JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

https://doi.org/10.61919/bhnh1y89

Original Article

Evaluating Knowledge, Attitudes, and Practices of Patients on Lifestyle Factors Associated with Dry Eye Disease

Malaika Chohan[1], Waqas Akram[1], Burhan Ahmed Khan[1], Ch. Muhammad Kashif[1], Mahtab Ahmad Khan[1], Ali Akhtar[1]*

[1] [1]Faculty of Pharmaceutical Sciences, University of Central Punjab, Lahore, Pakistan

***Corresponding author: Ali Akhtar, aliakhtar5657@gmail.com**

"Cite this Article" Received: 08 March 2026; **Accepted**: 29 April 2026; **Published**: 11 May 2026

Author Contributions: Concept: MC, WA; Design: BAK, CMK; Data Collection: MAK; Analysis: AA; Drafting: MC, WA, BAK, CMK, MAK, AA. **Ethical Approval**: University of Central Punjab, Lahore, Pakistan. **Informed Consent**: Written informed consent was obtained from all participants; **Conflict of Interest**: The authors declare no conflict of interest. **Funding**: No external funding; **Data Availability**: Available from the corresponding author on reasonable request; **Acknowledgments**: N/A.

ABSTRACT

Background: Dry eye disease is a multifactorial ocular surface disorder influenced by tear-film instability, inflammation, visual discomfort, and modifiable lifestyle factors such as prolonged screen exposure, poor sleep quality, smoking, physical inactivity, environmental exposure, and dietary habits. Objective: This study aimed to assess knowledge, attitudes, and practices regarding lifestyle-related dry eye disease among diagnosed adult patients and to examine associations between KAP domains and selected demographic, clinical, and behavioral characteristics. Methods: A cross-sectional observational study was conducted from 1 February 2026 to 1 April 2026 among adults aged 18–70 years diagnosed with dry eye disease. Data were collected using a structured 43-item questionnaire covering demographic characteristics, knowledge, attitudes, and practices. Of 535 enrolled participants, 529 valid responses were analyzed. Descriptive statistics, group comparisons, Pearson correlation analysis, and path analysis were performed. Results: The mean knowledge, attitude, and practice scores were 22.22 ± 4.078, 19.04 ± 2.547, and 22.50 ± 5.339, respectively. Knowledge was significantly associated with attitude ($r = 0.184$, $p < 0.001$), while attitude was weakly but significantly associated with practice ($r = 0.098$, $p = 0.024$). Knowledge was not significantly associated with practice ($r = -0.051$, $p = 0.239$). Path analysis showed significant effects of age, DED exposure among relatives or friends, daily exercise, gender, knowledge, and attitude on KAP domains. Conclusion: Participants showed uneven knowledge, generally favorable attitudes, and variable preventive practices, indicating that education alone may be insufficient without structured behavioral support. Keywords: Dry eye disease, lifestyle factors, knowledge, attitude, practice, screen exposure, patient education.

INTRODUCTION

Dry eye disease (DED) is a multifactorial disorder of the ocular surface characterized by tear-film instability, ocular discomfort, visual disturbance, and inflammatory damage to the ocular surface, with potential impairment of daily functioning and quality of life when symptoms persist or progress (1). Globally, the reported prevalence of DED varies widely, ranging from approximately 5% to 50%, reflecting differences in diagnostic criteria, population characteristics, environmental exposure, and symptom-based versus sign-based assessment methods (2). In Pakistan, DED has also emerged as a relevant public-health and clinical concern, with reported prevalence around 18.7%, and its burden may be intensified by aging, sleep disturbance, environmental pollution, screen exposure, and changing lifestyle behaviors (3,4). Because DED can interfere with reading, driving, screen-based work, occupational productivity, and overall visual comfort, prevention and self-management strategies are increasingly important alongside pharmacological and clinical treatment approaches (5).

Recent evidence suggests that DED should not be viewed only as an isolated ocular disorder but also as a condition influenced by modifiable lifestyle factors. Prolonged use of visual display terminals, reduced blinking during screen exposure, inadequate or poor-quality sleep, physical inactivity, smoking, long-term contact lens use, poor eye-makeup practices, insufficient hydration, dietary imbalance, and exposure to air pollution have all been implicated in tear-film dysfunction or worsening ocular-surface symptoms (4,6,7). In urban Pakistani settings, environmental exposures such as smog and air pollution may further aggravate ocular irritation and tear-film instability, creating an important local context for studying lifestyle-related DED (8). At the same time, protective behaviors such as regular physical activity, planned screen breaks, sleep optimization, adequate hydration, ocular hygiene, smoking avoidance, and dietary intake of nutrients such as omega-3 fatty acids and antioxidant vitamins may contribute to symptom reduction and improved tear-film stability in selected patients (9,10).

Despite increasing recognition of lifestyle-related risk factors, effective prevention depends not only on clinical diagnosis but also on patients' knowledge, attitudes, and daily practices. The knowledge–attitude–practice framework is widely used in health research to assess whether individuals understand a condition, perceive its risk and preventability appropriately, and translate awareness into protective behaviors (11). In DED, this framework is particularly relevant because many recommended behaviors, such as limiting continuous screen exposure, improving sleep routines, maintaining eyelid hygiene, modifying diet, avoiding smoke exposure, and seeking timely care, require sustained patient engagement rather than one-time treatment. However, patients may experience ocular symptoms without recognizing lifestyle contributors, and favorable attitudes toward eye health may not necessarily translate into consistent preventive practices. This disconnect can limit the effectiveness of routine counseling and delay behavioral modification.

Existing literature has examined the epidemiology, clinical features, diagnostic approaches, and treatment options for DED, but fewer studies have specifically evaluated how patients understand and respond to lifestyle-related contributors to the disease. Recent KAP-based research has highlighted gaps in patient awareness regarding lifestyle-related dry eye, yet local evidence from Pakistan remains limited, particularly among diagnosed adults recruited from community, hospital, and university-linked settings (12). This gap is important because educational interventions and counseling strategies are most effective when they are informed by the specific misconceptions, attitudes, and behavioral barriers present in the target population. Identifying demographic and lifestyle factors associated with KAP scores may also help clinicians target counseling toward groups with lower awareness or weaker preventive behaviors.

