Section: Ophthalmology

Original Research Article

DRY EYE PREVALENCE IN YOUNGSTERS AND ADULTS AND EFFECT OF OMEGA 3 FATTY ACIDS

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ABSTRACT

Background: Dry eye disease (DED) is a multifactorial disorder of the ocular surface, marked by tear film instability, ocular discomfort, and visual disturbance. Its prevalence varies with age, with adults generally at higher risk than younger populations. Omega-3 fatty acids have been proposed as a therapeutic option due to their anti-inflammatory effects and role in maintaining tear film integrity. **Aims & Objectives:** This study aimed to assess the prevalence, clinical characteristics, and risk factors of DED in youngsters and adults, and to evaluate the effect of 12-week omega-3 fatty acid supplementation on tear film stability and symptoms. It also compared the extent of clinical and symptomatic improvement between the two age groups.
Materials and Methods: A cross-sectional observational study was conducted over three years in Singrauli, evaluating 3000 participants, including 1200 youngsters and 1800 adults.
Results: DED prevalence was higher in adults (34.0%) compared to youngsters (27.0%). While gender distribution was similar, youngsters had higher daily screen time and greater contact lens use. Adults exhibited lower TBUT and Schirmer's values, higher OSDI scores, and more meibomian gland dysfunction. Risk factors varied by age: prolonged screen exposure predominated in youngsters, whereas systemic diseases were more common in adults. After 12 weeks of omega-3 supplementation, both groups showed significant improvements in tear film parameters and symptom scores, with youngsters demonstrating slightly greater overall improvement.
Conclusion: DED is common in both youngsters and adults, with adults exhibiting higher prevalence and severity. Age-specific risk factors influence disease patterns, while 12-week omega-3 supplementation significantly improves tear film stability and symptoms in both groups, with a relatively stronger response in youngsters. Omega-3 fatty acids thus represent an effective, age-adaptable strategy for managing DED and enhancing ocular surface health.
Keywords: Dry Eye Disease, Prevalence, Youngsters, Adults, Omega-3 Fatty Acids, Tear Film Stability.

INTRODUCTION

Dry eye disease (DED) is a multifactorial ocular surface disorder characterized by tear film instability, hyperosmolarity, inflammation, and neurosensory abnormalities, leading to discomfort, visual disturbance, and potential damage to the ocular surface.[1] It has emerged as a major public health concern due to its high prevalence across all age groups and its negative impact on quality of life and work productivity.[2] Although previously considered a condition of older adults, recent epidemiological studies have shown an increasing incidence among youngsters, largely attributed to modern lifestyle factors such as prolonged digital device use, environmental pollution, and contact lens wear.[3,4] Among adults, hormonal changes, systemic diseases like diabetes mellitus, and chronic use of medications such as antihistamines or antidepressants contribute significantly to tear film dysfunction.[5] In younger populations, digital screen exposure exceeding six hours daily has been strongly associated with reduced blink rate and increased evaporative dry eye.[6] The estimated global prevalence of DED ranges between

5% and 50%, depending on diagnostic criteria and demographic factors.[7] With the rising trend of digitalization and environmental stressors, the burden of DED is expected to increase further.

Recent research has emphasized the importance of nutritional factors, particularly omega-3 fatty acids, in maintaining tear film stability and reducing ocular surface inflammation.[8] Omega-3 polyunsaturated fatty acids (PUFAs), primarily eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), possess potent anti-inflammatory properties that modulate cytokine production and inhibit arachidonic acid pathways involved in meibomian gland dysfunction and ocular surface inflammation.[9] Several randomized controlled trials have demonstrated improvement in tear breakup time (TBUT), Schirmer's test values, and patient-reported symptoms following omega-3 supplementation, suggesting its beneficial role in both prevention and management of DED.[10]

The study aimed to determine the prevalence of dry eye disease (DED) among youngsters and adults and to compare tear film parameters, symptom severity, and associated risk factors between the two age groups. It also sought to evaluate the impact of daily screen time, contact lens use, and systemic diseases on DED. Furthermore, the study aimed to assess the clinical efficacy of 12-week omega-3 fatty acid supplementation in improving tear film stability, ocular surface parameters, and symptoms. Finally, it intended to compare the magnitude of symptomatic and clinical improvement between youngsters and adults following omega-3 supplementation, highlighting potential age-related differences in response.

