



## Association between Dietary Omega-3 Intake and Dry Eye Syndrome in Adults: A Cross-Sectional Study

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**Abstract.** Dry eye syndrome (DES) is a common ocular surface disorder that can impair visual function and quality of life, particularly among working-age adults. Although DES has a multifactorial etiology, nutritional factors, such as omega-3 fatty acid intake, have been suggested to modulate inflammation associated with the condition. This study aimed to investigate the association between dietary omega-3 intake and dry eye syndrome in adults. This cross-sectional analytical observational study included 88 participants aged 15-59 years. Participants were selected using consecutive non-random sampling and assessed with a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) to estimate omega-3 intake, while dry eye symptoms were evaluated using the Ocular Surface Disease Index (OSDI). Statistical analyses included chi-square and Fisher's exact test. The results showed that 51.1% of the participants had insufficient omega-3 intake (<250 mg/day), and 29.5% experienced dry eye syndrome. No statistically significant association was found between sex or age and DES occurrence. However, a significant association was found between omega-3 intake and dry eye syndrome ( $p < 0.001$ ), with individuals consuming insufficient omega-3 having a substantially higher risk of developing DES. These findings suggest that adequate omega-3 intake may play a protective role in dry eye syndrome. This study underscores the potential of dietary interventions as a strategy for preventing and managing DES.

**Keywords:** Dry Eye Syndrome; Nutritional Intake; Ocular Surface; Omega-3 Fatty Acids; Working Adults.

### 1. INTRODUCTION

The adult population of Indonesia constitutes a part of the working-age population. The data showed that they accounted for 70.72% of the total population in Indonesia (Badan Pusat Statistik, 2021). Increasing productivity must be balanced with good health to ensure that productivity is not disrupted by underlying medical conditions, such as dry eye syndrome. Dry Eye Syndrome (DES) is a condition affecting the tears and the surface of the eye, causing symptoms like discomfort, blurry vision, and instability of tear film. It's also linked with increased tear film osmolarity and inflammation (Craig et al., 2017; Arisjulianto & Siregar, 2024).

Dry eye syndrome tends to become more common with age, particularly among adults and the elderly. Recent studies have estimated the global prevalence range to be 5-50% (Pang et al., 2025). Estimated prevalence of dry eye syndrome approximately 11.59% (Papas, 2021). Underlying medical conditions, environment influences, prolonged computer use, contact lenses wear, the use of certain medication (antihistamines, antidepressants), and low fatty acids intake increase the risk of dry eye syndrome (Stapleton et al., 2017).

Omega-3 fatty acids, obtained from both plant and marine sources, exert anti-inflammatory effects by influencing cellular pathways that involve arachidonic acid, leading to a reduction in pro-inflammatory mediators. Adequate dietary omega-3 intake has also been associated with possible protective effects in persistent ocular diseases, including age-related macular degeneration and dry eye syndrome (Zhang et al., 2020). Omega-3 supplement intake has been shown to be significantly associated with the Ocular Surface Disease Index (Epitropoulos et al., 2016). However, other studies have reported that there was no significant difference between omega-3 intake and placebo after 12 months (Asbell et al., 2018). Currently, no studies in Indonesia have addressed the association between Omega-3 and dry eye syndrome in adults.

Given the conflicting findings of previous studies and the lack of research in Indonesia, this study aimed to investigate the association between omega-3 fatty acid intake and OSDI scores among the adult working-age population in Indonesia.

## **2. LITERATURE REVIEW**

### **Definition and Clinical Manifestations of Dry Eye Syndrome**

Dry eye syndrome is a complex condition that affects both the tear film and the ocular surface. This condition encompasses a spectrum of symptoms arising from impaired ocular lubrication, resulting from a reduction in either the quality or quantity of tears on the ocular surface (Craig et al., 2017). Common clinical manifestations are burning sensation, redness, excessive blinking, sandy feeling in the eye, ocular pain, excessive tearing, and vision fluctuation (Mohamed et al., 2022).

### **Pathophysiology of Dry Eye Syndrome**

Tear hyperosmolarity arises from several contributing factors, including hormonal imbalances, pharmacological agents, environmental influences, dysfunction of the lacrimal gland, reduced aqueous tear flow, and excessive evaporation of tears (Harrell et al., 2023). Inflammatory signaling pathways are activated when ocular surface epithelial and immune cells are exposed to hyperosmotic stress. This process promotes the release of pro-inflammatory cytokines, including IL-1 $\beta$ , TNF- $\alpha$ , and IL-6, as well as chemokines and matrix metalloproteinases, such as MMP-3 and MMP-9. In addition, it contributes to the activation of mitogen-activated protein kinase (MAPK) pathways. The release of inflammatory cytokines by Th1 and Th17 cells contributes to injury of the ocular surface epithelium as well as goblet cell loss, resulting in decreased mucin production, faster tear evaporation, and instability of the tear film (Bron et al., 2017; Wolffsohn et al., 2017).