Therefore, this cross-sectional study was designed to assess knowledge, attitudes, and practices regarding lifestyle-related dry eye disease among adults diagnosed with DED and to examine whether demographic and behavioral characteristics are associated with KAP scores. The study specifically addresses the research question: among adult patients with dry eye disease, what is the level of knowledge, attitude, and practice regarding lifestyle-related risk factors and preventive behaviors, and how are these domains associated with participant characteristics such as education, income, smoking status, physical activity, and prior exposure to DED among relatives or friends?

MATERIALS AND METHODS

This cross-sectional observational study was conducted among adults diagnosed with dry eye disease to assess their knowledge, attitudes, and practices regarding lifestyle-related factors associated with dry eye disease. The study was carried out in community, ophthalmology hospital, and university-linked settings in Lahore, Pakistan, from 1 February 2026 to 1 April 2026. A cross-sectional design was selected because it allowed simultaneous assessment of participants' demographic characteristics, lifestyle exposures, and KAP domains at a single point in time, making it suitable for identifying patterns of awareness, perceptions, and preventive behaviors among patients with diagnosed dry eye disease.

Eligible participants were adults aged 18 to 70 years who had been diagnosed with dry eye disease by an experienced ophthalmologist, were able to understand and complete the questionnaire, and were willing to undergo the required eye-related assessment procedures. Participants who did not provide informed consent or submitted incomplete or invalid questionnaire responses were excluded from the final analysis. Participants were recruited from the selected study settings using a structured approach, and all eligible individuals were informed about the purpose of the study, the voluntary nature of participation, confidentiality of responses, and their right to withdraw at any stage without any effect on their care or academic status. Written informed consent was obtained before data collection.

Data were collected using a structured questionnaire developed after reviewing relevant literature and expert recommendations on patients' knowledge, attitudes, and practices regarding lifestyle-related dry eye disease. The questionnaire was prepared in English and consisted of five dimensions with 43 items, including demographic and lifestyle characteristics, knowledge-related items, attitude-related items, and practice-related items. The demographic section collected information on age, gender, residence, education level, employment status, monthly household income, smoking status, alcohol use, history of dry eye disease among relatives or friends, presence of other eye diseases, sleep disorders, makeup habits, and regular physical exercise. The knowledge section assessed participants' awareness of dry eye disease, lifestyle-related risk factors, symptoms, prevention, and the potential role of lifestyle modification. The attitude section assessed participants' perceptions regarding the importance of lifestyle behaviors, screen exposure, diet, hydration, and preventive care in dry eye disease. The practice section evaluated routine behaviors related to eye care, screen-use habits, diet, reminders for healthy eye practices, physical activity, and other preventive actions.

Responses were scored according to predefined scoring rules for each KAP domain. Knowledge items were scored according to the level of awareness, with higher scores indicating greater knowledge. Attitude and practice items were assessed using Likert-type response categories, with item scoring applied according to the direction of each question so that total domain scores reflected the intended construct. Domain scores were calculated by summing the item scores within each section. Participants' KAP scores were then categorized into predefined levels to describe inadequate, moderate, or adequate knowledge; negative, neutral, or positive attitudes; and negative, moderate, or positive practices. A score exceeding 70% of the maximum possible score for a domain was considered indicative of adequate knowledge, encouraging attitude, or positive practice, respectively.

The main study variables were knowledge, attitude, and practice scores related to lifestyle-associated dry eye disease. Independent variables included demographic characteristics, socioeconomic factors, behavioral factors, and clinical or exposure-related variables, including education level, income, smoking status, alcohol use, sleep disorder status, makeup habits, regular physical exercise, and history of dry eye disease among relatives or friends. Dry eye disease status was defined on the basis of diagnosis by an experienced ophthalmologist. Regular physical exercise, smoking, alcohol use, sleep disorder status, makeup habits, and prior exposure to dry eye disease through relatives or friends were recorded as self-reported categorical variables. The primary outcomes were total knowledge, attitude, and practice scores, while secondary outcomes included associations between these scores and participant characteristics, as well as correlations among the three KAP domains.

Several steps were used to reduce bias and improve data quality. The questionnaire was structured uniformly for all participants to minimize interviewer- or setting-related variation. Eligibility criteria were applied before enrollment to ensure that the study population consisted of adults with diagnosed dry eye disease. Incomplete responses and responses completed in an invalid manner were excluded from analysis. The questionnaire items were developed with reference to prior KAP work and expert input to improve content relevance. Data were reviewed before analysis for completeness, coding accuracy, and plausibility. Potential confounding was addressed analytically by examining demographic

and behavioral variables in relation to KAP scores and by including relevant variables in path analysis to explore direct and indirect relationships among participant characteristics and KAP domains.

The sample size was calculated using the standard formula for cross-sectional studies, based on a 95% confidence level, an assumed variability of 50%, and an acceptable margin of error. Additional participants were targeted to compensate for possible incomplete or invalid responses. A total of 535 participants were enrolled, and 529 valid responses were included in the final analysis after excluding invalid questionnaires, yielding a response validity rate of approximately 98.87%.

Data were analyzed using descriptive and inferential statistical methods. Categorical variables were summarized as frequencies and percentages, while continuous variables were summarized as mean and standard deviation when normally distributed. The distribution of continuous KAP scores was assessed before group comparisons. For two-group comparisons, independent-samples t-tests were used for normally distributed data, while the Mann–Whitney U test was used for non-normally distributed data. For comparisons involving more than two groups, analysis of variance was applied where assumptions were satisfied. Associations between categorical participant characteristics and KAP scores were examined using appropriate comparative tests according to the number of groups and distribution of the data. Pearson correlation analysis was used to assess relationships among knowledge, attitude, and practice scores. Path analysis was performed to examine direct and indirect relationships between demographic or behavioral factors and KAP domains, including potential mediation pathways among knowledge, attitude, and practice. Variables showing meaningful associations in preliminary analyses, along with theoretically relevant demographic and behavioral factors, were considered for model fitting. Non-significant paths were removed during model refinement, and modification indices were used to improve model specification where appropriate.

