Assessing the acceptability rate and Comparison of lutein-zeaxanthin, Omega-3, and tears eye Drops in dry Eye disease

Komal Mushtaq*, Nimra Gul*, Lubna Mushtaq, Aqsa Yousaf*, Sidra Laraib*, Hafsa Nazeer*, Shafqat Shahzad***

*The University of Faisalabad
** D.G.Khan Medical College

Abstract- To evaluate the difference in the effect of Lutein-Zeaxanthin, and Omega-3 oral supplements on evaporative dry eye. And assessing the acceptability rate of patient with oral supplements and artificial tears eye drop for the management of evaporative dry eye.A Quasi-Experimental study was conducted at the Department of Ophthalmology in DG Eye Care Hospital, Dera Ghazi Khan from September 2022 to May 2023. The sample size was calculated using a Rao-soft sample calculator by estimating the prevalence rate with a confidence interval of 95% and a margin of error of 5%. A total of 90 patients were selected. Data was collected in a questionnaire format and analyzed through SPSS software version 23. Out of 90 patients, Group 1 (Omega-3 oral supplement) had a mean value and standard deviation of n 11.17+.874, group 2 lutein-zeaxanthin oral supplement had a mean value and standard deviation of 9.53+.730 and group 3 artificial tears eye drop had a mean value of 10.57+.165. The overall results showed that a significant difference of p=0.00 ($p<0.05$) was present between the omega-3 oral supplement with the lutein-zeaxanthin oral supplement and artificial tears eye Drop, with a slightly significant value of p=0.046 ($p<0.05$). The lutein-zeaxanthin oral supplement showed a significant difference of p=0.000 and p=0.000 with other treatments. Meanwhile, the artificial tears eye drop showed a difference of p=0.046 ($p<0.05$) with the omega-3 oral supplement. The overall results showed that a significant difference of p=0.00 ($p<0.05$) was present. The study showed omega-3 was more effective, and artificial tear eye drops had a minimal difference in effectiveness compared to omega-3 fatty acids, which showed remarkable potential in decreasing the symptoms associated with dry eye.

Index Terms- Dry Eye, Lutein-Zeaxanthin, Omega-3, tears Eye Drop

I. Introduction

The Dry eye or dry eye syndrome is a multifactorial condition of the ocular surface and is characterized by an unstable tear film that may also result in ocular surface damage. The accompanied symptoms include double vision, dry eyes, eyestrain, fatigue, irritation, a burning sensation, redness, decreased visual acuity, and ocular discomfort [1].

The two most common types of dry eye disease are aqueous deficit dry eye and evaporative dry eye. Evaporative dry eye is caused by a deficient tear film lipid layer, which increases tear evaporation. Over 85% of cases of dry eye disorders have meibomian gland dysfunction, which has both a cause and an effect known as blepharitis, or inflammation of the lid margin [2]. Other blepharitis diagnoses include atopy, seborrheic skin disease, staphylococcal infection, and demodex insect infection. Around 10% of people have aqueous deficiency dry eye, while more than 80% have hyper-evaporative dry eye associated with meibomian gland dysfunction (MGD) or both [3].

The pathophysiology of the dry eye involves the accumulation of inflammatory mediators, including interleukins (IL-6, IL1, and IL-7), chemokines (CCL2), interferon, and tumor necrosis factor-alpha (TNF-alpha). These mediators contribute to the loss of goblet cells, tear film instability, hyperosmolarity, and subsequent damage to the ocular surface [4].

For the treatment of dry eye, options include wearing contact lenses, consuming foods rich in omega-3 fatty acids, lutein, and zeaxanthin, and using artificial tear products. In dry eye disease (DED), omega-3 is vital for regulating the immunological and inflammatory responses [5]. Furthermore, omega-3 prevents the synthesis of interleukin-1 and tumor necrosis factor-alpha, which are linked to dry eye disease. Meals higher in omega-3 acids, such as sharks, salmon, sardines, and other ocean fish, were once thought to help DED. The U.S.

Drug and Food Administration (FDA) has established that an appropriate daily dose of omega-3 is 3 g under the direction of a physician (3000 mg). Antioxidants such as lutein and zeaxanthin help prevent several chronic eye illnesses, including dry eye [6]. The recommended dosage is 6 mg to 30 mg once a day, and 15 to 40 mg of lutein daily can offer the best possible protection for dry eyes. They are sold as dietary supplements, such as Xanthin Plus, which has 10 mg of lutein and 2 mg of zeaxanthin. Fruits and vegetables are the primary sources of lutein, a poor diet may result in reduced intakes of lutein and zeaxanthin, which may then contribute to a low retinal pigment density [7].

