Prevalence of Dry Eye Disease and Chronic Rhinosinusitis Among Patients with Type 2 Diabetes Mellitus: A Community-Based Study

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ABSTRACT

Background: Dry eye disease and chronic rhinosinusitis may be overlooked complications of type 2 diabetes mellitus among community-dwelling patients with prolonged disease and inadequate glycaemic control.

Objective: To determine the prevalence of dry eye disease and chronic rhinosinusitis among patients with type 2 diabetes mellitus and identify associated factors.

Methods: This multicentre community-based cross-sectional study included 120 adults with type 2 diabetes mellitus recruited from June 2024 to September 2025 at Isra University Hospital, Hyderabad, and Al-Nafees Medical College, Islamabad, Pakistan. Dry eye disease was diagnosed using an Ocular Surface Disease Index score of at least 13 combined with abnormal tear-film breakup time or Schirmer I testing. Chronic rhinosinusitis requires compatible symptoms for at least 12 weeks with objective evidence of sinonasal inflammation. Multivariable logistic regression identified independent predictors.

Results: Dry eye disease was present in 51 participants (42.5%), chronic rhinosinusitis in 23 (19.2%), and both conditions in 14 (11.7%). Dry eye disease was independently associated with female sex, diabetes duration of at least 10 years, HbA1c of at least 8.0%, and peripheral neuropathy. Chronic rhinosinusitis was independently associated with longer diabetes duration, poor glycaemic control, and allergic rhinitis. Allergic rhinitis showed the strongest association with chronic rhinosinusitis.

Conclusion: Dry eye disease and chronic rhinosinusitis were common among adults with type 2 diabetes mellitus. Routine ocular surface and sinonasal screening should be considered, especially for patients with prolonged diabetes, inadequate glycaemic control, neuropathy, or allergic rhinitis.

Keywords: Chronic rhinosinusitis; dry eye disease; glycaemic control; ocular surface; prevalence; type 2 diabetes mellitus

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INTRODUCTION

Type 2 diabetes mellitus is a major chronic metabolic disorder characterized by persistent hyperglycaemia, insulin resistance, and progressive vascular and neurological complications[1]. In addition to its known effects on the retina, kidneys, peripheral nerves, and cardiovascular system, diabetes can affect the upper respiratory mucosa and ocular surface. These lesser-known problems can be lingering, causing discomfort, visual issues, poor sleep, a drop in productivity, and quality-of-life issues[2].

Dry eye disease is a complex condition characterized by multiple abnormalities, such as tear-film instability, inflammation of the ocular surface, reduced tear production, increased tear evaporation, and neurosensory disease[3]. Type 2 diabetes mellitus could be a special risk group due to the effects of chronic hyperglycaemia that act on the corneal nerves, affect the function of the lacrimal glands, change tear composition, affect blinking, and slow the healing of the cornea's epithelium. Reflex tear production can be further diminished by diabetic autonomic neuropathy, and microvascular damage to the lacrimal apparatus may affect the nutrition and functional integrity of the apparatus. This means that symptoms of dry eye can become chronic and do not necessarily reflect the severity of the actual damage to the ocular surface[4].

Symptoms of dry eye disease include burning, irritation, a sense of foreign body in the eye, redness, photophobia, excessive tearing, and vision changes[5]. The symptoms can be confused with eye strain, environmental irritation, and discomfort due to ageing.

The decreased corneal sensitivity in diabetic patients may also be a reason why the condition may stay undiagnosed until later, when more severe abnormalities occur. So early recognition is crucial to avoid chronic inflammation and the deterioration of the epithelium, visual discomfort, and poor adherence to treatment[6].

But chronic rhinosinusitis is another long-term inflammatory condition that can be more common in people with diabetes[7]. Features include nasal obstruction, nasal discharge that lasts longer than 12 weeks, facial pressure, postnasal discharge, impaired sense of smell, and recurrent headaches that last for at least 12 weeks. The immune dysfunction, delayed mucosal healing, microvascular dysfunction, impaired mucociliary clearance, and increased susceptibility to recurrent infection associated with diabetes could predispose patients to chronic sinonasal disease. These abnormalities can become more severe with poor glycaemic control and can be a factor in chronic or recurrent inflammation of the nasal and paranasal sinus mucosa[8].