Ethical approval for the study was obtained from the Ethics Committee, Office of Research Innovation and Commercialization, University of Central Punjab, Lahore. All participants provided written informed consent before completing the questionnaire. Participation was voluntary, and participants were informed that they could withdraw at any time without penalty. Data were collected anonymously and handled confidentially. Access to the dataset was restricted to the research team, and analyses were conducted using coded data to preserve participant privacy and ensure data integrity.

RESULTS

A total of 535 participants were enrolled, of whom 529 provided valid responses and were included in the final analysis, giving a response validity rate of 98.87%. The study population was predominantly male, with 371 males (70.1%) and 158 females (29.9%). Most participants were from urban areas (87.0%), had completed graduation-level education (87.9%), and were either unemployed (48.4%) or students (46.5%). Nearly half of the participants reported a monthly household income below 50,000 PKR (45.0%), while 42.5% reported an income between 100,000 and 200,000 PKR. Most participants had never smoked (95.8%) or consumed alcohol (98.3%). A history of dry eye disease among relatives or friends was reported by 341 participants (64.5%), while 32 participants (6.0%) reported other eye diseases and 40 participants (7.6%) reported sleep disorders. Regular physical exercise was reported by 341 participants (64.5%), and makeup habits were reported by 137 participants (25.9%).

Table 1. Baseline Characteristics of Study Participants

Variable	Category	n (%)
Gender	Male	371 (70.1)
	Female	158 (29.9)
Residence	Rural	30 (5.7)
	Urban	460 (87.0)
	Suburban	39 (7.4)
Education level	Primary education	7 (1.3)
	Secondary	51 (9.6)
	Graduation	465 (87.9)

Variable	Category	n (%)
	Post-graduation	6 (1.1)
Employment status	Employed	20 (3.8)
	Unemployed	256 (48.4)
	Housewife	7 (1.3)
	Student	246 (46.5)
Monthly household income	<50,000 PKR	238 (45.0)
	50,000–100,000 PKR	52 (9.8)
	100,000–200,000 PKR	225 (42.5)
	>200,000 PKR	14 (2.6)
Smoking status	Former smoker, now quit	10 (1.9)
	Current smoker	12 (2.3)
	Never smoked	507 (95.8)
Alcohol status	Former drinker, now abstinent	7 (1.3)
	Current drinker	2 (0.4)
	Never drank	520 (98.3)
DED in relatives/friends	Yes	341 (64.5)
	No	110 (20.8)
	Not clear	78 (14.7)
Other eye diseases	Yes	32 (6.0)
	No	497 (94.0)
Sleep disorders	Yes	40 (7.6)
	No	489 (92.4)
Makeup habits	Yes	137 (25.9)
	No	392 (74.1)
Regular physical exercise	Yes	341 (64.5)
	No	188 (35.5)

The mean knowledge, attitude, and practice scores were 22.22 ± 4.078, 19.04 ± 2.547, and 22.50 ± 5.339, respectively. Knowledge scores differed significantly across gender, residence, education level, employment status, monthly household income, smoking status, alcohol status, DED history among relatives or friends, sleep disorders, makeup habits, and regular physical exercise. Male participants had a higher mean knowledge score than female participants (22.95 ± 3.824 vs. 20.51 ± 4.154, $p = 0.013$). Urban residents had higher knowledge scores than rural and suburban participants, with mean values of 22.48 ± 3.782, 19.17 ± 5.382, and 21.54 ± 5.246, respectively ($p < 0.001$). Participants with graduation-level education had the highest knowledge score among education groups (22.51 ± 3.807), while post-graduates had the lowest score (15.17 ± 4.708; $p < 0.001$). Participants reporting DED among relatives or friends had higher knowledge scores than those without such exposure or those who were unsure (23.33 ± 3.496 vs. 20.06 ± 3.390 and 20.42 ± 5.327; $p < 0.001$).

Table 2. Knowledge, Attitude, and Practice Scores by Sociodemographic Characteristics

Variable	Category	Knowledge, Mean ± SD	p-value	Attitude, Mean ± SD	p-value	Practice, Mean ± SD	p-value
Overall score	Total	22.22 ± 4.078	—	19.04 ± 2.547	—	22.50 ± 5.339	—
Gender	Male	22.95 ± 3.824	0.013	18.85 ± 2.201	<0.001	23.84 ± 4.752	0.669
	Female	20.51 ± 4.154		19.50 ± 3.178		19.35 ± 5.330	
Residence	Rural	19.17 ± 5.382	<0.001	20.40 ± 4.576	<0.001	23.33 ± 5.241	<0.001
	Urban	22.48 ± 3.782		19.05 ± 2.150		22.60 ± 5.322	
	Suburban	21.54 ± 5.246		17.92 ± 3.950		20.62 ± 5.359	
Education level	Primary education	15.43 ± 1.272	<0.001	22.86 ± 5.429	<0.001	24.71 ± 7.697	<0.001
	Secondary	21.35 ± 4.967		18.84 ± 3.728		21.41 ± 4.566	
	Graduation	22.51 ± 3.807		19.00 ± 2.287		22.62 ± 5.388	
	Post-graduation	15.17 ± 4.708		19.17 ± 2.137		19.50 ± 2.258	
Employment status	Employed	17.15 ± 4.511	0.007	19.10 ± 5.684	<0.001	20.25 ± 4.876	<0.001
	Unemployed	24.85 ± 3.217		18.95 ± 1.938		21.24 ± 2.707	
	Housewife	17.71 ± 5.851		20.00 ± 3.958		19.00 ± 2.380	
	Student	20.03 ± 2.817		19.10 ± 2.673		24.09 ± 6.847	
Monthly household income	<50,000 PKR	20.69 ± 2.660	<0.001	18.77 ± 2.143	<0.001	23.85 ± 6.689	<0.001
	50,000–100,000 PKR	16.92 ± 3.613		19.58 ± 5.578		21.71 ± 6.207	
	100,000–200,000 PKR	25.20 ± 2.832		19.16 ± 1.575		21.20 ± 2.211	
	>200,000 PKR	20.14 ± 6.620		19.86 ± 3.394		23.36 ± 6.380	

Attitude scores also varied significantly across several participant characteristics. Rural participants had the highest mean attitude score (20.40 ± 4.576), followed by urban participants (19.05 ± 2.150) and

suburban participants (17.92 ± 3.950; p < 0.001). Participants with primary education had the highest attitude score (22.86 ± 5.429), while those with secondary and graduation-level education had lower mean scores of 18.84 ± 3.728 and 19.00 ± 2.287, respectively (p < 0.001). Attitude scores also differed significantly by employment status and monthly household income, indicating that socioeconomic and occupational characteristics were associated with variation in perceptions toward lifestyle-related DED.