### Diagnostic Approach

The diagnosis of dry eye begins with a patient history through validated questionnaires, one of the most widely used is the Ocular Surface Disease Index (OSDI). Following this subjective assessment, objective assessments are performed, including the measurement of the tear film break-up time using fluorescein dye. Ocular surface staining is performed using either fluorescein or lissamine green to assess epithelial damage. Tear production is quantified using the Schirmer I test, with or without anesthesia, or via the Schirmer II test with nasal stimulation (Wolffsohn et al., 2017).

### Omega-3 Dietary Intake

Omega-3 fatty acids are obtained from two primary dietary sources, based on their chain length. Plant-based foods, such as flaxseed and chia seeds, are rich in short-chain omega-3s, particularly alpha-linolenic acid (ALA), whereas the long-chain forms, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), are primarily derived from seafood, especially oily fish (Zhang et al., 2020).

**Table 1.** Dietary Sources Omega-3 Fatty Acids (United State Departement of Agriculture, 2018).

Food Source	Household measure	EPA (g/100g)	DHA (g/100g)	Total Omega-3 (g/100g)
Salmon	1 fillet (100g)	0.7	1.5	2.2
Sardine (canned)	1 piece (35 g)	0.5	0.9	1.4
Anchovy	1 tablespoon (10g)	0.6	0.9	1.5
Mackerel	1 slice (80g)	0.5	0.7	1.2
Shrimp	5 medium pieces (50 g)	0.3	0.2	0.5
Gourami	1 slice (65g)	0.3	0.2	0.5
Oyster	1/2 cup (90g)	0.2	0.2	0.4
Catfish	1 medium fish (40g)	0.1	0.2	0.3
Red Snapper	1 slice (40g)	0.05	0.2	0.25

Adults are generally advised to consume approximately 250 mg/day of omega-3 fatty acids, particularly EPA and DHA (European Food Safety Authority, 2012).

### Dry Eye Syndrome and Omega-3 Intake

Dry eye syndrome is characterized by the presence of proinflammatory agents, including TNF- $\alpha$  and IL-1, in tear film. These agents initiate inflammatory cascades and trigger apoptosis. As end products of omega-3 metabolism, PGE3 and LTB5 inhibit the expression of

pro-inflammatory cytokine genes, such as TNF- $\alpha$ , IL-1 $\alpha$ , and IL-1 $\beta$ , thereby preventing apoptosis, reducing lacrimal gland secretion, and causing tear film hyperosmolarity in dry eye syndrome (Hyon & Han, 2021). In addition, EPA and DHA serve as precursors of anti-inflammatory mediators, such as resolvins, protectins, and maresins (Barabino et al., 2017). Studies have shown that resolvins help maintain ocular surface integrity by enhancing goblet cell mucin secretion and inhibiting the production of proinflammatory cytokines by corneal epithelial cells. (Hyon & Han, 2021).

### **3. METHODS**

This was an analytical observational study with a cross-sectional design. The subjects of this study were adult nurses aged 15–59 years working at a private hospital in Jepara, Indonesia with data collected in October 2021. Subjects were excluded if they had chronic eye diseases, a history of eye trauma, a history of eye surgery, contact lens use, a history of diabetes mellitus, menopause, or used medications known to influence tear film production or ocular surface integrity. The sample was selected using consecutive non-random sampling, resulting in 88 participants who met the inclusion and exclusion criteria. Omega-3 dietary intake was assessed using the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), which consists of a list of foods rich in Omega-3. Dry eye symptoms were evaluated using the OSDI questionnaire. Data analysis was performed using SPSS for Mac (version 25).

### **4. RESULT AND DISCUSSION**

#### **Univariate Analysis**

Among the 88 participants, the majority were female (n = 63; 71.6%). Most participants were aged 15–39 years, comprising 73 individuals (83.0%). Regarding dietary intake, 45 participants (51.1%) had insufficient omega-3 intake, defined as <250 mg/day. Based on the Ocular Surface Disease Index (OSDI) used to assess dry eye symptoms, 62 participants (70.5%) were classified as normal, with scores ranging from 0 to 12.