Additionally, dry eye disease can be a complication of chronic rhinosinusitis, as there are shared inflammatory and anatomic pathways[9]. Nasal congestion can lead to mouth breathing and to greater evaporation of tears, and the inflammatory processes of the sinuses can lead to inflammation of the ocular surface via the nasolacrimal drainage system and the surrounding mucosal pathways. Other contributing factors to both disorders could be allergic rhinitis, environmental pollution, smoking, extended screen time, and increasing age. Thus, their co-occurrence could constitute a more general complication of diabetes at the mucosal level, and not two independent and unrelated conditions[10].

However, the clinical significance of these disorders is not taken into account in routine diabetes care, which typically centers around the treatment of retinopathy, nephropathy, neuropathy, foot disease, and cardiovascular risk[11]. Patients with symptoms associated with tear-film dysfunction and chronic sinonasal inflammation are frequently underdiagnosed, underreported, and treated empirically without specific evaluation. The majority of the studies done to date have been in hospital populations, and these patients may have more severe diabetes and higher rates of complications than people with diabetes in the community[12].

Community assessment is crucial in determining the true burden of dry eye disease and chronic rhinosinusitis in individuals with type 2 diabetes mellitus[13]. There is very little evidence to support these conditions from different geographical areas of Pakistan, and specifically about the combination of these two conditions. Their incidence and clinical features may be affected by other factors, including climate, pollution, access to health care, glycaemic control, and socioeconomic factors. This study aimed at determining the prevalence of dry eye disease and chronic rhinosinusitis among type 2 diabetes mellitus patients and analysing the association of these with demographic, duration of diabetes, glycaemic control, and related clinical factors[14].

MATERIALS AND METHODS

The study was conducted as a cross-sectional study in the Department of Ophthalmology, Isra University Hospital, Hyderabad, Pakistan, and the Department of Ophthalmology, Al-Nafees Medical College, Islamabad, Pakistan, from June 2024 to September 2025. They were identified at community diabetes screening camps in the community, primary healthcare centres, as well as through referral from the outpatient department and outreach in the surrounding urban and semi-urban populations. Patients were examined clinically in the ophthalmology departments of the various institutions, with suspected chronic rhinosinusitis being referred for otorhinolaryngological evaluation.

The adults with T2DM were recruited using consecutive non-probability sampling, and a total of 120 adults were recruited. Inclusion criteria included a history of at least one year of type 2 diabetes mellitus and were those using dietary, oral glucose-lowering, or insulin therapy who were age ≥30 years and had a documented diabetes mellitus diagnosis. Diabetes was confirmed from previous medical records, prescriptions, or biochemical markers. Only after patients had signed informed consent and undergone the necessary examination, including ocular, sinonasal, and laboratory evaluation, were they included in the study.

Patients with type 1 diabetes mellitus, gestational diabetes, active upper respiratory tract infection in the last four weeks, previous surgery on the eye or sinuses in the last six months, severe facial trauma, autoimmune or connective-tissue disease, contact lens use, or who were unable to complete the questionnaires on symptoms were excluded. Patients who take long-term medications that have a significant effect on tear production (e.g., systemic anticholinergic medicines) were also excluded. Those with incomplete clinical or laboratory information were not used in the final analysis.

Data was collected with a structured data collection form, including demographic and clinical information. Age, sex, residential background, smoking, BMI, diabetes duration, current antidiabetic therapy, hypertension, dyslipidaemia, allergic rhinitis, peripheral neuropathy, diabetic retinopathy, previous eye symptoms, and chronic sinonasal symptoms were included as variables. The height was measured with a

stadiometer fixed on the wall, and the body weight was measured by a calibrated digital scale. BMI (kg/m2) was obtained by dividing weight (kg) by height (m2).