Practice scores differed significantly across residence, education, employment, and monthly income groups. Students had the highest mean practice score among employment groups (24.09 ± 6.847), whereas housewives had the lowest mean practice score (19.00 ± 2.380; p < 0.001). In income categories, participants earning less than 50,000 PKR had the highest practice score (23.85 ± 6.689), while those earning 100,000–200,000 PKR had the lowest practice score (21.20 ± 2.211; p < 0.001).

Smoking status, alcohol status, history of DED among relatives or friends, sleep disorders, makeup habits, and regular physical exercise showed notable differences in KAP scores. Participants who had never smoked had higher knowledge scores (22.44 ± 3.885) than current smokers (17.17 ± 5.766) and former smokers (17.30 ± 4.762; p < 0.001). Participants who never consumed alcohol had higher knowledge scores (22.33 ± 4.010) than former drinkers (17.57 ± 3.207) and current drinkers (12.00 ± 2.828; p < 0.001). Participants reporting regular physical exercise had higher knowledge and practice scores than those who did not exercise regularly, with knowledge scores of 23.23 ± 3.708 versus 20.40 ± 4.093 and practice scores of 23.86 ± 4.604 versus 20.02 ± 5.691.

Table 3. Knowledge, Attitude, and Practice Scores by Behavioral and Clinical Characteristics

Variable	Category	Knowledge, Mean ± SD	p-value	Attitude, Mean ± SD	p-value	Practice, Mean ± SD	p-value
Smoking status	Former smoker, now quit	17.30 ± 4.762	<0.001	20.10 ± 6.674	<0.001	21.70 ± 4.373	<0.001
	Current smoker	17.17 ± 5.766		19.25 ± 5.137		20.58 ± 6.585	
	Never smoked	22.44 ± 3.885		19.02 ± 2.319		22.56 ± 5.325	
Alcohol status	Former drinker, now abstinent	17.57 ± 3.207	<0.001	20.57 ± 7.913	<0.001	21.29 ± 4.821	<0.001
	Current drinker	12.00 ± 2.828		21.00 ± 1.414		22.50 ± 6.364	
	Never drank	22.33 ± 4.010		19.01 ± 2.413		22.57 ± 5.351	
DED with relatives/friends	Yes	23.33 ± 3.496	<0.001	18.75 ± 1.599	<0.001	24.07 ± 4.513	<0.001
	No	20.06 ± 3.390		19.66 ± 3.033		18.05 ± 4.885	
	Not clear	20.42 ± 5.327		19.44 ± 4.368		21.91 ± 5.673	
Other eye diseases	Yes	16.53 ± 3.689	0.426	19.56 ± 5.628	<0.001	20.56 ± 5.758	0.545
	No	22.59 ± 3.824		19.01 ± 2.215		22.62 ± 5.293	
Sleep disorders	Yes	18.25 ± 5.042	0.043	19.45 ± 5.922	<0.001	21.90 ± 7.489	<0.001
	No	22.55 ± 3.816		19.01 ± 2.050		22.55 ± 5.139	
Makeup habits	Yes	21.04 ± 3.447	<0.001	19.74 ± 3.000	0.004	19.10 ± 5.272	0.336
	No	22.64 ± 4.203		18.80 ± 2.323		23.68 ± 4.835	
Regular physical exercise	Yes	23.23 ± 3.708	0.047	18.72 ± 1.394	<0.001	23.86 ± 4.604	0.416
	No	20.40 ± 4.093		19.62 ± 3.776		20.02 ± 5.691	

In the item-level knowledge domain, the highest uncertainty was observed for lifestyle-related disease improvement and lifestyle-associated risk factors. A substantial proportion of participants selected “not clear” for whether dry eye symptoms or signs may improve or resolve after lifestyle modification. Participants also showed uncertainty regarding lifestyle behaviors associated with dry eye, including prolonged visual display terminal use, insufficient or poor-quality sleep, chronic late nights, long-term contact lens wear, poor eye-makeup habits, smoking, unprotected outdoor activities, and prolonged driving. These findings indicate that although overall participants had measurable awareness of DED, specific knowledge of modifiable lifestyle contributors was less consistent.

In the attitude domain, most participants recognized lifestyle exposure as clinically relevant to dry eye disease. A total of 88.3% of participants strongly agreed or agreed that prolonged electronic screen use was a major cause of their dry eye symptoms, while 10.2% remained neutral. In relation to diet, 74.5% strongly agreed or agreed that changing dietary habits to include omega-3-rich foods, such as soybeans, beef, eggs, deep-sea fish, walnuts, and flaxseeds, is beneficial for preventing dry eye, whereas 24.8%

remained neutral. These responses indicate generally favorable attitudes toward lifestyle modification, although uncertainty persisted for some dietary and preventive concepts.

In the practice domain, several gaps were observed between positive attitudes and routine preventive behavior. Overall, 28.7% of participants strongly agreed or agreed that they seldom changed their eye habits despite experiencing ocular discomfort. In addition, 41.2% disagreed or strongly disagreed that they used strategies to remind themselves to maintain healthy eye habits, and 24.2% disagreed or strongly disagreed that they used strategies to remind themselves to take proper care of their eyes. These findings suggest that reminder-based and habit-forming practices were not consistently adopted, even where participants recognized lifestyle-related contributors to dry eye disease.