Patients suffering from dry eye illnesses are still mostly treated with lubricating eye drops. Artificial tear eye drops are often buffered hypotonic or isotonic 6 solutions, used to increase the aqueous part of the tear layer as the primary line of remedy for the treatment of mild signs and they may also be used alone or in combination with other therapies depending on severity of the illness [8]. Artificial tears contain polymers, which are significant because they maintain the formulation's viscosity and help maintain the tear layers by increasing the lubrication duration. This provides lasting comfort and improves vision and duration. In the production of artificial tears, methyl, and hydroxypropyl cellulose derivatives are often used. Artificial tears made of hydroxypropyl methylcellulose (HMC) are available with and without preservatives and were recommended for use in

individuals with extremely dry eyes [9]. Artificial tears made from HMC function help in the lubrication of the eye surface and support in maintaining the stability of the surface. Artificial tears based on hydroxypropyl guar may be beneficial for individuals with evaporative dry eye diseases like meibomian gland disease as well as those who have ocular surface staining. Artificial tears made of sodium hyaluronate (SH) and polyvinyl alcohol (PVA)--based artificial tears are beneficial for several dry eye patients and are used to lubricate the eye's surface. Oil-based eye drops made of castor oil also help to regulate tears and cure meibomian gland disease [10].

Additionally, Prescription eye drops, and immunosuppressive medications with anti-inflammatory actions, such as cyclosporine eye drops (0.05– 0.2%), can lessen the signs of inflammation and eye damage to the surface. For those who cannot take cyclosporine, and have no advantages from it, tacrolimus eye drops (0.03-0.04%) are an acceptable alternative. Furthermore, making lifestyle changes, such as taking regular breaks from screen time, wearing protective eyewear outdoors, and quitting smoking, can help alleviate dry eye, and applying warm compresses to closed eyes can help stimulate tear production and alleviate dry eye discomfort [11]. Practicing blinking exercises, such as consciously blinking more frequently, can aid in distributing tears across the eyes. Creating a more humid environment, either through the use of a humidifier or by avoiding dry and windy conditions, can help maintain moisture levels. Proper eyelid hygiene, including gentle cleaning, can improve the functionality of the oil glands that contribute to tear stability.

The present study was conducted to assess the effectiveness of omega-3 fatty acids, Lutein-Zeaxanthin, oral supplements, and artificial tears eye drops for the management of evaporative dry eye along with evaluating the acceptability rate of patient with oral supplements and artificial tears eye drop for management of evaporative dry eye.

II.METHODOLOGY

A Quasi-Experimental study was carried out at the Department of Ophthalmology in DG Eye Care Hospital, Dera Ghazi Khan from September 2022 to May 2023. Non-probability convenient technique was used to collect the patient's data. This research was carried out after explaining the consequences, information, complete information, and obtaining an informed consent all required parameters were collected/noted on a self-structured proforma. After obtaining informed written and verbal consent from patients, data was collected from DG Eye Care Hospital, Dera Ghazi Khan.

A total of 90 patients of both genders ages ranging from 16 to 25 years were selected for this study. Data was obtained from the population of Evaporative Dry Eye (EDE) patients with mild and moderate ranges and evaporative. Dry Eye (Intrinsic or Extrinsic factors) using contact lenses. The tear breakup time (TBUT) and Schirmer II test, is an assessment used to check for evaporative dry eye disorder. The Schirmer test was conducted 10 minutes after the TBUT test to prevent conjunctiva-corneal stains from affecting the results.

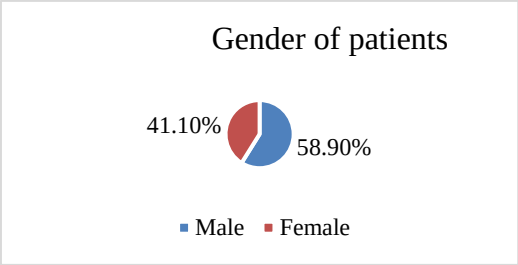
The sample size was 180 eyes of 90 patients. The OSDI provided a final score between 0 and 100, with a score between 13 and 22 denoting mild dry eye symptoms and 23 to 32 denoting moderate dry eye symptoms. The patient's verbal and written agreement/consent was acquired once they had been fully informed of the aims and design of the research. The sample size was calculated using a Rao-soft calculator with a confidence interval of 95% and a margin of error of 5%.

