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EFFECT OF SYSTEMIC STEROIDS ON TEAR FILM STABILITY

Original Research

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ABSTRACT

Background: Systemic corticosteroids are widely prescribed for managing inflammatory and autoimmune conditions; however, their impact on ocular surface health, particularly tear film stability, remains underexplored. Alterations in tear production can compromise visual comfort and ocular integrity, making it essential to assess the potential ocular side effects of systemic medications. This study investigated the association between systemic steroid use and tear film stability using clinical tear production measurements.

Objective: To evaluate the clinical outcomes of the effect on tear film stability associated with systemic steroid use.

Methods: This randomized controlled trial was conducted at the Department of Ophthalmology, University of Lahore Teaching Hospital. A total of 100 participants aged 20 to 50 years, of both genders, were enrolled using non-probability convenient sampling and divided equally into two groups (n = 50 each). Group One included individuals not using systemic steroids, while Group Two comprised patients undergoing systemic steroid therapy. Tear film stability was assessed using Schirmer test strips and slit-lamp biomicroscopy. Ethical approval was obtained, and informed consent was secured. Data were analyzed using SPSS version 26. Independent samples t-test and Mann-Whitney U test were applied to evaluate group differences.

Results: The mean age of participants was 23.43 ± 2.324 years. Intraocular pressure ranged from 14 to 18 mmHg (mean 16.09 ± 1.303 mmHg). Schirmer test scores in Group One ranged from 12 to 18 mm with a mean of 14.32 ± 1.558 mm, whereas Group Two ranged from 5 to 14 mm with a significantly lower mean of 9.24 ± 2.446 mm. The mean difference in tear production between groups was 5.08 mm ($p < 0.001$), indicating significantly reduced tear film stability among steroid users.

Conclusion: Systemic steroid use was significantly associated with reduced tear production, suggesting its negative impact on tear film stability. Routine ocular screening should be considered prior to initiating steroid therapy.

Keywords: Corticosteroids, Dry Eye, Intraocular Pressure, Schirmer Test, Systemic Steroids, Tear Film, Tear Production.

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INTRODUCTION

The ocular surface is a complex anatomical and physiological interface comprised of various epithelial and glandular tissues that work in harmony to support visual clarity and ocular health. One of the most critical components of this interface is the tear film, a multilayered structure secreted by these tissues, which plays a vital role in lubricating the eye, maintaining a smooth optical surface for refraction, and protecting against environmental irritants and microbial invasion. Although the tear film is a visibly observable element of the eye, its structure and dynamic behavior—especially in relation to blinking—remain less thoroughly understood. Blinking, often underestimated, significantly influences the distribution, stability, and function of the tear film, thus contributing to overall ocular homeostasis. Tear film instability is central to the pathophysiology of dry eye disease (DED), a multifactorial ocular surface disorder characterized by loss of tear film homeostasis and accompanied by ocular symptoms such as discomfort, visual disturbance, and inflammation (1). The disorder emerges when either tear production is insufficient or the tears evaporate too rapidly, leading to desiccation and damage to the ocular surface (2). DED is not only a widespread public health concern but also a leading cause of ocular morbidity, with a global prevalence ranging from 5% to 50% depending on regional, environmental, and demographic factors (3). Among the most commonly reported symptoms are ocular dryness, irritation, blurred vision, and photophobia—symptoms that can significantly impair daily functioning and quality of life.