Correlation analysis showed a weak positive association between knowledge and attitude scores ($r = 0.184$, $p < 0.001$). Knowledge and practice scores had a weak negative, statistically non-significant association ($r = -0.051$, $p = 0.239$). Attitude and practice scores showed a weak positive but statistically significant association ($r = 0.098$, $p = 0.024$). These findings indicate that better knowledge was associated with more favorable attitudes, while attitudes had a small but significant relationship with preventive practices.

Table 4. Correlation Analysis Between Knowledge, Attitude, and Practice Scores

Domain Pair	Correlation Coefficient (r)	p-value
Knowledge–Attitude	0.184	<0.001
Knowledge–Practice	-0.051	0.239
Attitude–Practice	0.098	0.024

Path analysis further evaluated direct and indirect relationships between participant characteristics and KAP domains. Age had a significant negative total effect on knowledge (β = -0.144, 95% CI: -0.227 to -0.060; $p < 0.001$), attitude (β = -0.165, 95% CI: -0.246 to -0.081; $p < 0.001$), and practice (β = -0.138, 95% CI: -0.221 to -0.054; $p = 0.001$). Having relatives or friends with DED also showed significant negative total effects on knowledge (β = -0.326, 95% CI: -0.400 to -0.248; $p < 0.001$), attitude (β = -0.131, 95% CI: -0.214 to -0.046; $p = 0.003$), and practice (β = -0.279, 95% CI: -0.356 to -0.199; $p < 0.001$). Knowledge had a significant positive effect on attitude (β = 0.184, 95% CI: 0.100 to 0.265; $p < 0.001$), while attitude had a significant positive effect on practice (β = 0.098, 95% CI: 0.013 to 0.182; $p = 0.024$). Knowledge did not show a statistically significant effect on practice (β = -0.051, 95% CI: -0.136 to 0.034; $p = 0.239$). Daily exercise and gender showed significant effects on practice, with β values of -0.345 and -0.385, respectively, both with $p < 0.001$.

Table 5. Path Analysis of Factors Associated With Knowledge, Attitude, and Practice Scores

Model Path	Standardized Total Effect β	95% CI	p-value
Age → Knowledge	-0.144	-0.227 to -0.060	<0.001
DED in relatives/friends → Knowledge	-0.326	-0.400 to -0.248	<0.001
Age → Attitude	-0.165	-0.246 to -0.081	<0.001
DED in relatives/friends → Attitude	-0.131	-0.214 to -0.046	0.003
Smoking → Attitude	-0.057	-0.142 to 0.028	0.189
Education → Attitude	-0.082	-0.166 to 0.003	0.059
Knowledge → Attitude	0.184	0.100 to 0.265	<0.001
Age → Practice	-0.138	-0.221 to -0.054	0.001
DED in relatives/friends → Practice	-0.279	-0.356 to -0.199	<0.001
Smoking → Practice	0.045	-0.041 to 0.130	0.303
Education → Practice	0.006	-0.079 to 0.091	0.894
Knowledge → Practice	-0.051	-0.136 to 0.034	0.239
Daily exercise → Practice	-0.345	-0.418 to -0.267	<0.001
Gender → Practice	-0.385	-0.456 to -0.310	<0.001
Attitude → Practice	0.098	0.013 to 0.182	0.024

Overall, the results showed that participants had measurable but uneven knowledge of lifestyle-related DED, generally favorable attitudes toward lifestyle modification, and variable preventive practices. The strongest descriptive differences in knowledge were observed across education, income, smoking status, alcohol status, exposure to DED among relatives or friends, and regular physical exercise. The correlation findings indicated that knowledge was more closely linked with attitude than with practice,

while the path analysis suggested that practice was more strongly associated with attitude, daily exercise, gender, age, and DED exposure among relatives or friends than with knowledge alone.

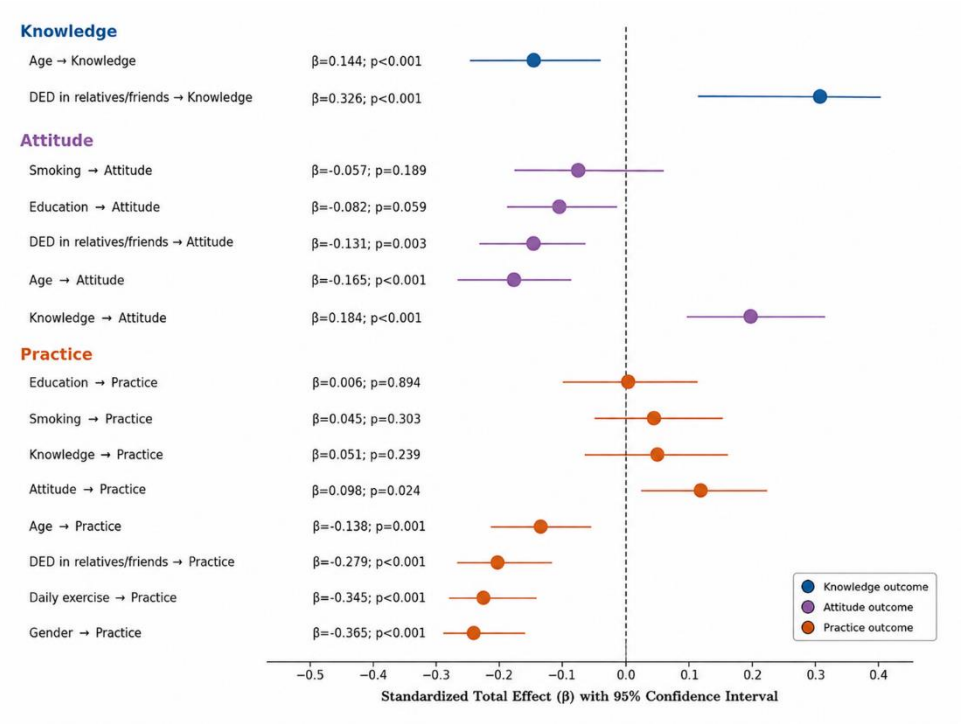

Figure 1. Standardized Pathway Effects Across Knowledge, Attitude, and Practice Domains

The strongest standardized effects were observed for practice-related pathways, particularly gender (β = -0.385, 95% CI: -0.456 to -0.310, p < 0.001), daily exercise (β = -0.345, 95% CI: -0.418 to -0.267, p < 0.001), and DED among relatives or friends (β = -0.279, 95% CI: -0.356 to -0.199, p < 0.001). Knowledge was significantly associated with attitude (β = 0.184, 95% CI: 0.100 to 0.265, p < 0.001), while attitude showed a smaller but significant association with practice (β = 0.098, 95% CI: 0.013 to 0.182, p = 0.024). In contrast, knowledge had no significant direct association with practice (β = -0.051, 95% CI: -0.136 to 0.034, p = 0.239), indicating that preventive behaviors were more strongly aligned with attitudinal and behavioral characteristics than with knowledge alone.