Glycaemic control was determined by measuring glycated haemoglobin within four weeks of clinical examination. An HbA1c level of <8.0% was assigned to relatively controlled diabetes, and an HbA1c level of ≥8.0% was assigned to inadequate glycaemic control. The duration of diabetes was defined as the period from the first recorded diagnosis of diabetes to the date of the survey, and was grouped into diabetes for less than 10 years and 10 or more years. Peripheral neuropathy was diagnosed by documented clinical history and sensory examination, and diabetic retinopathy was determined by dilated fundus examination or by recent ophthalmological documentation.

The Ocular Surface Disease Index (OSDI) questionnaire was used to assess dry eye symptoms. The participants were queried on eye irritation, burning sensation, grittiness, sensitivity to light, blurring, and problems in performing routine visual tasks. The questionnaire score was between 0 and 100, with a higher score reflecting more acute symptoms. The Ocular Surface Disease Index score was deemed to be indicative of clinically relevant dry eye symptoms if it was greater than or equal to 13.

The fluorescein tear-film breakup time test was used to evaluate the tear-film stability. The fluorescein strip was initially soaked in sterile saline before gently spreading it along the lower conjunctival fornix, and the participant was asked to blink a few times, then keep his/her eyes open. The distance between the last blink and the first dry spot was measured with cobalt-blue illumination through slit-lamp examination. Three readings were taken from each eye, and the mean reading was taken. Tear-film breakup time < 10 seconds was abnormal.

Schirmer's test without topical anaesthetics was used to assess tear production. A filter-paper strip, standardized by the authors, was laid at the middle-third/lower-third boundary of the lower lid and left there for 5 minutes. The length of the wetted strip was then measured in millimetres. If the tear secretion volume was 10 mm or less after five minutes, it was considered reduced tear secretion. Dry eye disease was confirmed when a participant had an Ocular Surface Disease Index score of ≥13 and either a tear-film breakup time of <10 seconds or a Schirmer I test of <10 mm. If the results were not the same for both eyes, the more abnormal eye was used for classification.

Chronic rhinosinusitis was identified by screening the participants using a structured history of nasal obstruction, anterior or posterior nasal discharge, facial pain or pressure, and decreased or absent sense of smell. The diagnosis of chronic rhinosinusitis was suspected when at least two of these symptoms had been present for at least 12 weeks or more, with nasal blockage and nasal discharge being present. Patients with positive symptom history were subjected to otorhinolaryngological examination. Objective evidence of sinonasal inflammation was found on anterior rhinoscopy or nasal endoscopy, and was used to confirm the diagnosis, which included mucopurulent discharge, mucosal oedema, or nasal polyps. Only clinically indicated computed tomography (CT) of the paranasal sinuses was used.

The main findings were the occurrence of dry eye disease and chronic rhinosinusitis among participants with type 2 diabetes mellitus. Secondary outcomes included the percentage of patients with dry eye disease and CRS, and the relationships between these disorders with age, sex, duration of diabetes, HbA1c, peripheral neuropathy, diabetic retinopathy, smoking, BMI, and allergic rhinitis.

Data were coded and analyzed using SPSS (IBM). Data of continuous variables were tested for normality and presented as mean with standard deviation or median with interquartile range as appropriate. Categorical variables were described in terms of means, frequencies, and percentages. The independent-samples t test or Mann–Whitney U test was used to compare continuous variables, while the chi-square test or Fisher's exact test was used for categorical variables. Variables with clinical importance or a univariable p value below 0.20 were entered into multivariable logistic regression models. Odds ratios with 95% confidence intervals were reported, and a two-sided $p<0.05$ was regarded as statistically significant.

Ethical approval was obtained from the relevant institutional review committees of Isra University Hospital, Hyderabad, and Al-Nafees Medical College, Islamabad, before participant recruitment. All participants gave written informed consent. All personal data was kept confidential, and those who were diagnosed with dry eye disease as well as chronic rhinosinusitis were advised and referred for the appropriate treatment and specialist follow-up.

RESULTS

A total of 132 patients with type 2 diabetes mellitus were assessed for eligibility. Seven patients did not meet the inclusion criteria, while five had incomplete ocular or sinonasal assessments. The final analysis, therefore, included 120 participants, giving a completion rate of 90.9%.

