetes patients in the Ophthalmology Department. This provided a homogenous study population, having identical baseline characteristics. The data collection procedure was highly complex and involved administering OSDI questionnaires among participants which shed light on the subjective aspects related to eye health. The report also mentioned full records that outlined their general health status as well as those that affected their eyes. As part of a comprehensive ophthalmic examination, there were clinical examinations that included the Schirmer Test, Tear break-up time (TBUT), Non-invasive break-up time (NIBUT), and the Ocular Surface Analysis (OSA). Participants were apprised of the complexity of each of the clinical tests so that they understood clearly how the various aspects of the research worked. To extract useful information from the gathered data, descriptive statistics were run into SPSS software for analysis. In employing ANOVA and Pearson's correlation in our analysis, we were able to delve into intricate association patterns and variations that existed within the data. This was for a year duration constituting one-year time scale enabling the study of ocular surface disease of type 2 diabetes patients on ocular surface disease. This strong and rigorous approach requires the informed consent of participants, thorough data gathering, and sophisticated statistics is the reason why this study can make a substantial contribution to the ocular health and diabetes discourse.

3. Results

The research investigated the correlation between the type of diabetes and dry eye, along with an exploration of the relationship between dry eye and the duration of diabetes. Schirmer's test was employed to measure tear production, yielding a mean value of 10.23 ± 6.51. The study cohort comprised 155 participants, with 65 being male and 90 females. Diabetes types were distributed as follows: 42 cases of type 1 and 113 cases of type 2. Dry eye severity was categorized into normal (28 cases), mild (33 cases), moderate (68 cases), and severe (26 cases). Further characterization included tear meniscus height grades (normal in 83 cases, abnormal in 72 cases), tear film normalcy (83 normal, 72 abnormal), and meibography results (34 normal, 77 mild, 44 moderate). The study utilized ANOVA to analyse the data, revealing significant differences in Schirmer's test values for both eyes (OD F=8.001, OS F=7.989). TBUT values for the right eye (OD F=0.851) and left eye (OS F=1.479) also demonstrated variability. Tear meniscus height exhibited

differences with OD F=1.116 and OS F=1.190, while lipid layer differences were noted with OD F=1.048 and OS F=0.999. Meibography differences were observed with OD F=1.992 and OS F=1.821. Sigma values in ANOVA indicated statistical significance for Schirmer's test (0.00), while TBUT for OD and OS had sigma values of 0.559 and 0.170, respectively. Tear meniscus height sigma values for OD and OS were 0.356 and 0.309, respectively. Lipid layer sigma values for OD and OS were 0.403 and 0.439, and meibography sigma values for OD and OS were 0.061 and 0.078. Notably, the study found no statistically significant association between the duration of diabetes and dry eye parameters as shown in **Figure 1**. The research outcomes underscore a significant relationship between diabetes type and various dry eye indicators as shown in **Figure 2**. Understanding these connections is crucial for tailored approaches in the clinical management of dry eye, considering the specific nuances associated with different diabetes types. However, the duration of diabetes did not emerge as a significant factor influencing the observed dry eye characteristics in this study.