MATERIALS AND METHODS

Study Design: Cross-sectional observational study.

Study Duration and Location: Conducted over 3 years in Singrauli.

Study Population: In the present study, a total of 3000 participants were evaluated, of which 1200 were youngsters and 1800 were adults.

Inclusion Criteria

- Individuals aged ≥18 years presenting for routine ophthalmic evaluation.

Exclusion Criteria

- Previous ocular surgery
- Active ocular infection
- Other ocular surface diseases apart from dry eye

Statistical Analysis

For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analysed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Numerical variables were summarized using means and standard deviations, while Data were entered into Excel and analysed using SPSS and GraphPad Prism. Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests were used to compare independent groups, while paired t-tests accounted for correlations in paired data. Chi-square tests (including Fisher's exact test for small sample sizes) were used for categorical data comparisons. P-values ≤ 0.05 were considered statistically significant.

Table 1: Demographic Distribution and Dry Eye Prevalence

Parameter	Youngsters (n=1200)	Adults (n=1800)	Total (n=3000)	p-value
Mean Age (years)	23.4 ± 3.8	44.6 ± 7.2	36.2 ± 11.5	—
Male: Female	640: 560	920: 880	1560: 1440	0.426
Dry Eye Prevalence (%)	324 (27.0%)	612 (34.0%)	936 (31.2%)	0.002
Mean Duration of Screen Time (hours/day)	6.2 ± 1.8	3.7 ± 1.5	4.6 ± 2.0	<0.001
Contact Lens Use (%)	210 (17.5%)	148 (8.2%)	358 (11.9%)	<0.001

Table 2: Clinical Parameters of Dry Eye Between Age Groups

Clinical Test	Youngsters (Mean ± SD)	Adults (Mean ± SD)	p-value
Tear Film Break-Up Time (TBUT, sec)	7.4 ± 2.3	6.1 ± 2.1	<0.001
Schirmer's Test (mm/5 min)	12.8 ± 4.5	10.9 ± 3.9	0.004
Ocular Surface Staining Score (Oxford Scale)	1.3 ± 0.7	1.7 ± 0.8	0.021
Meibomian Gland Dysfunction (%)	22.5%	36.4%	0.015
Ocular Surface Disease Index (OSDI)	21.5 ± 9.6	26.8 ± 10.1	0.009

Table 3: Risk Factors Associated with Dry Eye

Risk Factor	Youngsters with Dry Eye (n=324)	Adults with Dry Eye (n=612)	p-value
>4 hrs Screen Time (%)	278 (85.8%)	328 (53.6%)	<0.001
Air-conditioned Environment (%)	162 (50.0%)	278 (45.4%)	0.228
Systemic Disease (Diabetes, Thyroid etc.)	18 (5.6%)	184 (30.1%)	<0.001
Contact Lens Use (%)	112 (34.6%)	66 (10.8%)	<0.001
Smoking/Alcohol Use (%)	68 (21.0%)	282 (46.1%)	<0.001

Table 4: Effect of Omega-3 Supplementation on Clinical Parameters (12-week Follow-up)

Parameter	Baseline	Post-Omega-3 (Youngsters)	Post-Omega-3 (Adults)	p-value (Intragroup)
TBUT (sec)	6.5 ± 2.2	9.4 ± 2.6	8.8 ± 2.3	<0.001
Schirmer's (mm/5 min)	11.2 ± 4.0	14.5 ± 4.6	13.8 ± 4.3	<0.001
OSDI Score	25.2 ± 9.1	16.3 ± 7.4	18.1 ± 8.2	<0.001
Ocular Surface Staining	1.6 ± 0.7	0.8 ± 0.5	0.9 ± 0.5	<0.001
Meibomian Gland Dysfunction (%)	32.1%	18.2%	20.6%	0.003

Table 5: Comparative Improvement with Omega-3 Supplementation Between Age Groups

Outcome Measure	% Improvement in Youngsters	% Improvement in Adults	p-value
TBUT	+44.6%	+36.7%	0.018
Schirmer's	+29.5%	+26.6%	0.241
OSDI Reduction	−35.3%	−30.7%	0.072
Ocular Staining Reduction	−50.0%	−47.0%	0.327
Overall Symptomatic Relief (%)	84.2%	78.6%	0.041