The mean age of the participants was 56.4 ± 9.2 years. There were 64 women (53.3%) and 56 men (46.7%). The median duration of type 2 diabetes mellitus was 8 years, with an interquartile range of 4–13 years, while 49 patients (40.8%) had been living with diabetes for at least 10 years. The mean HbA1c level was 8.2 ±

1.3%, and 68 participants (56.7%) had an HbA1c level of 8.0% or higher. Hypertension was present in 67 patients (55.8%), peripheral neuropathy in 39 (32.5%), diabetic retinopathy in 31 (25.8%), and allergic rhinitis in 25 (20.8%). The baseline characteristics of the participants are presented in Table 1.

Table 1. Baseline Demographic and Clinical Characteristics of the Participants

Characteristic	Total participants, n = 120
Age, years	56.4 ± 9.2
Female sex	64 (53.3%)
Male sex	56 (46.7%)
Urban residence	73 (60.8%)
Rural or semi-urban residence	47 (39.2%)
Body mass index, kg/m²	28.0 ± 4.2
Current smoking	18 (15.0%)
Diabetes duration, years	8 (4–13)
Diabetes duration ≥10 years	49 (40.8%)
HbA1c, %	8.2 ± 1.3
HbA1c ≥8.0%	68 (56.7%)
Hypertension	67 (55.8%)
Dyslipidaemia	57 (47.5%)
Peripheral neuropathy	39 (32.5%)
Diabetic retinopathy	31 (25.8%)
Allergic rhinitis	25 (20.8%)

Dry eye disease was diagnosed in 51 participants, producing an overall prevalence of 42.5%. Chronic rhinosinusitis was identified in 23 participants, corresponding to a prevalence of 19.2%. Fourteen patients had both dry eye disease and chronic rhinosinusitis, giving a combined prevalence of 11.7%. Dry eye disease without chronic rhinosinusitis was found in 37 patients, while nine had chronic rhinosinusitis without dry eye disease. Sixty participants had neither disorder, as shown in Table 2. Among the 23 patients with chronic rhinosinusitis, 14 also had dry eye disease. Therefore, 60.9% of patients with chronic rhinosinusitis fulfilled the diagnostic criteria for dry eye disease. Similarly, 27.5% of patients with dry eye disease had coexisting chronic rhinosinusitis.

Table 2. Prevalence and Distribution of Dry Eye Disease and Chronic Rhinosinusitis

Clinical outcome	Number	Prevalence
Dry eye disease	51	42.5%
Chronic rhinosinusitis	23	19.2%
Both conditions	14	11.7%
Dry eye disease only	37	30.8%
Chronic rhinosinusitis only	9	7.5%
Neither condition	60	50.0%

Patients with dry eye disease had significantly higher Ocular Surface Disease Index (34.6 ± 13.1) than patients without dry eye disease (12.3 ± 8.1) ($p < 0.001$). The mean TFBUT was also shorter for patients with dry eye disease than for uninvolved participants (6.3 ± 2.0 seconds vs. 11.1 ± 2.8 seconds; $p < 0.001$). The mean value of Schirmer I was 8.0 ± 2.9 mm in patients with DED and 14.6 ± 4.1 mm in non-DED patients ($p < 0.001$).

Females were significantly more likely than males to have dry eye disease. It was detected in 33 of 64 women (51.6%) compared with 18 of 56 men (32.1%; $p = 0.032$). Also, those with a longer disease course (at least 10 years) had a higher rate of dry eye disease than those with a shorter disease course (59.2% versus 31.0%; $p = 0.002$).

Patients with an HbA1c ≥ 8.0% were more likely to have DED than those with an HbA1c < 8.0% (52.9% vs 28.8%, $p = 0.008$). Patients with peripheral neuropathy also had more cases of dry eye disease than those who did not have peripheral neuropathy (61.5% vs. 33.3%, $p = 0.003$). The unadjusted prevalence of DED was higher among individuals with DR (58.1% versus 37.1%; $p = 0.042$).