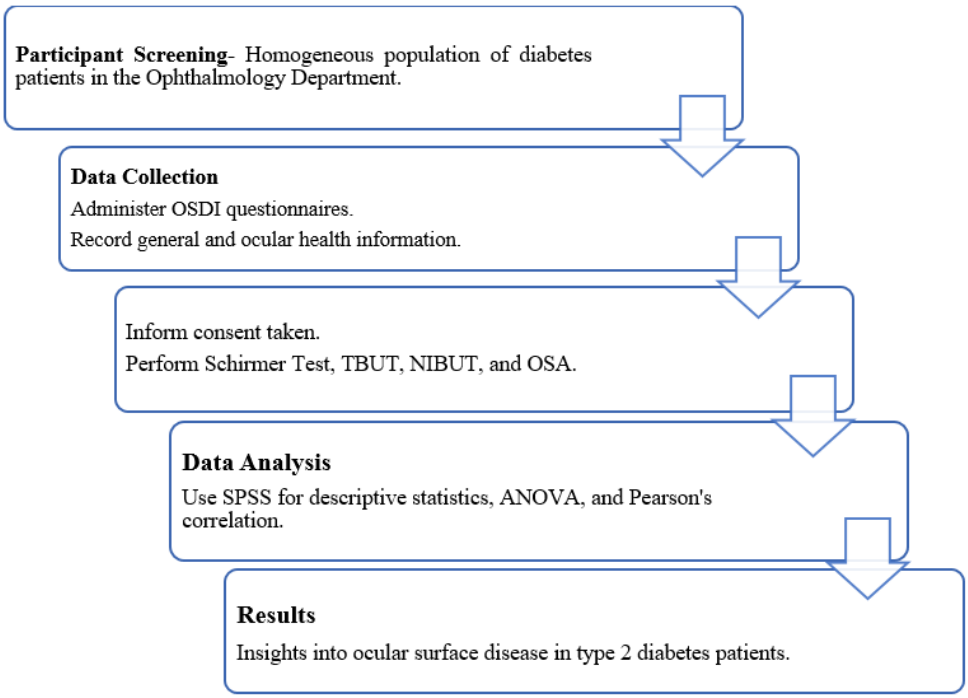

Figure 1: A flow chart of the methodology shows how the study was conducted

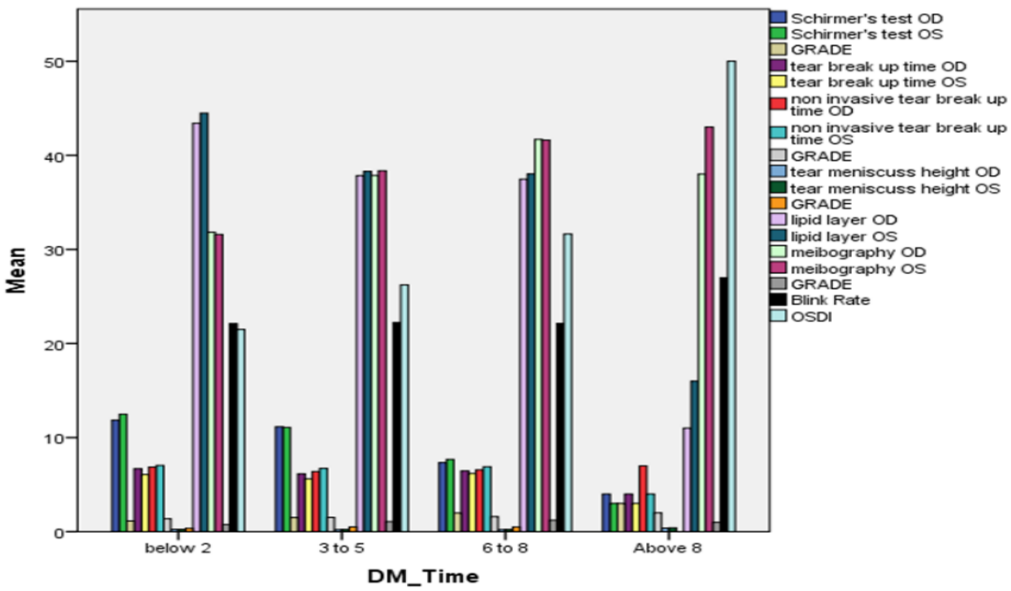

Figure 2: This figure shows that as the time of diabetes increases the tear function test result shows an abnormality in tears resulting in the severity of dry eye. The X-axis represents the mean of all the tests while the Y-axis represents the time of diabetes mellitus