Patients were divided into 3 groups, lutein-zeaxanthin oral supplements with 2 mg zeaxanthin and 10 mg lutein were prescribed to 30 patients; omega-3 oral supplements with 120 mg DHA and 180 mg EPA were prescribed to 30 patients; and artificial eye drops containing 5 Ml of polyethylene glycol and propylene glycol were prescribed to 30 patients.

Data was entered and analyzed through SPSS software version 23. The result was accepted at the level of a 95% confidence interval. For repeated measures, ANOVA was used for further analysis of data.

III.RESULTS

Out of the total 90 subjects, 53 (58.9%) were male and 37 were female (41.1%), the gender distribution is shown in graph no. 1.



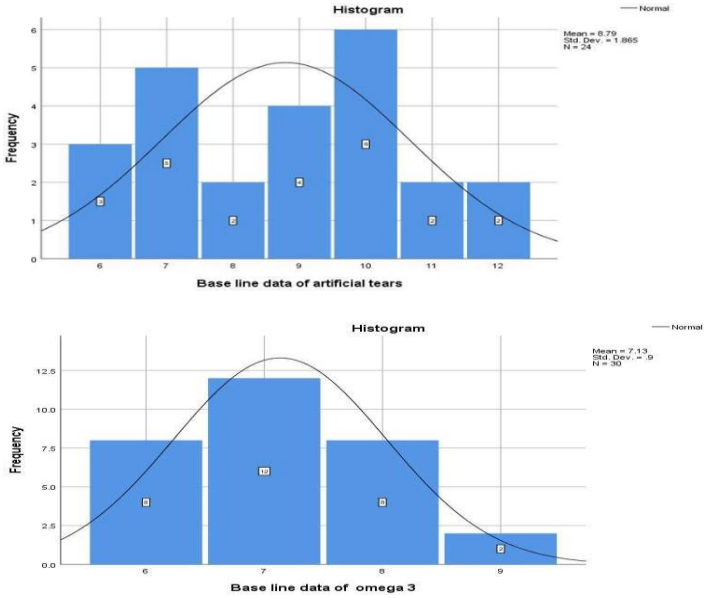
The Minimum age of the patients was recorded as 16years and the maximum 26 years, the mean was calculated as 20.48 and the standard deviation was 2.712, as shown in Table No. 1

Table. No. 1: Mean age and std. Deviation

Age	N	Minimum (Years)	Maximum (Years)	Mean± Std. Deviation
Age of Patients	90	16	26	20.48±2.712

The normality of data was assessed in 90 patients with mild to moderate symptoms of dry eye, with the saphiro_wilk test. P>0.05 showcased that data was normally distributed. The mean value and standard deviation of omega-3 oral supplement were 8.60 ± 1.003

on the first follow-up, 9.67 ±0.884 on the second follow-up, and 11.17 ± 0.874 on the third follow-up respectively.



Within subjects, the p-value was less than 0.05 which means that the result was significant Within subjects, the p-value was less than 0.05 which means that the results were significant the descriptive statistics, mean in between the different follow-ups were assessed using SPSS and presented in Table No. 2.

Table no. 2 The Descriptive statistics and ANOVA analysis of three different treatments.

Treatment Options	Treatment data	Mean (N=30)	Std. Deviation	Greenhouse- Geisser	Sig.
lutein-zeaxanthin oral supplement	Baseline	7.13	.776	0.883	.000
	First follow-up	7.83	.791		
	2nd Follow-up	8.63	.718		
	3rd Follow-up	9.53	.730		
Artificial tears	Baseline	6.80	.997	.806	.000
	First follow-up	8.13	1.634		
	2nd Follow-up	9.50	1.548		
	3rd Follow-up	10.57	1.165		
Omega 3	Baseline	7.13	.900	0.819	.000
	First follow-up	8.60	1.003		
	2nd Follow-up	9.67	.884		
	3rd Follow-up	11.17	.874		

The degree of freedom between groups and within groups was 2 and 87 respectively. The sum of squares between groups and within groups was 40.9 and 77 individually. Table no. 2 shows the ANOVA analysis which describes the variation between groups and within the group in all therapies. Between and within groups, p=0.000 (p<0.05) shows a significant difference in all three therapies. Table no 3 compares the mean differences between different pairs of follow-up periods for the measurement of the TBUT test. When comparing follow-up period 1 with other periods, observed positive mean differences were -2.567, -1.500, +1.500, and std deviation 0.177, 0.133, 0.133 for periods 2, 3, and 4, respectively. This suggested that the measurement of the TBUT test tends to increase as it progresses from the first follow-up period to the last follow-up period of the study as shown in Table No. 3

Table. No 3: The Pairwise comparisons of omega-3.