DISCUSSION

The present study assessed knowledge, attitudes, and practices regarding lifestyle-related dry eye disease among adults diagnosed with DED and demonstrated an important gap between awareness, perception, and routine preventive behavior. Although participants showed generally favorable attitudes toward lifestyle modification and reported some positive eye-care practices, knowledge regarding specific modifiable contributors to DED remained uneven. This pattern suggests that patients may recognize dry eye as a clinically meaningful condition but may not fully understand how daily behaviors such as prolonged screen exposure, poor sleep quality, smoking, contact lens use, eye-makeup habits, outdoor exposure, hydration, diet, and physical inactivity contribute to tear-film instability and ocular discomfort. Similar gaps have been reported in health-behavior research, where awareness of disease presence does not always translate into detailed understanding of risk mechanisms or consistent self-management behavior (13,14).

The finding that participants expressed strong agreement regarding the role of electronic screen exposure is clinically relevant, particularly in contemporary populations with high visual display terminal use. Reduced blink rate, incomplete blinking, and prolonged ocular surface exposure during screen use may aggravate tear evaporation and worsen symptoms in susceptible individuals. This aligns with evidence linking prolonged sedentary behavior and visual display terminal exposure with DED risk,

supporting the need for patient counseling that goes beyond medication and includes practical screen-hygiene strategies such as scheduled visual breaks, conscious blinking, ergonomic viewing distance, and limitation of uninterrupted screen time (15). However, uncertainty regarding the broader group of lifestyle-related risk factors indicates that counseling should not focus exclusively on screens but should also address sleep quality, smoking avoidance, diet, hydration, outdoor protection, makeup-related ocular irritation, and contact lens practices.

The weak but significant positive association between knowledge and attitude indicates that participants with higher disease-related awareness tended to hold more favorable perceptions toward lifestyle modification. This finding supports the knowledge–attitude component of the KAP framework, in which improved understanding can shape beliefs about disease prevention and self-care. Nevertheless, knowledge was not significantly associated with practice, suggesting that information alone may be insufficient to produce sustained behavioral change. This is an important clinical finding because it implies that educational interventions should be paired with practical behavior-support strategies, including reminders, simplified lifestyle checklists, patient-specific counseling, and follow-up reinforcement. Prior behavioral research similarly shows that knowledge may initiate awareness, but actual practice often depends on motivation, perceived barriers, habit formation, self-efficacy, and environmental support (16,17).

The significant relationship between attitude and practice, although weak, suggests that patients who perceive lifestyle modification as useful may be more likely to adopt preventive behaviors. This finding highlights the importance of shaping patient beliefs during clinical encounters. In DED management, clinicians can strengthen attitudes by explaining the biological plausibility of lifestyle changes in simple terms: screen breaks reduce evaporative stress, adequate sleep supports ocular surface recovery, hydration may support tear homeostasis, and dietary improvement may reduce inflammatory burden. Counseling should be individualized and behavior-oriented rather than limited to general advice. For example, instead of simply advising patients to reduce screen use, clinicians may recommend the 20-20-20 rule, blinking exercises, environmental humidification, and phone-based reminders. Smartphone-based patient-reported outcome tools and digital health interventions have shown feasibility in dry eye assessment and monitoring, making digital reminder systems a practical strategy for reinforcing preventive habits (18,19).

Participants showed favorable attitudes toward omega-3-rich dietary modification, but a substantial proportion remained neutral, reflecting uncertainty about the role of diet in DED prevention and management. Nutritional counseling may therefore be an important but underused component of dry eye care. Diets rich in omega-3 fatty acids and antioxidant vitamins have been explored for their potential role in improving tear-film stability and reducing inflammatory activity, although clinical responses vary across patients and study designs (20,21). The present findings suggest that patients may be receptive to dietary advice, but they need clear, evidence-based, and culturally appropriate explanations of what dietary changes are realistic, affordable, and clinically relevant. In Pakistani settings, dietary counseling should consider local food availability, socioeconomic variation, and patient preferences to improve adherence.

The practice findings indicate that many participants did not consistently use reminder strategies or modify eye habits despite discomfort. This gap between attitude and action is clinically important because DED is often chronic and recurrent, requiring sustained daily self-care rather than episodic symptom-driven behavior. Patients may intend to follow preventive practices but fail because of competing routines, academic or occupational screen demands, lack of structured reminders, or uncertainty about which behaviors are most effective. Short counseling sessions, printed infographics, mobile alerts, and clinic-based lifestyle checklists may help convert favorable attitudes into consistent action. Similar approaches have been used in other health-literacy and behavior-change contexts, where

simplified communication and repeated cues improve patient engagement with preventive practices (22,23).

Age showed negative associations with knowledge, attitude, and practice domains, indicating that older participants may have lower KAP scores or may require different educational approaches. Older patients may experience more severe or chronic ocular symptoms but may have less access to digital health information, lower familiarity with lifestyle-related terminology, or reduced ability to modify established routines. This finding supports the need for age-sensitive counseling materials, including verbal explanations, large-font printed instructions, caregiver involvement when appropriate, and practical demonstrations during clinical visits. Because DED prevalence often increases with age and may coexist with systemic disease, medication use, and ocular surface vulnerability, older adults represent an important priority group for targeted education (24).