Several risk factors have been implicated in the development of DED, including advanced age, female gender, Asian ethnicity, autoimmune conditions, hormonal imbalances, mental health disorders, allergy, environmental exposure to pollutants, prolonged digital screen usage, use of contact lenses, and history of ocular surgery (4). Pharmacological agents such as antihistamines, antidepressants, and hormonal therapies have also been shown to alter tear production or composition, contributing to the disease burden (5). Based on the Ocular Surface Disease Index (OSDI) diagnostic threshold of >12, studies have revealed high prevalence rates across diverse populations, including 57.1% among recent study participants, with symptom severity ranging from mild to severe (6). Comparable figures have been reported globally—50.5% in Brazil, 59.6% in Serbia, and over 60% in Dubai—suggesting a consistent and growing impact of DED across geographic and cultural boundaries (7,8). Pathophysiologically, DED may be categorized into aqueous-deficient and evaporative subtypes. Aqueous-deficient DED results from impaired function of the lacrimal glands, leading to insufficient production of the watery component of the tear film. This compromises ocular lubrication and increases the risk of epithelial damage and inflammation (9). In contrast, evaporative DED typically arises from meibomian gland dysfunction, which affects the lipid layer of the tear film. The lipid layer is crucial for slowing down tear evaporation and preserving tear film stability; its dysfunction thus leads to rapid tear evaporation and exacerbates dry eye symptoms (10). Environmental factors, such as low humidity, wind exposure, and extended screen time, further compound the problem by accelerating tear evaporation (11).

Considering the intricate etiology and broad impact of DED, early detection and accurate classification of its subtypes are essential for effective clinical management. Furthermore, public awareness and preventive strategies must be emphasized, especially among high-risk groups. Despite its high prevalence and significant burden, dry eye disease often remains underdiagnosed and inadequately treated, underscoring the need for continued research. The objective of the present study is to evaluate the prevalence and severity of dry eye disease in a specific population using the OSDI scoring system and to explore the associated demographic and environmental risk factors in order to support better clinical understanding and management strategies.

METHODS

This randomized controlled trial was conducted in the Ophthalmology Department of The University of Lahore Teaching Hospital, Lahore, over a period of four months following the approval of the study synopsis. Ethical approval was obtained from the Ethical Review Committee of The Superior University, Lahore, and all participants gave both written and verbal informed consent after being thoroughly briefed on the objectives and procedures of the study. Adequate time was given to each participant to review the information and voluntarily agree to participate. The study enrolled a total of 100 participants, including both male and female patients aged between 20 and 50 years. Participants were recruited from the outpatient department (OPD) during routine ophthalmic consultations. The inclusion criteria consisted of adults within the specified age range presenting for general ophthalmologic evaluation (12). Initial

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evaluation included assessment of visual acuity and refraction. Tear film stability was subsequently assessed using the Schirmer's test and slit-lamp biomicroscopy. Schirmer test strips were used to measure aqueous tear production, a standard method for identifying dry eye disease, while the slit-lamp examination helped in assessing ocular surface integrity. Data collected were entered and analyzed using IBM SPSS software version 26. Wilcoxon signed ranks test was applied to find the normality of data. As data was not normally distributed hence T-test was applied to find the significance of data. P-value < 0.05 was considered as *momentous* value.

RESULTS

A total of 100 participants were included in the study, with a gender distribution of 53% females and 47% males. The participants were divided equally into two groups: the "First" group, comprising individuals not using systemic steroids, and the "Second" group, consisting of individuals on systemic steroid therapy. Descriptive statistics revealed that the First group had Schirmer test scores ranging from 12 to 18, with a mean of 14.32 ± 1.56, indicating relatively stable and higher tear production with lower variability. In contrast, the Second group presented with Schirmer test scores ranging from 5 to 14, with a significantly lower mean of 9.24 ± 2.45, suggesting impaired tear production and greater variability in measurements. The Mann-Whitney U test was employed to assess the difference in tear production between the two groups. The results demonstrated a statistically significant difference in Schirmer test distributions ($U = 91.5$, standardized test statistic = -8.027, $p < 0.001$), confirming that participants using systemic steroids had significantly lower median tear production. Mean ranks further supported this observation, with the First group showing a higher mean rank of 73.67 compared to 27.33 for the Second group. To validate the findings, an independent samples t-test was also performed. Levene's test indicated unequal variances ($F = 12.12$, $p = 0.001$), but the t-test still showed a highly significant difference between the two groups ($t = 12.39$, $p < 0.001$). The mean difference in Schirmer test scores was 5.08 ± 0.41, emphasizing a clinically relevant reduction in tear production among systemic steroid users. These findings confirm a significant impairment in tear film stability among individuals receiving systemic steroids when compared to those not on steroid therapy.