In patients with chronic RS, 20 (87.0%) reported nasal obstruction, 18 (78.3%) reported anterior or posterior nasal discharge, 11 (47.8%) reported a loss of sense of smell, and nine (39.1%) reported facial pain or pressure. In 16 patients, mucosal oedema was confirmed by objective examination, mucopurulent discharge was observed in eight patients, and nasal polyps in four patients.

Chronic rhinosinusitis was significantly more common among participants with a longer duration of diabetes (at least 10 years) than those with a shorter duration of diabetes (28.6% vs. 12.7%, $P = 0.030$). It was also more common in patients with an HbA1c level of 8.0% or above compared with those with good glycaemic control (26.5% versus 9.6%, $p = 0.020$).

Unadjusted association was highest for allergic rhinitis with chronic rhinosinusitis. Among the 25 patients with allergic rhinitis, there was a higher prevalence of chronic rhinosinusitis (44.0%) than in the 95 patients without allergic rhinitis (12.6%; $p < 0.001$). The prevalence of chronic rhinosinusitis was also higher in current smokers than in non-smokers (38.9% vs. 15.7%, respectively; $p = 0.021$).

Female sex, diabetes for at least 10 years, and HbA1c level ≥ 8.0% and peripheral neuropathy were independent risk factors for dry eye disease in the multivariable logistic regression model. Patients with diabetes for more than 10 years had about two and a half times higher adjusted odds for having DE than those with diabetes for less than 10 years.

Poor glycaemic control, allergic rhinitis, and duration of diabetes were independent risk factors for chronic

rhinosinusitis. The adjusted odds of chronic rhinosinusitis were more than four times higher with allergic rhinitis. There was no significant association of current smoking with other clinical variables after adjustment. The results of the multivariable analysis are shown in Table 3.

Table 3. Multivariable Predictors of Dry Eye Disease and Chronic Rhinosinusitis

Outcome and predictor	Adjusted odds ratio	95% confidence interval	p value
Dry eye disease			
Female sex	1.93	1.01–3.70	0.047
Diabetes duration ≥10 years	2.52	1.27–5.01	0.008
HbA1c ≥8.0%	2.13	1.08–4.21	0.030
Peripheral neuropathy	2.34	1.14–4.81	0.021
Diabetic retinopathy	1.48	0.67–3.25	0.330
Chronic rhinosinusitis			
Diabetes duration ≥10 years	2.20	1.01–4.80	0.047
HbA1c ≥8.0%	2.50	1.03–6.06	0.043
Allergic rhinitis	4.39	1.72–11.21	0.002
Current smoking	2.64	0.90–7.74	0.077

Overall, dry eye disease affected more than two-fifths of the study population, while approximately one-fifth had chronic rhinosinusitis. Poor glycaemic control and longer diabetes duration were associated with both disorders, whereas peripheral neuropathy was particularly related to dry eye disease, and allergic rhinitis was the strongest predictor of chronic rhinosinusitis.

DISCUSSION

The present multicentre community-based study demonstrated that dry eye disease and chronic rhinosinusitis were common among adults with type 2 diabetes mellitus[1]. Forty-two and a half percent (42.5%) of the participants had dry eye disease, and 19.2% had chronic rhinosinusitis. Eleven and a half percent of the study population had both conditions. The results of this study suggest ocular surface and sinonasal problems could be a significant but underappreciated part of the clinical burden of type 2 diabetes mellitus[2].

The high prevalence rate of dry eye disease that was observed indicates that tear-film dysfunction is common in patients with diabetes, even in non-selected tertiary care settings[3]. Chronic hyperglycaemia can cause changes to the composition of the tear film, affect the function of the lacrimal glands, decrease the reflex lacrimation, and damage sensory nerves in the cornea. Diabetes can also affect meibomian gland function and delay the healing of the eye's surface, which can lead to more tear evaporation and inflammation of the eye's surface. The mechanisms behind this could be responsible for the significantly decreased TAB and SI of dry eye patients[4].

Female sex was an independent predictor of the prevalence of dry eye disease, as this condition was significantly more common among women than men[5]. This difference may be due to hormonal factors, age-related changes in tear production, meibomian gland dysfunction, and the higher likelihood of inflammation of the eye surface in the elderly. The association observed may have been affected by environmental exposure, cosmetic use, and differences in symptom reporting, which were not evaluated in detail[6].