Participants with DED among relatives or friends demonstrated significant associations with KAP domains, suggesting that prior exposure to the disease within social networks may influence awareness and behavior. However, exposure alone may not ensure accurate knowledge or effective practice. Patients may learn from relatives or peers but may also inherit misconceptions, incomplete advice, or symptom-normalizing attitudes. Clinicians should therefore ask patients what they already know about DED and correct misinformation during consultation. Social exposure can also be used constructively by involving family members in educational sessions, especially when lifestyle changes require household support, such as reducing smoke exposure, improving indoor air quality, or encouraging scheduled screen breaks.

Regular physical exercise was strongly associated with practice scores, emphasizing the broader relationship between health-promoting lifestyles and eye-care behavior. Individuals who engage in regular exercise may already have stronger self-regulation, better health motivation, and greater willingness to adopt preventive routines. Exercise has also been discussed as a potential supportive factor in DED through systemic anti-inflammatory effects, improved metabolic health, and associations with healthier daily behavior patterns (25,26). These findings suggest that dry eye counseling may be more effective when integrated into broader lifestyle guidance rather than presented as isolated ocular advice. Ophthalmology clinics can incorporate brief recommendations on physical activity, sleep hygiene, smoking avoidance, and screen practices as part of comprehensive DED management.

Gender showed a strong association with practice in the path model, indicating that preventive behaviors may differ between male and female participants. Gender-related differences in health-seeking behavior, symptom reporting, cosmetic exposure, occupational screen use, and adherence to self-care routines may contribute to this pattern. Because makeup habits were also associated with KAP differences, counseling should include practical guidance on safe eye cosmetics, eyelid hygiene, removal of makeup before sleep, and avoidance of products that irritate the ocular surface. Gender-sensitive education should avoid assumptions but should address behavior patterns that may be more common in particular groups, including cosmetic use, occupational exposure, and differences in care-seeking behavior (27,28).

Smoking and alcohol-related categories showed differences in descriptive KAP scores, although some path-analysis associations were not statistically significant. Smoking remains clinically relevant in DED because tobacco smoke can aggravate ocular surface irritation, oxidative stress, and inflammatory responses. Even when multivariable pathways are not statistically significant, smoking cessation counseling remains appropriate as part of general ocular and systemic health promotion. Patients who smoke may also have lower engagement with preventive behaviors, making brief, nonjudgmental counseling and referral to cessation support useful in clinical practice (29). Alcohol use was uncommon in the present sample, limiting interpretability, but lifestyle counseling should still consider hydration, sleep disruption, and general health behaviors where relevant.

Education and income were associated with differences in KAP scores, suggesting that socioeconomic context influences how patients understand and manage DED. Higher education or income may increase access to health information, but this does not always guarantee better practice. Conversely, patients with lower socioeconomic resources may face barriers such as limited clinic access, lower health literacy, crowded living conditions, environmental exposure, and reduced ability to purchase lubricants, protective eyewear, or recommended dietary items. Educational interventions should therefore be designed for accessibility, using simple language, visual aids, low-cost lifestyle recommendations, and culturally relevant examples. Health-literacy research supports the value of tailored communication for improving preventive behaviors in diverse populations (30,31).

The study has several limitations. Its cross-sectional design prevents causal interpretation, so associations between demographic factors, knowledge, attitudes, and practices should be understood as relational rather than directional proof of behavior change. The use of self-reported questionnaire responses may introduce recall bias and social desirability bias, particularly for smoking, alcohol use, exercise, screen habits, and preventive practices. The study population was dominated by urban residents and participants with graduation-level education, which may limit generalizability to rural, older, less educated, or healthcare-limited populations. In addition, KAP scores reflect reported awareness and behavior rather than objective clinical severity, tear-film parameters, or longitudinal symptom outcomes. Future research should include multicenter recruitment, validated local-language instruments, clinical severity grading, and longitudinal or interventional designs to determine whether structured lifestyle education improves both behavior and dry eye outcomes.

Overall, the findings indicate that lifestyle-related DED management requires more than clinical diagnosis and symptomatic treatment. Patients need structured, practical, and repeated education that explains modifiable risk factors and converts positive attitudes into sustainable daily behaviors. The weak direct relationship between knowledge and practice suggests that future interventions should combine information with behavior-change tools, including reminders, individualized counseling, visual materials, and follow-up reinforcement. Integrating lifestyle counseling into routine ophthalmic care may improve patient engagement, particularly among groups with lower knowledge, inconsistent practices, or higher exposure to behavioral and environmental risk factors.

CONCLUSION

This study found that adults diagnosed with dry eye disease demonstrated uneven knowledge, generally favorable attitudes, and variable preventive practices regarding lifestyle-related contributors to dry eye disease. Participants recognized the importance of common lifestyle factors such as prolonged electronic screen use and dietary modification, but uncertainty remained regarding broader modifiable risks, including sleep quality, smoking, contact lens use, eye-makeup habits, hydration, outdoor exposure, and routine behavioral prevention. Knowledge was significantly associated with attitude, and attitude was significantly associated with practice; however, knowledge did not show a significant direct relationship with practice, indicating that awareness alone may be insufficient to produce sustained preventive behavior. Practice patterns were more strongly associated with behavioral and demographic factors, including regular physical exercise, gender, age, and DED exposure among relatives or friends. These findings highlight the need for structured, patient-centered educational strategies that combine clear information with practical behavior-support tools, such as reminder systems, lifestyle checklists, screen-hygiene counseling, dietary guidance, smoking-avoidance advice, and individualized follow-up, to improve long-term self-care and preventive practices among patients with dry eye disease.

REFERENCES

1. Sheppard J, Shen Lee B, Periman LM. Dry eye disease: identification and therapeutic strategies for primary care clinicians and clinical specialists. Ann Med. 2023;55(1):241-252.

2. Stapleton F, Alves M, Bunya VY, Jalbert I, Lekhanont K, Malet F, et al. TFOS DEWS II Epidemiology Report. Ocul Surf. 2017;15(3):334-365.

3. Brito C, Lages-Alcantara H, Limeira J, Silva J, Neto S, Melo J, et al. Persistent xerophthalmia in a patient with rheumatological disease and primary Sjogren's syndrome: case report from Northern Brazil. 2023:191-196.