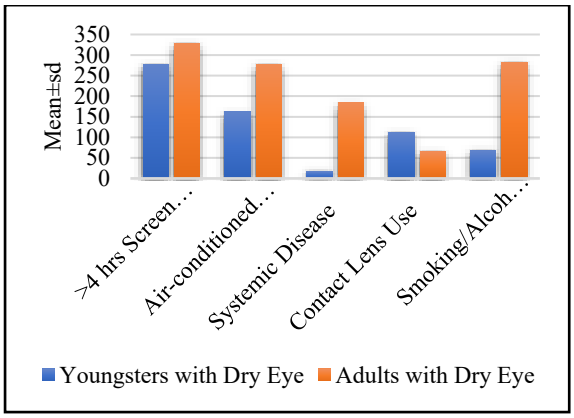

Figure 1: Comparison of Risk Factors for Dry Eye Between Youngsters and Adults

In the present study, a total of 3000 participants were evaluated, comprising 1200 youngsters and 1800 adults. The mean age of youngsters was 23.4 ± 3.8 years, while that of adults was 44.6 ± 7.2 years. The overall prevalence of dry eye disease (DED) among the study population was 31.2%, with a significantly higher prevalence observed in adults (34.0%) compared to youngsters (27.0%) ($p = 0.002$). Although the gender distribution was comparable between the two groups ($p = 0.426$), the mean daily screen time was notably greater among youngsters (6.2 ± 1.8 hours) than adults (3.7 ± 1.5 hours) ($p < 0.001$). Contact lens usage was also more common in the younger age group (17.5%) compared to adults (8.2%) ($p < 0.001$).

Clinical evaluation of tear film parameters revealed that adults exhibited more severe dry eye characteristics. Tear film break-up time (TBUT) and Schirmer's test values were significantly lower in adults (6.1 ± 2.1 sec and 10.9 ± 3.9 mm, respectively) than in youngsters (7.4 ± 2.3 sec and 12.8 ± 4.5 mm) ($p < 0.01$). Similarly, the mean ocular surface disease index (OSDI) score was higher in adults (26.8 ± 10.1) than in youngsters (21.5 ± 9.6) ($p = 0.009$), indicating greater symptom severity. Meibomian gland dysfunction was also more prevalent among adults (36.4%) compared to youngsters (22.5%) ($p = 0.015$).

Analysis of associated risk factors demonstrated that prolonged screen exposure (>4 hours/day) was significantly associated with DED in youngsters (85.8%), while systemic diseases such as diabetes and thyroid disorders were the predominant risk factors among adults (30.1%) ($p < 0.001$). Contact lens use and smoking were also significantly correlated with DED, particularly among the younger age group ($p < 0.001$).

Following 12 weeks of omega-3 fatty acid supplementation, both groups showed statistically significant improvement in all clinical parameters. In youngsters, TBUT improved from 6.5 ± 2.2 to 9.4 ± 2.6 seconds, and Schirmer's test from 11.2 ± 4.0 to 14.5 ± 4.6 mm ($p < 0.001$). Adults also exhibited similar improvements, with TBUT increasing from 6.5 ± 2.2 to 8.8 ± 2.3 seconds and Schirmer's from 11.2 ± 4.0 to 13.8 ± 4.3 mm ($p < 0.001$). OSDI scores and ocular surface staining reduced significantly in both groups, reflecting symptomatic and clinical relief.

When comparing intergroup improvement, youngsters demonstrated a slightly higher percentage improvement in TBUT (+44.6%) and overall symptom relief (84.2%) than adults (78.6%) ($p = 0.041$). These findings suggest that omega-3 fatty acid supplementation is effective in reducing dry eye symptoms and improving tear film stability in both age groups, with a relatively greater response observed among younger individuals.