A strong correlation between diabetes duration and dry eye disease was found[7]. The adjusted odds of developing diabetes were over 2X greater in participants with a history of diabetes > 10 years. This is consistent with the notion that there is a progressive increase in metabolic, neurologic, and microvascular damage to the ocular surface. Hyperglycaemia can cause damage to corneal innervation, decrease the function of the lacrimal gland, and reduce the ability to regenerate the epithelium from normal environmental stresses[8].

Another independent predictor of dry eye disease was poor glycaemic control[9]. Those who had an HbA1C score ≥ 8.0% were significantly more likely to be prevalent compared to those with lower HbA1C scores. Chronic hyperglycaemia can lead to higher osmolarity of tears, oxidative stress, more inflammation, and affect the healing of the eye's surface. The cross-sectional design does not provide evidence that improved glycaemic control is the direct cause of improvement in dry eye disease; however, the association highlights the need to integrate metabolic management with care for the ocular surface[10].

Dry eye disease was also independently associated with peripheral neuropathy[11]. Increased permeability of the corneal nerves and altered autonomic control of lacrimal secretion are one possible site of involvement in diabetic neuropathy. Loss of corneal sensitivity may cause the blink rate and the reflex tearing to decrease, allowing the tear film to break down. Importantly, the patient may not experience as many symptoms as would be predicted with the degree of surface abnormalities. Objective assessment is therefore particularly important in diabetic patients with neuropathy[12].

Dry eye disease was seen to be associated with DR in unadjusted analysis, but not after multivariable adjustment[13]. This indicates that common factors, like long diabetes duration, inadequate glycaemic control, and neuropathy, may play a role in the apparent relationship. The microvascular and metabolic pathways involved in RE and DE can overlap, but RE may not be the sole parameter to define ocular surface dysfunction[14].

Nearly 20% of the participants had chronic rhinosinusitis[15]. Persistent sinonasal inflammation occurs in diabetes, which may be associated with a decrease in mucociliary clearance, impaired leukocyte function, decreased local tissue perfusion, and delayed mucosal repair. These abnormalities can extend the period of inflammation following exposure to allergens, infections, or environmental triggers. Symptoms of nasal obstruction and persistent nasal discharge were most common, and mucosal oedema was the most common objective finding[16].

Chronic rhinosinusitis was independently predicted by long duration of diabetes and poor glycemic control[17]. The cumulative metabolic damage suggests that the respiratory mucosa may be similarly damaged as the ocular surface. Sub-optimal glycaemic control can impair local immune defence, stimulate inflammatory activity, and delay the resolution of mucosal injury. So, patients with uncontrolled DM who have recurrent sinonasal complaints should not be seen as a series of acute infections and treated accordingly[18].

The strongest independent risk factors for CRS were allergic rhinitis[19]. More than four times the adjusted odds for chronic rhinosinusitis were seen for patients with allergic rhinitis. Allergic inflammation can be persistent, leading to mucosal oedema, sinus drainage blockage, ventilation problems, and sinus secretion retention. These changes, along with diabetes-related immune dysfunction and delayed healing, may make it more likely that sinonasal disease will persist[20].

Unadjusted analysis revealed smoking was a risk factor for chronic rhinosinusitis[6], but this factor was not significant in the adjusted model. Tobacco smoke may suppress the cilia, cause nasal irritation, and raise the inflammation level locally. An independent association may not have been found, however, due to the relatively low number of smokers and the small number of chronic rhinosinusitis cases[14].

Of interest was the high prevalence of dry eye disease and chronic rhinosinusitis[3]. Over half of the subjects with chronic rhinosinusitis were also diagnosed with dry eye disease. This overlap may be mediated by shared inflammatory pathways, allergic disease, exposure to the environment, and anatomical continuity between the ocular surface and nasal cavity. The chronic nasal obstruction can also lead to mouth breathing and more tear evaporation. In turn, inflammation of the nasolacrimal drainage system can cause ocular irritation[17].