(I) factor1	(J) factor1	Mean Difference (I-J)	Standard. Error	Sig.	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
1	2	1.467	.124	.000	-1.819	-1.114
	3	-2.533	.142	.000	-2.935	-2.132
	4	-4.033	.176	.000	-4.532	-3.535
2	1	1.467	.124	.000	1.114	1.819
	3	-1.067	.151	.000	-1.495	-.639
	4	-2.567	.177	.000	-3.069	-2.064
3	1	2.533	.142	.000	2.132	2.935
	2	1.067	.151	.000	.639	1.495
	4	-1.500	.133	.000	-1.878	-1.122
4	1	4.033	.176	.000	3.535	4.532
	2	2.567	.177	.000	2.064	3.069
	3	1.500	.133	.000	1.122	1.878

A significant difference of p=0.00 (p <0.05) was present between the omega-3 oral supplement with the lutein-zeaxanthin oral supplement and artificial tears eye drop, with a slightly significant value of p=0.046 (p<0.05). The lutein-zeaxanthin oral supplement showed a significant difference (p=0.000 and p=0.000 with other treatments). Meanwhile, the artificial tears eye drop showed a slightly significant difference of p=0.046 (p<0.05) with the omega-3 and lutein-zeaxanthin oral supplements as shown in table no. 4 below.

Table no. 4 Multiple comparisons between different groups

Treatment Option (l)	Treatment Option (J)	Mean Difference (I-J)	Std. Error	Sig.
Omega-3 oral supplement	lutein-ZeaxanthinOral supplement	1.633	.243	.000
	Artificial Tears Eye Drop	.600	243	.046
lutein-Zeaxanthin Oral supplement	Omega-3 oral supplement	-1.633	.243	.000
	Artificial Tears Eye Drop	-1.033	.243	.000
Artificial Tears Eye Drop	Omega-3 oral supplement	-.600	.243	.046

Assistance for eye drops was required by 29 patients (96.67%), while only 1 patient (3.33%) did not require any assistance. Dropping eye drops outside was reported by 25 patients (83.33%), while only 5 patients (16.67%) did not experience this issue. Squeezing the waste of extra drops was reported by (83.33%); 23 patients (76.67%) found it hard to squeeze the bottle, while 7 patients (23.33%) had a negative response. Confirmation of drops pouring was reported by 11(36.67%), whereas (63.33%) did not feel the need for confirmation. Opening the bottle was the problem for 20 patients (66.7%), while 10 patients (33.3%) did not face any problems. Too much blinking was experienced by 19 patients (63.33%), Holding the bottle over the eye was difficult for 23 patients (76.67%), while 7 patients (23.33%) did not encounter any problems. Tilting the head back was hard for 27 patients (90%), whereas 3 patients (10%) did not find it challenging. 20 patients (66.67%) had shaky hands, while 10 patients (33.33%) did not experience this problem. 13 patients (43.33%) reported these problems to a health professional, whereas 17 patients (56.67%) did not. Carrying eye drops was problematic for 28 patients (93.33%), while 2 patients (6.67%) did not face any issues. Blurred vision was reported by 22 patients (73.33%), while 8 patients (26.67%) did not have blurred vision. 9 patients (30%) liked the taste in their throat, whereas 21 patients (70%) did not find it pleasant. Using eye drops within 1 month before expiration was practiced by 26 patients (86.67%), while 4 patients (13.33%) did not follow this practice. 29 patients (96.67%) touched the dropper tip, while only 1 patient (3.33%) did not touch it. None of the patients reported any other issues as shown in table no. 5

Table No. 5 Patient response against the three different therapies.