**Table 2.** Demographic Characteristics of Participants (n=88).

Distribution		Frequency (n)	Percentage (%)
<b>Gender</b>		63	71.6
Female			
Male		25	28.4
<b>Age</b>			
Young (15–39 years)	adult (15–39 years)	73	83.0
Late (40–59 years)	adult (40–59 years)	15	17.0
<b>Omega-3 Intake</b>		45	51.1
Insufficient (<250mg/day)			
Adequate (>250mg/day)		43	48.9
<b>OSDI</b>		26	29.5
Dry eye syndrome (>12)			
Normal (0-12)		62	70.5

### Bivariate Analysis

Although females exhibited a higher prevalence of dry eye syndrome in this study, chi-square testing produced a *p*-value of 0.176 (*p* > 0.05), demonstrating no statistically significant association with sex. The calculated odds ratio (OR = 0.511) and risk ratio (RR = 0.635) further suggested reduced odds and risk for females relative to males; however, these findings were not statistically significant.

**Table 3.** Bivariate Analysis of Sex, Age, and Omega-3 Intake in Relation to Dry Eye Syndrome in Adults.

Variable	Dry Eye Syndrome		<i>p</i>	OR	RR
	Yes	No			
<b>Gender</b>					
Female	16	47	0.176*	0.511	0.635
Male	10	15			
<b>Age</b>					
Young adult (15-39 years)	19	54	0.128 ‡	0.402	0.558
Late Adult (40-59 years)	7	8			
<b>Omega-3 Intake</b>					
Insufficient	22	23	0.000*	9.326	5.256
Adequate	4	39			

\*Chi-square

‡ Fisher’s exact

Age was not significantly associated with dry eye syndrome ( $p = 0.128$ ). Although OR (0.402) and RR (0.558) indicated lower odds and risks among younger adults, these differences were not statistically significant. In contrast, participants with insufficient Omega-3 intake showed a higher proportion of dry eye syndrome (48.9%) than those with adequate intake (9.3%). A statistically significant association was identified between Omega-3 intake and dry eye syndrome, as indicated by the chi-square test ( $p < 0.001$ ). The OR (9.326) and RR (5.256) indicated that participants with insufficient Omega-3 intake ( $<250$  mg/day) had approximately 9.3 times higher odds and 5.3 times higher risk of developing dry eye syndrome than those with adequate intake ( $\geq 250$  mg/day).

### **Sex and Dry Eye Syndrome in Adults**

A higher proportion of dry eye syndrome was observed among female (61.5%) than male (38.5%). This result supports the findings of Alqurashi et al., (2024), who observed a higher prevalence of dry eye symptoms among female university students and a significant association with symptom severity. This difference may be explained by hormonal factors. Estrogen suppresses lipid production in the meibomian glands, whereas testosterone enhances lipid secretion. Hormonal changes in women may contribute to the instability of the tear film. Despite the higher prevalence observed in women, no statistically significant association was found between sex and dry eye syndrome ( $p = 0.176$ ).

### **Age and Dry Eye Syndrome in Adults**

Age was not significantly associated with dry eye syndrome in the population, suggesting that young adults (15–39 years) tended to have a lower likelihood and risk of developing dry eye syndrome compared to older adults (40–59 years) ( $p = 0.128$ ,  $p > 0.05$ ; OR = 0.402; RR = 0.558). This result may be explained by the relatively homogeneous age distribution in our study, in which the majority of the subjects were in the younger age group. In addition, age-related changes in tear production and ocular surface function are typically more pronounced in older populations, particularly those  $> 60$  years, which were not included in this study.

### **Omega-3 Dietary Intake and Dry Eyes Syndrome in Adults**

One of the factors influencing dry eye syndrome is nutritional status. Omega-3 fatty acids play an important role in reducing the symptoms and preventing from dry eye syndrome. This finding is supported by studies conducted by Epitropoulos et al., (2016) and Bhargava et al., (2015) indicating that Omega-3 intake can improve dry eye syndrome symptoms, tear osmolarity, and result in a low OSDI score.

## 5. CONCLUSION

This study showed that there was no association between sex, age and the occurrence of dry eye syndrome in adults. In contrast, a statistically significant association was observed between omega-3 intake and dry eye syndrome. These findings highlight the potential role of nutritional factors, especially omega-3 fatty acids, in the development of dry eye syndrome.

Future studies are recommended to use more objective diagnostic methods, such as Tear Break-Up Time (TBUT) and the Schirmer test, and measure blood levels of omega-3 fatty acids. Further research should include a more diverse age range and consider additional risk factors, such as digital device use, environmental exposure, and systemic conditions to provide a more comprehensive understanding of dry eye disease.

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