Table 1: Comparison of Schirmer Test Scores Between Steroid and Non-Steroid User Groups

Study Group		N	Minimum	Maximum	Mean	Std. Deviation
Schirmer Test	First	50	12	18	14.32	1.558
	Second	50	5	14	9.24	2.446

Table 2: Gender Distribution of Study Participants

	Frequency	Percent	Valid Percent	Cumulative Percent
Female	53	53.0	53.0	53.0
Male	47	47.0	47.0	100.0
Total	100	100.0	100.0	

Table 3: Independent-Samples Mann-Whitney U Test Summary

Total N	100
Mann-Whitney U	91.500
Wilcoxon W	1366.500
Test Statistic	91.500
Standard Error	144.330
Standardized Test Statistic	-8.027
Asymptotic Sig. (2-sided test)	0.000

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Table 4: Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means				
Schirmer Test	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	12.12	0.001	12.39	98	0.000	5.08	0.41
Equal variances not assumed			12.39	83.13	0.000	5.08	0.41

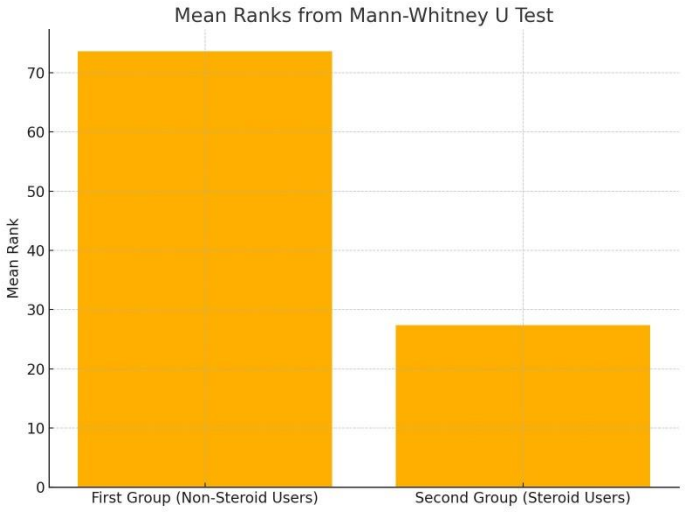

Figure 1 Mean Ranks from Mann-Whitney U Test

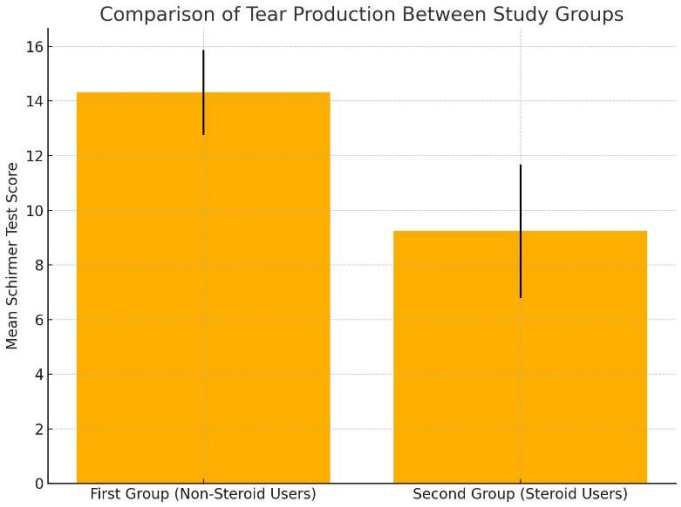

Figure 2 Comparison of Tear Production Between Study Groups

DISCUSSION

The findings of this study indicated a statistically and clinically significant reduction in tear production among individuals using systemic steroids, as demonstrated by lower Schirmer test values and greater variability compared to non-steroid users. The mean Schirmer score in the steroid group was notably reduced, highlighting the potential impact of systemic corticosteroids on tear film homeostasis. These results are aligned with previous investigations suggesting that corticosteroids, through their immunosuppressive and anti-inflammatory mechanisms, can reduce lacrimal gland output and destabilize tear film integrity (13). Comparative analysis with earlier studies further reinforces the current findings. In one investigation, patients with seasonal allergic conjunctivitis receiving topical corticosteroids exhibited alterations in tear meniscus area and corneal thickness, with statistically significant differences post-treatment. Although topical administration was used, the physiological implications on tear dynamics resonate with those observed in systemic administration, particularly in terms of reduced tear volume and altered ocular surface parameters (14,15). Another study assessing the influence of oral contraceptives on androgen levels and tear parameters reported a significant decline in tear secretion and tear film stability among users, mirroring the tear film suppression noted in the present research (16,17). Additionally, long-term application of low-dose topical corticosteroids in patients with Sjögren's syndrome demonstrated control over dry eye symptoms, though without significant difference in Schirmer scores across treatment types, implying that both systemic and local steroid exposure could have variable impacts on different ocular metrics (18,19).