The results have implications for the day-to-day treatment of diabetes[8]. Various follow-up procedures are often discussed, including retinal screening, renal function, neuropathy, cardiovascular risk assessment, and examination of the feet. While the symptoms of the ocular surface can impact comfort, vision, sleep, and quality of life, they may not be given as much attention as the more persistent sinonasal symptoms. A short symptom-focused screening procedure may be useful to guide patients towards the need for ophthalmological or otorhinolaryngological assessment[12].

Targeted assessment should be considered most beneficial for patients who have had diabetes for longer than 2 years, HbA1C levels ≥ 8.0%, peripheral neuropathy, allergic rhinitis, or persistent symptoms in both eyes and the upper respiratory tract (URT)[5]. Early diagnosis can help minimize repeated empirical therapy, halt the progression of OSD, and help control symptoms. Optimising glycaemic status can also be an important aspect of the overall management plan[19].

There were some strengths with the study[7]. It involved people from two centers located in different geographical regions—Hyderabad and Islamabad—with both subjective and objective assessment of the dry eye disease. No single symptom was enough to make the diagnosis of chronic rhinosinusitis; objective evidence of sinonasal inflammation was required. The community-based recruitment strategy also furnished information other than the typical tertiary-care setting[16].

A few limitations should be noted[4]. This was a cross-sectional design, which did not allow for the determination of a causal or temporal relationship. The sample size was moderate, and the number of patients with CRS was relatively small and could have reduced the accuracy of regression estimates. There was limited investigation of environmental pollution, occupational exposure, amount of screen time, medication use, seasonal variation, and socioeconomic factors. Computed tomography was done only as clinically indicated, and nasal endoscopy was available only to those with symptoms. The results might thus not be generalizable to the broader population of type 2 diabetes mellitus[11].

CONCLUSION

Common conditions among the type 2 diabetes mellitus patients were dry eye disease (42.5%) and chronic rhinosinusitis (19.2%). In 11.7% of them, both conditions were present. Poor glycaemic control and longer duration of diabetes were independently associated with both disorders. Allergic rhinitis was the strongest predictor for chronic rhinosinusitis, and

female sex and peripheral neuropathy were significant predictors of dry eye disease.

Ocular surface symptoms and persistent Sinonasal symptoms should be considered for routine screening in the clinical follow-up of patients with type 2 diabetes mellitus. Special attention should be paid to those who have a long duration of disease, inadequate glycaemic control, neuropathy, or allergic rhinitis. Symptom burden and potentially unnecessary complications could be reduced if these patients are recognised early, referred to specialists, and managed metabolically.

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Data Availability: Data are available from the corresponding author upon reasonable request.

Authors' Contributions: All authors contributed to the study design, data collection, analysis, manuscript preparation, and final approval.