Questions asked of patients	Yes N (%)	No N (%)
Required assistance for eye drops	29 (96.7%)	1 (3.3%)
Frequency of dropping eye drops outsideye	25 (83.3%)	5(16.7%)
Squeezing results waste of extra drops	25 (83.3%)	5 (16.7%)
Hard to squeeze the bottle	23 (76.7%)	7 (23.3%)
Confirmation of drops during poring	11 (36.7%)	19 (63.3%)
Hard to open a bottle	20 (66.7%)	10 (33.3%)
Too much blinking	19 (63.3%)	11 (36.7%)
Hard to hold the Bottle over the eye	23(76.7%)	7 (23.3%)
Hard to tilt the head back	27 (90%)	3 (10%)
Shaky Hand	20 (66.7%)	10 (33.3%)
Ever reported these problems to a health	13 (43.3%)	17 (56.7%)
The problem in carrying eye drops	28 (93.3%)	2 (6.7%)
Blurred vision	22 (73.3%)	8 (26.7%)
Like the taste in Throat	9 (30%)	21 (70%)
Using drops within 1 month before expiration	26 (86.7%)	4 (13.3%)
Does touch the dropper tip	29(96.7%)	1 (3.3%)

IV.DISCUSSION

The results showed mean difference and standard deviation of the Omega-3 oral supplement were 8.60 ± 1.003 on the first follow-up, 9.67 ± 0.884 on the second follow-up, and 11.17 ± 0.874 on the third follow-up, respectively. A previous study showed the same result when assessing the efficiency of omega-3 oral supplementation for the treatment of dry eye, the TBUT and OSDI scores greatly increased in both populations. In comparison, the MGD score was 6.9 2.1 vs. 7.9 2.8, p= 0.033, and the TBUT value was 6.01 1.25 s vs. 5.10 1.30 s, p=0.043 While greatly reducing dry eye discomfort, the standard deviation in median measurements was 0.968 and the 95% confidence interval (CI); p=0.001) [13].

In the present study, patients with mild to moderate symptoms of dry eye were selected. The mean age of participants was 20.48 years, with a standard deviation of 2.712. While comparing the first follow-up period with the other periods, positive mean differences -2.567, -1.500, +1.500, and standard deviations 0.177, 0.133, and 0.133 were observed as the values for periods 2, 3, and 4, respectively. This suggests that the measurement of the TBUT test tends to increase as the study progresses from the first follow-up period to the last follow-up period [15]. The results were remarkably similar to a study that focused on the assessment and management of dry eye in 2018. The average age of the participants was 60.0 ± 12.3 years. At the beginning of the study, the mean OSDI score was 45.0, and the standard deviation was 15.1, and the recent study showed significant findings in that patients were given a supplement containing 180 mg of EPA and 120 mg of DHA for 3 months. In the third month, significant improvements in the TBUT test and OSDI disease in omega-3 levels p=0.000 and TBUT values 7.13, 8.60, 9.67, and 11.17 were observed [16,17]

The study showed results when comparing the effects of a lutein-zeaxanthin oral supplement in 30 patients with the effects of omega-3 supplements in another group of 30 patients over three months. While comparing both oral supplements, Omega-3- 3 oral supplements had a mean value and standard deviation of 11.17 +.874, while lutein-zeaxanthin oral supplements had a mean value and standard deviation of 9.53+.730 [18]. Omega-3 oral supplements showed a significant difference compared to lutein-zeaxanthin oral supplements. A previous study conducted showed the same result when assessing the efficacy of lutein, zeaxanthin, curcumin, and vitamin D in reducing eye swelling and improving tear quantity in dry eyes. The group (lutein- zeaxanthin) showed significant improvements [19]. The mean of Artificial Tears eye drops was 8.13 1.634 on the first follow-up, 9.50 1.548 on the second follow-up, and 10.57 1.165 on the third follow-up, respectively. Within subjects, the p-value is less than 0.05, which means that the result is significant with a 95% confidence interval for the difference. A research study showcased similar findings in a study conducted in 2022 to evaluate the use of hyaluronic acid (HA) for the management of eye dryness [20]. The findings indicated that artificial tears with 0.2% to 0.5% HA effectively reduced the symptoms and signs of dry eye. HA was found to have beneficial effects on the eye's surface, including anti-allergic, antioxidant, and anti-toxic properties. HA therapy was shown to alleviate DED symptoms and improve its effects [21].