4. Hanyuda A, Sawada N, Uchino M, Kawashima M, Yuki K, Tsubota K, et al. Relationship between unhealthy sleep status and dry eye symptoms in a Japanese population: the JPHC-NEXT study. Ocul Surf. 2021;21:306-312.

5. Kojima T, Dogru M, Kawashima M, Nakamura S, Tsubota K. Advances in the diagnosis and treatment of dry eye. Prog Retin Eye Res. 2020;78:100842.

6. Hanyuda A, Sawada N, Uchino M, Kawashima M, Yuki K, Tsubota K, et al. Physical inactivity, prolonged sedentary behaviors, and use of visual display terminals as potential risk factors for dry eye disease: JPHC-NEXT study. Ocul Surf. 2020;18(1):56-63.

7. Ejaz Z, Masood F, Nadeem A, Ahmed A, Ahmad E, Chaudhry M. Blurred vision: the ophthalmological effect of smog in Pakistan. Dialogues Health. 2024;5:100199.

8. Kharel Sitaula R, Khatri A. Knowledge, attitude and practice of computer vision syndrome among medical students and its impact on ocular morbidity.

9. Navarro-Lopez S, Moya-Ramón M, Gallar J, Carracedo G, Aracil-Marco A. Effects of physical activity/exercise on tear film characteristics and dry eye associated symptoms: a literature review. Cont Lens Anterior Eye. 2023;46(4).

10. Asbell PA, Maguire MG, Peskin E, Bunya VY, Kuklinski EJ. Dry Eye Assessment and Management (DREAM©) Study: study design and baseline characteristics. Contemp Clin Trials. 2018;71:70-79.

11. Song K, Ye S, Li S, Wu N, Kang Z. Patients' knowledge, attitudes, and practices regarding lifestyle-related dry eye. Sci Rep. 2025;15(1):12050.

12. Lee F, Suryohusodo AA. Knowledge, attitude, and practice assessment toward COVID-19 among communities in East Nusa Tenggara, Indonesia: a cross-sectional study. Front Public Health. 2022;10.

13. Lutala P, Muula A. Brief behaviour change counselling in non-communicable diseases in Mangochi, Southern Malawi: a hypothetical acceptability study. Pilot Feasibility Stud. 2022;8(1):69.

14. Zeng X, Li Y, Lu L, Wen H, Wang G, Zuo C. A randomized controlled clinical study on Zuo's acupuncture treatment for prediabetes. Medicine (Baltimore). 2022;101(8).

15. Huang R, Su C, Fang L, Lu J, Chen J, Ding Y. Dry eye syndrome: comprehensive etiologies and recent clinical trials. Int Ophthalmol. 2022;42(10):3253-3272.

16. Messmer EM, Ahmad S, Benitez Del Castillo JM, Mrukwa-Kominek E, Rolando M, Vitovska O, et al. Management of inflammation in dry eye disease: recommendations from a European panel of experts.

17. Nagino K, Okumura Y, Akasaki Y, Fujio K, Huang T, Sung J, et al. Smartphone app-based and paper-based patient-reported outcomes using a disease-specific questionnaire for dry eye disease: randomized crossover equivalence study.

18. Nagino K, Okumura Y, Yamaguchi M, Sung J, Nagao M, Fujio K, et al. Diagnostic ability of a smartphone app for dry eye disease: protocol for a multicenter, open-label, prospective, and cross-sectional study.

19. Boydell K, Croguennec J. A creative approach to knowledge translation: the use of short animated film to share stories of refugees and mental health. Int J Environ Res Public Health. 2022;19(18):11468.

20. Mtuy TB, Mepukori J, Lankoi J, Lees S. Empowering Maasai women behind the camera: photovoice as a tool for trachoma control. Res Involv Engagem. 2021;7(1):51.

21. Mittal R, Patel S, Galor A. Alternative therapies for dry eye disease.

22. Mohamed HB, Abd El-Hamid BN, Fathalla D, Fouad EA. Current trends in pharmaceutical treatment of dry eye disease: a review. Eur J Pharm Sci. 2022;175:106206.

23. Khalid A, Haque S, Alvi S, Ferdous M, Genereux O, Chowdhury N, et al. Promoting health literacy about cancer screening among Muslim immigrants in Canada: perspectives of Imams on the role they can play in community.

24. Liao L, Feng H, Jiao J, Zhao Y, Ning H. Nursing assistants' knowledge, attitudes and training needs regarding urinary incontinence in nursing homes: a mixed-methods study. BMC Geriatr. 2023;23(1):39.

25. Heckman CJ, Wackowski OA, Mukherjee R, Hatsukami DK, Stepanov I, Delnevo CD, et al. Cigarette relighting: a series of pilot studies investigating a common yet understudied smoking behavior. Int J Environ Res Public Health. 2021;18(12):6494.

26. Li X, Kang B, Eom Y, Zhong J, Lee HK, Kim HM, et al. Comparison of cytotoxicity effects induced by four different types of nanoparticles in human corneal and conjunctival epithelial cells. Sci Rep. 2022;12(1):155.

27. Hasemann L, Lampe D, Nebling T, Thiem U, von Renteln-Kruse W, Greiner W. Effectiveness of a multi-component community-based care approach for older people at risk of care dependency: results of a prospective quasi-experimental study. BMC Geriatr. 2022;22(1):348.

28. Tiguman G, Silva M, Galvão T. Health services utilization in the Brazilian Amazon: panel of two cross-sectional studies.

29. Ward LJ, Nilsson S, Hammar M, Lindh-Åstrand L, Berin E, Lindblom H, et al. Resistance training decreases plasma levels of adipokines in postmenopausal women. Sci Rep. 2020;10(1):19837.

30. Yusefi AR, Barfar E, Daneshi S, Bayati M, Mehralian G, Bastani P. Health literacy and health promoting behaviors among inpatient women during COVID-19 pandemic. BMC Womens Health. 2022;22(1):77.

31. Millett GA. New pathogen, same disparities: why COVID-19 and HIV remain prevalent in U.S. communities of colour and implications for ending the HIV epidemic. J Int AIDS Soc. 2020;23(11):e25639.