4. Discussion

This study offers valuable knowledge into the relationship between dry eye, diabetes, and related ocular parameters. To discover possible relationships between the type of diabetes, duration of diabetes, and dry eye symptoms which will help us to better understand this complex interplay were aimed by the investigation. The important variation seen in Schirmer's test values for both eyes shows that diabetes affects the tear glands. This result agrees with the previous studies that claim type 2 diabetes can impair tear secretion because of dysfunction in the lacrimal gland. Distinct patterns observed in tear breakup time (TBUT) values, height of the tear's meniscus, and lipid layer parameters prove the multiplexed nature of dry eyes among people with diabetes. Interestingly, even though there are considerable differences in tear secretion, stability of tears, and characteristics of the tear film were observed this study did not show a statistically significant correlation between duration of diabetes and dry eye parameters. This shows that even though the type of diabetes can affect ocular health significantly, the duration of the disease might not be a key determiner of dry eye severity in this group. The different meibography results add more information to the structural changes in the meibomian glands, which are crucial for preserving the lipid layer of tears. It is important to evaluate the meibomian glands in diabetic patients for a thorough understanding of dry eye. In 2013, Sagdik et al.[14] found a strong link between Teardrop Salt Levels (TFO) and diabetes duration, with dryness worsening as illness duration increased. In 2019, Johanna et al.[15] found a connection between type 2 diabetes, dry eye problems, and meibomian gland dysfunction using the Ocular Surface Disease Index (OSDI) questionnaire, non-invasive tear time breakup, and interferometry patterns. Results showed that people with diabetes had higher OSDI scores, which matched meibomian gland dysfunction. However, as diabetes duration increased, both OSDI and meibography scores increased, indicating a direct relationship between dry eye problems worsening. In 2021, Sarkar et al.[16] found a strong link between age and dry eye syndrome in type II diabetics, but not gender. The length of time with diabetes and not controlling it had a significant connection to dryness. The pathophysiological pathways connecting diabetes with dry eyes are complex, with elevated blood sugar levels leading to nerve damage controlling tear production and inflammation and oxidative stress affecting the eye's surface, leading to unstable tear film and increased evaporation.[6] Sigma values from ANOVA show the strength of the observed diversity, involving some TBUT readings and Schirmer's tests having statistically significant results. This stresses the importance of evaluating and treating dry eye based on the type of diabetes in diabetic patients. Although the research was extensive, some limits ought to be addressed. Our ability to make inferences using the cross-sectional design is limited as well; the study population did not reflect all diabetes subtypes and duration. Longitudinal studies with bigger heterogeneous cohorts would be useful in future investigations aimed at better understanding these dynamic relations. The study gives important details about the complex link between dry eye problems and different kinds of diabetes. As diabetes is becoming more common around the world, it impacts our eye health, this includes dry eye disease.[17] Study findings the main discovery of the study is that there is a big link between signs of dry eye problems and types of diabetes. In simple words, the differences in TBUT and Schirmer's test results for both eyes between diabetes categories show how different types of diabetes can affect tear production and stability. The study group also gives a clear view of the level of dry eye seriousness. Many people in the study had moderate-to-severe dry eye issues, showing how important it is for real life. Moreover, the results of meibography, the height of the tear meniscus, and normal tear film give extra details. These show how complicated dry eye can be in people with diabetes. The medical work will be greatly changed by the links between measures of dry eye and diabetes type that have been discovered. Making plans for dry eye care that match the kind of diabetes a person has can make their results better and help treatments work well. Specific ways of treatment, such as targeting different routes that cause dry eye in type 1 and type 2 diabetes might be helped by knowing these two types.[18] This result is different from other earlier studies[14-16] that suggested a possible long-lasting effect of high blood sugar on the eye's parts and how they work.

5. Future Directions and Restraints

It is harder to figure out cause and effect or measure time links when using a cross-sectional method. Moreover, the age group of people in the study - like if there are many men or women and what kinds of diabetes they have - might not be normal for bigger groups. Maybe, in future studies, using a type of design that checks people over time could help understand better how dry eyes grow and connect with diabetes. Looking more into possible reasons like swelling ways or brain problems could help us understand better the connections that have been discovered.

6. Conclusion

Ultimately, this research demonstrates that distinct approaches are required in medical care due to a robust correlation between different types of diabetes and dry eye symptoms. Diabetics are more likely to experience issues with dry eyes. Patients with diabetes can manage their visual issues by taking preventative measures and being conscious of their dry eyes.

7. Source of Funding

None.

8. Conflict of Interest

None.