In the current study, of the total 90 subjects, 53 (58.9%) were male and 37 were female (41.1%). Group 1 (omega-3 oral supplement) had a mean value and standard deviation of 11.17+.874, group 2 (lutein-zeaxanthin oral supplement) had a mean value and standard deviation of 9.53+ .730 and group 3 (artificial tears eye

drop) had a mean value 10.57+.165. In 2022, the OSDI scores of the SH group decreased from 5.1 to 2.33 on day 29, with a confidence interval of 1.3 to 0.4. On day 91, the OSDI ratings of the SH+PEG group showed a significant increase (p=0.0002), suggesting further improvement in symptoms [22].

The overall results showed that a significant difference of p=0.00, (p<0.05) was present between the omega-3 oral supplement with the lutein-zeaxanthin oral supplement and the omega-3 oral supplement with Artificial Tears Eye Drop, with a slightly significant value of p=0.046 (p <0.05). The lutein-zeaxanthin oral supplement showed a significant difference (p=0.000 and p=0.000 with other treatments). Meanwhile, the Artificial Tears Eye Drop showed a slightly significant difference of p=0.046, (p<0.05) with the omega-3 oral supplement23-24.

V.Conclusion

The study showed that omega-3 was more effective, and artificial tear eye drops had a minimal difference in effectiveness compared to omega-3 fatty acids, which showed remarkable potential in decreasing the symptoms associated with dry eye. The findings of this study also showed that omega-3 and lutein-zeaxanthin oral supplements can be used for longer periods with minimal side effects by patients with a higher acceptability rate as compared to artificial tears eye drops.

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CONFLICT OF INTEREST

None

DISCLAIMER

None

REFERENCES

[1] Uchino M, Kawashima M, Uchino Y, Suzuki N, Mitamura H, Mizuno M, et al. The evaluation of dry eye mobile apps for screening of dry eye disease and educational tear event in Japan. The Ocular Surface. 2018 Oct 1; 16(4): 430-5.

[2] Huang X, Zhang P, Zou X, Xu Y, Zhu J, He J et al. Two-year incidence and associated factors of dry eye among residents in Shanghai communities with type 2 diabetes mellitus. Eye & Contact Lens. 2020 Jan 1; 46: S42-9.

[3] Findlay Q, Reid K. Dry eye disease: when to treat and when to refer. Australian prescriber. 2018 Oct; 41(5): 160.

[4] Rathnakumar K, Ramachandran K, Baba D, Ramesh V, Anebaracy V, Vidhya R, et al. Prevalence of dry eye disease and its association with dyslipidemia. Journal of Basic and Clinical Physiology and Pharmacology. 2018 Mar 1; 29(2): 195-9.

[5] Labetoulle M, Benitez-del-Castillo JM, Barabino S, Herrero Vanrell R, Daull P, Garrigue JS, et al. Artificial tears: biological role of their ingredients in the management of dry eye disease. International Journal of Molecular Sciences. 2022 Feb 23; 23(5): 2434.

[6] Joossen C, Baán A, Moreno-Cinos C, Joossens J, Cools N, Lanckacker E, et al. A novel serine protease inhibitor as a potential treatment for dry eye syndrome and ocular inflammation. Scientific Reports. 2020 Oct 14; 10(1): 17268.

[7] Messmer EM. Pathophysiology of dry eye disease and novel therapeutic targets. Experimental Eye Research. 2022 Apr 1; 217: 108944.

[8] Baudouin C, Irkeç M, Messmer EM, Benítez-del-Castillo JM, Bonini S, Figueiredo FC, et al. Clinical impact of inflammation in dry eye disease: proceedings of the ODISSEY group meeting. Acta ophthalmologica. 2018 Mar; 96(2): 111-9.

[9] Castro JS, Selegatto IB, Castro RS, Miranda EC, de Vasconcelos JP, De Carvalho KM, et al. Prevalence and Risk Factors of self-reported dry eye in Brazil using a short symptom questionnaire. Scientific Reports. 2018 Feb 1; 8(1): 2076.

[10] Ahn S, Eom Y, Kang B, Park J, Lee HK, Kim HM, et al. Effects of menthol-containing artificial tears on tear stimulation and ocular surface integrity in normal and dry eye rat models. Current Eye Research. 2018 May 4; 43(5): 580- 7.