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The strength of this study lies in its randomized controlled design and the use of both parametric and non-parametric statistical methods, enhancing the reliability and robustness of the findings. Moreover, standardized objective tools such as the Schirmer test and slit-lamp examination were utilized for clinical assessment, allowing reproducibility and comparability with prior literature (20). The sample size was adequate and gender distribution balanced, which supports generalizability to some extent. However, the study also has limitations. The use of a non-probability convenience sampling technique may have introduced selection bias, and the absence of detailed information regarding the duration, dosage, and indication of systemic steroid use limits the depth of interpretation. Furthermore, the study did not stratify results based on potential confounding variables such as age subgroups, comorbidities, environmental exposures, or duration of digital screen use, which are known contributors to tear film instability.

The implications of these findings are clinically relevant. They underscore the importance of careful ophthalmic evaluation before initiating systemic corticosteroid therapy, especially in patients predisposed to or symptomatic of dry eye disease. Integrating ocular surface assessments such as Schirmer testing into routine evaluation protocols for patients scheduled to receive systemic steroids may help preemptively identify and manage tear film disturbances. Future research should aim to incorporate longitudinal follow-up to monitor changes in tear film parameters over time with varying steroid regimens. Inclusion of multimodal diagnostic tools, along with hormonal profiling and lifestyle assessments, would enhance the understanding of the interplay between systemic medications and ocular surface health. Furthermore, evaluating protective or mitigating interventions—such as tear substitutes or lipid-enhancing therapies—in patients requiring long-term steroid use could help optimize both systemic and ocular outcomes. In conclusion, the current study substantiates the association between systemic steroid use and reduced tear production, contributing to the growing body of evidence on medication-induced ocular surface disorders. It reinforces the necessity for vigilant ocular monitoring in systemic therapy protocols and highlights an important, yet often overlooked, aspect of patient care.

CONCLUSION

This study concluded that systemic steroid use is significantly associated with reduced tear film stability, as evidenced by notably lower tear production in users compared to non-users. The findings highlight a clear and clinically meaningful difference in ocular surface health between the two groups. These results underscore the importance of evaluating tear film function prior to initiating systemic steroid therapy, especially in patients at risk of dry eye disease. The study contributes to growing clinical awareness regarding the ocular side effects of systemic medications and supports the integration of routine ocular assessments into broader systemic treatment protocols to ensure comprehensive patient care.

AUTHOR CONTRIBUTION

Author	Contribution
Areej Chaudhary*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Ummara Shafiq	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Tahir Shaukat	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published

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