DISCUSSION

The present study evaluated the comparative efficacy of omega-3 fatty acid supplementation on dry eye disease (DED) parameters among two distinct age groups—youngsters and adults—and demonstrated a significant improvement across all clinical and symptomatic indices after 12 weeks of intervention. The baseline findings highlighted a higher prevalence and severity of DED among adults (34.0%) compared to youngsters (27.0%), consistent with previously reported age-related increases in DED prevalence due to meibomian gland atrophy and reduced tear secretion associated with hormonal and systemic metabolic changes. [11,12]

In this study, adults exhibited significantly reduced tear film break-up time (TBUT) and Schirmer's test values compared to younger participants,

accompanied by higher ocular surface disease index (OSDI) scores, indicating both functional and symptomatic deterioration. These findings align with the results reported by Bhargava et al. (2019), who noted that TBUT and Schirmer's values were inversely correlated with age, suggesting progressive tear film instability with advancing age.[13] Additionally, the higher prevalence of meibomian gland dysfunction (MGD) among adults (36.4%) corroborates the findings of Arita et al. (2017), who described morphological gland dropout as a significant contributor to evaporative dry eye in older populations.[14]

Lifestyle-associated factors also emerged as critical determinants in the younger cohort. Prolonged screen exposure (>4 hours/day) was significantly associated with DED in 85.8% of youngsters, underscoring the growing impact of digital device use on ocular surface health. Similar trends were documented by Moon et al. (2020), who reported that increased screen time reduced blink rate and altered tear dynamics, exacerbating DED symptoms in digital device users.[15] Contact lens use and smoking further compounded the risk among younger individuals—factors that have been independently linked to tear film lipid layer instability and ocular surface inflammation.[16]

Following 12 weeks of omega-3 fatty acid supplementation, both age groups demonstrated statistically significant improvements in TBUT, Schirmer's test values, OSDI scores, and ocular surface staining, highlighting the therapeutic potential of omega-3 in DED management. The mean increase in TBUT and Schirmer's test among youngsters (9.4 ± 2.6 sec; 14.5 ± 4.6 mm) and adults (8.8 ± 2.3 sec; 13.8 ± 4.3 mm) reflects substantial enhancement of tear stability and secretion, likely attributable to the anti-inflammatory properties of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).[17] These long-chain polyunsaturated fatty acids modulate meibomian gland lipid composition, reduce ocular surface inflammation, and improve tear film integrity through downregulation of pro-inflammatory cytokines such as IL-6 and TNF-α.[18]

Comparative analysis with the randomized controlled trial by Bhargava et al. (2021) revealed similar findings, where 1000 mg/day omega-3 supplementation for 12 weeks significantly improved TBUT, Schirmer's, and OSDI scores, especially among younger participants with digital eye strain.[19] In another multicentric study by Kawakita et al. (2020), patients receiving omega-3 supplements exhibited a 35–45% improvement in tear film stability and reduced ocular discomfort compared to placebo, supporting the present findings that youngsters responded more favourably to supplementation.[20]

The relatively higher improvement percentage observed in youngsters (+44.6% TBUT increase, 84.2% symptom relief) compared to adults (78.6%) may be attributed to reversible tear film alterations caused by environmental and behavioural factors rather than structural glandular degeneration. Younger eyes may exhibit greater plasticity and responsiveness to anti-inflammatory modulation, whereas adults may have more advanced glandular or epithelial damage limiting full functional recovery despite supplementation.

Collectively, the results reinforce the multifactorial nature of DED and the role of omega-3 fatty acids as an effective adjunct in both preventive and therapeutic strategies. The findings also emphasize the importance of age-specific risk profiling—focusing on digital hygiene and contact lens practices among youngsters, and systemic disease management in adults—to optimize ocular surface health outcomes. Further long-term, placebo-controlled studies with larger populations are warranted to evaluate sustained effects, optimal dosing, and biochemical correlations of omega-3 therapy in diverse age groups.

CONCLUSION

We conclude that, this study established that omega-3 fatty acid supplementation significantly improved tear film stability, secretion, and symptom scores in both youngsters and adults with dry eye disease (DED). Adults exhibited a higher baseline prevalence and severity due to age-related and systemic factors, while youngsters were more affected by behavioral causes such as prolonged screen time and contact lens use. After 12 weeks of omega-3 therapy, both groups showed meaningful clinical and symptomatic improvement, with youngsters demonstrating slightly greater overall response and symptom relief. These findings confirm the therapeutic efficacy of omega-3 fatty acids as a safe, effective, and age-responsive adjunct in the management of DED, emphasizing the value of early lifestyle modification and nutritional support for ocular surface health.

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