[11] Acar D, Molina-Martínez IT, Gómez-Ballesteros M, Guzmán-Navarro M, Benítez-del-Castillo JM, Herrero-Vanrell R. Novel liposome-based and in situ gelling artificial tear formulation for dry eye disease treatment. Contact Lens and Anterior Eye. 2018 Feb 1; 41(1): 93-6.

[12] Tong L, Htoon HM, Hou A, Acharya RU, Tan JH, Wei QP, et al. Acupuncture and herbal formulation compared with artificial tears alone: evaluation of Dr. eye symptoms and associated tests in a randomized clinical trial. BMJ Open Ophthalmology. 2018 Jun 1; 3(1): 000150.

[13] Pellegrini M, Senni C, Bernabei F, Cicero AF, Vagge A, Maestri A, et al. The role of nutrition and nutritional supplements in ocular surface diseases. Nutrients. 2020 Mar 30; 12(4): 952.

[14] Pellegrini M, Senni C, Bernabei F, Cicero AF, Vagge A, Maestri A, et al. The role of nutrition and nutritional supplements in ocular surface diseases. Nutrients. 2020 Mar 30; 12(4): 952.

[15] Asbell PA, Maguire MG, Peskin E, Bunya VY, Kuklinski EJ. Dry eye assessment and management (DREAM©) study: study design and baseline characteristics. Contemporary Clinical Trials. 2018 Aug 1; 71: 70-9.

[16] Sheppard JD, Nichols KK. Dry Eye Disease Associated with Meibomian Gland Dysfunction: Focus on Tear Film Characteristics and the Therapeutic Landscape. Ophthalmology and Therapy. 2023 Jun; 12(3): 1397-418.

[17] Muz OE, Orhan C, Erten F, Tuzcu M, Ozercan IH, Singh P, et al. A novel integrated active herbal formulation ameliorates dry eye syndrome by inhibiting inflammation and oxidative stress and enhancing glycosylated phosphoproteins in rats. Pharmaceuticals. 2020 Oct 7; 13(10): 295.

[18] Radkar P, Lakshmanan PS, Mary JJ, Chaudhary S, Durairaj SK. A Novel ingredient supplement reduces inflammation of the eye and improves the production and quality of tears in humans. Ophthalmology and Therapy. 2021 Sep; 10(3): 581-99.

[19] Hynnekleiv L, Magno M, Vernhardsdottir RR, Moschowits E, Tønseth KA, Dartt DA, et al. Acta ophthalmologica. 2022 Dec; 100(8): 844-60.

[20] Labetoulle M, CBL-101 Study Group, Mortemousque B. Performance and Safety of a Sodium Hyaluronate Tear Substitute with Polyethylene Glycol in Dry Eye Disease: A Multicenter, Investigator-Masked, Randomized, Noninferiority Trial. Journal of Ocular Pharmacology and Therapeutics. 2022 Nov 1; 38(9): 607-16.

[21] Guo F, Zhang Q, Fan MN, Ma L, Chen C, Liu XH, et al. Fruit and vegetable consumption and its relation to risk of asthenopia among Chinese college students. International Journal of Ophthalmology. 2018; 11(6): 1020.

[22] Fondi K, Wozniak PA, Schmidl D, Bata AM, Witkowska KJ, Popa-Cherecheanu A, et al. Effect of hyaluronic acid/trehalose in two different formulations on signs and symptoms in patients with moderate to severe dry eye disease. Journal of ophthalmology. 2018 Aug 1; 2018.

[23] Downie LE, Vingrys AJ. Oral omega-3 supplementation lowers intraocular pressure in normotensive adults. Translational vision science & technology. 2018 May 1; 7(3): 1-.

[24] Ziemanski JF, Wolters LR, Jones-Jordan L, Nichols JJ, Nichols KK. Relation between dietary essential fatty acid intake and dry eye disease and meibomian gland dysfunction in postmenopausal women. American journal of ophthalmology. 2018 May 1; 189: 29-40

AUTHORS

First Author – Komal Mushtaq The University of Faisalabad
Second Author – Nimra Gul The University of Faisalabad
Third Author – Lubna Mushtaq, D.G.Khan Medical College
Fourth Author- Aqsa Yousaf, The University of Faisalabad
Fifth Author- Sidra Laraib, The University of Faisalabad
Sixth Author- Hafsa Nazeer, The University of Faisalabad
Seventh Author- Shafqat Shahzad, The University of Faisalabad
Correspondence Author – Dr. Lubna Mushtaq,