9. Ethical

Ethical No.: EC/NEW/INST/2022/531/124.

References

1. Messmer EM. The pathophysiology, diagnosis, and treatment of dry eye disease. *Deutsch Ärztebl Int.* 2015;112(5):71.
2. Lee R, Wong TY, Sabanayagam C. Epidemiology of diabetic retinopathy, diabetic macular edema and related vision loss. *Eye Vis.* 2015;2:17.
3. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, et al. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Res Clin Pract.* 2022;183:109119.
4. Arokiasamy P, Salvi S, Selvamani Y. Global burden of diabetes mellitus: prevalence, pattern, and trends. In: Handbook of Global Health. Cham: Springer; 2021. p. 495–538.
5. Bu Y, Shih KC, Tong L. The ocular surface and diabetes, the other 21st Century epidemic. *Exp Eye Res.* 2022;220:109099.
6. Morya AK, Ramesh PV, Kaur K, Gurnani B, Heda A, Bhatia K, Sinha A. Diabetes more than retinopathy, it's effect on the anterior segment of eye. *World J Clin Cases.* 2023;11(16):3736–49.
7. Shaikh S, Thakur R, Bandamwar K. Development of a novel digital eye strain scoring index. *Neuroquantology.* 2022;20(14):219–29.
8. Zaman MN, Singh V. Effect of blink rate among visual display terminal and nonvisual display terminal user. *Indian J Public Health Res Dev.* 2019;10(8):139.
9. Begum NAP, Roy R. Singh S. Comparision of accommodative facility and assessment of tearfilm before & after 6-7 hrs of usage of digital screen*. Int J Innov Sci Res Technol*. 2020;5(4):152–62.
10. Hasan ZA. Dry eye syndrome risk factors: A systemic review*. Saudi J Ophthalmol.* 2021;35(2):131.
11. Cloete L. Diabetes mellitus: an overview of the types, symptoms, complications and management. *Nurs Stand*. 2022;37(1):61–6.
12. Pooja HV, Bhat SK, Gowda HT. Correlation of dry eye status with the duration of diabetes and the severity of diabetic retinopathy in type 2 diabetes mellitus patients. *Indian J Clin Exp Ophthalmol.* 2019;5(1):12–5.
13. Manaviat MR, Rashidi M, Afkhami-Ardekani M, Shoja MR. Prevalence of dry eye syndrome and diabetic retinopathy in type 2 diabetic patients. *BMC Ophthalmol.* 2008:8:10.
14. Sağdık HM, Tetikoğlu M, Uçar F, Uğurbaş SC, Ugurbas SH. Tear film osmolarity in patients with diabetes mellitus. *Ophthal Res.* 2013;50(1):1–5.
15. Johanna GP, Antonio LA, Andrés GS. Correlation between type 2 diabetes, dry eye and Meibomian glands dysfunction. *J Optometry.* 20191;12(4):256–62.
16. Sarkar KC, Bhattacharyya S, Sarkar P, Maitra A, Mandal R. An observational study on the prevalence of dry eyes in type 2 diabetes mellitus patients and its relation to the duration and severity of disease. *J Med Sci Health.* 2021;7(1):68-72.
17. Casper DS, Chang JS. Diabetic eye disease. In: The columbia guide to basic elements of eye care: A manual for healthcare professionals. Cham: Springer; 2019. p. 235–50.
18. Nirmal J, Radhakrishnan K, Moreno M, Natarajan JV, Laude A, Lim TH, et al. Drug, delivery and devices for diabetic retinopathy (3Ds in DR). *Expert Opin Drug Deliv.* 2016;13(11):1625–37.
19. Guwahat S. Chapter 2 Determination of appropriate Sample Size. *Bull Gauhati Univ Math Assoc Int J Appl Math Stat Sci.* 2013;12:28.

Cite this article: Singh S, Saifi A, Mahawar J, Pant M, Negi N, Thakur R. A comprehensive approach to the critical care management of dry eye syndrome in patients with diabetes mellitus*. Indian J Clin Exp Ophthalmol*. 2025;11(2):263–267.