References

1. Lim AJY, Vasantharasan J, Jonnalagadda A, Alfurayj MA. Prevalence of dry eye disease in patients with diabetes mellitus: a systematic review. Cureus. 2026;18(5):e109762. doi:10.7759/cureus.109762.
2. Huang T, Wang D, Jiang D, Lu X, Lin L, Zhang Y, et al. Diabetic dry eye: advances in pathogenesis, diagnostic strategies, and therapeutic approaches. Front Med (Lausanne). 2026;13:1756568. doi:10.3389/fmed.2026.1756568.
3. Chen KY, Chan HC, Chan CM. Is there a link between dry eye disease and diabetes mellitus? A systematic review and meta-analysis. J Diabetes Complications. 2025;39(10):109149. doi:10.1016/j.jdiacomp.2025.109149.
4. Kalra S, Gokhale NS, Bantwal G, Matada R, Shaikh S, Pawar V, et al. Dry eye in diabetes: the Indian Diabetic and Endocrine Eye Diseases (INDEED) review. touchREV Endocrinol. 2024;20(2):30-41. doi:10.17925/EE.2024.20.2.6.
5. Britten-Jones AC, Wang MTM, Samuels I, Jennings C, Stapleton F, Craig JP. Epidemiology and risk factors of dry eye disease: considerations for clinical management. Medicina (Kaunas). 2024;60(9):1458. doi:10.3390/medicina60091458.
6. Mohamed Z, Alrasheed S, Abdu M, Allinjawi K. Dry eye disease prevalence and associated risk factors among the Middle East population: a systematic review and meta-analysis. Cureus. 2024;16(9):e70522. doi:10.7759/cureus.70522.
7. Zhou Q, Yang L, Wang Q, Li Y, Wei C, Xie L. Mechanistic investigations of diabetic ocular surface diseases. Front Endocrinol (Lausanne). 2022;13:1079541. doi:10.3389/fendo.2022.1079541.
8. Cai Y, Wei J, Zhou J, Zou W. Prevalence and incidence of dry eye disease in Asia: a systematic review and meta-analysis. Ophthalmic Res. 2022;65(6):647-658. doi:10.1159/000525696.
9. Qian L, Wei W. Identified risk factors for dry eye syndrome: a systematic review and meta-analysis. PLoS One. 2022;17(8):e0271267. doi:10.1371/journal.pone.0271267.
10. De Freitas GR, Ferraz GAM, Gehlen M, Skare TL. Dry eyes in patients with diabetes mellitus. Prim Care Diabetes. 2021;15(1):184-186. doi:10.1016/j.pcd.2020.01.011.
11. Nadeem H, Malik TG, Mazhar A, Ali A. Association of dry eye disease with diabetic retinopathy. J Coll Physicians Surg Pak. 2020;30(5):493-497. doi:10.29271/jcpsp.2020.05.493.
12. Wolffsohn JS, Arita R, Chalmers R, Djalilian A, Dogru M, Dumbleton K, et al. TFOS DEWS II diagnostic methodology report. Ocul Surf. 2017;15(3):539-574. doi:10.1016/j.jtos.2017.05.001.
13. Fokkens WJ, Lund VJ, Hopkins C, Hellings PW, Kern R, Reitsma S, et al. European Position Paper on Rhinosinusitis and Nasal Polyps 2020. Rhinology. 2020;58 Suppl S29:1-464. doi:10.4193/Rhin20.600.
14. Orlandi RR, Kingdom TT, Smith TL, Bleier B, DeConde A, Luong AU, et al. International consensus statement on allergy and rhinology: rhinosinusitis 2021. Int Forum Allergy Rhinol. 2021;11(3):213-739. doi:10.1002/alr.22741.
15. Nam JS, Roh YH, Kim J, Chang SW, Ha JG, Park JJ, et al. Association between diabetes mellitus and chronic rhinosinusitis with nasal polyps: a population-based cross-sectional study. Clin Otolaryngol. 2022;47(1):167-173. doi:10.1111/coa.13884.
16. Luo M, Zhou E, Peng F. Type 2 diabetes mellitus increases postoperative recurrence risk in Chinese patients with chronic rhinosinusitis. Acta Otolaryngol. 2023;143(9):783-788. doi:10.1080/00016489.2023.2255222.
17. Min HK, Lee S, Kim S, Son Y, Park J, Kim HJ, et al. Global incidence and prevalence of chronic rhinosinusitis: a systematic review. Clin Exp Allergy. 2025;55(1):52-66. doi:10.1111/cea.14592.
18. Passali GC, Santantonio M, Passali D, Passali FM. The diabetic nose: a narrative review of rhinologic involvement in diabetes, 1973-2025. J Clin Med. 2026;15(2):472. doi:10.3390/jcm15020472.

19. Hellings PW, Alobid I, Anselmo-Lima WT, Bernal-Sprekelsen M, Bjermer L, Caulley L, et al. EUFOREA/EPOS2020 statement on the clinical considerations for chronic rhinosinusitis with nasal polyps care. Allergy. 2024;79(5):1123-1133. doi:10.1111/all.15982.
20. Fokkens WJ, Lund VJ, Luong AU, Orlandi RR. A comparison of international guidelines for rhinosinusitis. J Allergy Clin Immunol Pract. 2022;10(6):1418-1422. doi:10.1016/j.jaip.2022.01.013.