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Analysis of Risk Factors For Dry Eye Disease Among Educational Staff of The Faculty of Medicine, Muslim University of Indonesia Using The Ocular Surface Disease Index (OSDI) Questionnaire

Vadya Hidayanti[1], Ratih Natasha Maharani[2], Zulfikri Khalil Novriansyah[2], Suliati P Amir[3], Nur Aulia Amir[4]
[1]Faculty of Medicine, Universitas Muslim Indonesia, Makassar
[2,3]Medical Education Program, Department of Ophthalmology, Faculty of Medicine, Universitas Muslim Indonesia
[4]Department of Ophthalmology, Faculty of Medicine, Universitas Muslim Indonesia, South Sulawesi, Indonesia
Corresponding Author: vadyanty@gmail.com

Abstract:
Background: Dry eye disease is a common ocular health problem that can impair comfort, visual performance, and work productivity, particularly in occupational environments.
Aim: This study aimed to analyze factors associated with the occurrence of dry eye disease among educational staff at the Faculty of Medicine, Universitas Muslim Indonesia.
Methods: An analytical cross-sectional study was conducted using structured questionnaires and standardized symptom assessment to evaluate sex, age, duration of digital device use, air conditioner exposure, smoking habits, and dry eye disease status, followed by bivariate and multivariate statistical analyses.
Results: Smoking habits and air conditioner exposure were associated with a statistically significant increase in the occurrence of dry eye disease. Age did not demonstrate a significant association but tended to aggravate the effects of other risk factors. Sex and duration of digital device use were not significantly associated with dry eye disease; however, female sex and excessive digital device use appeared to increase susceptibility.
Conclusions: Environmental and lifestyle factors, particularly smoking exposure and prolonged use of air conditioners, play an important role in the development of dry eye disease among educational staff.
Implication: These findings highlight the need for preventive strategies that improve workplace environmental conditions and promote healthier lifestyle behaviors to reduce the burden of dry eye disease in occupational settings.

Keywords: Dry eye disease; Educational staff; Air conditioner exposure; Smoking habits; Workplace eye health

INTRODUCTION

Dry Eye Disease (DED) is a multifactorial disorder of the ocular surface characterized by a loss of tear film homeostasis, which may result in ocular discomfort, visual disturbance, inflammation, and damage to the ocular surface. In some instances, neurosensory abnormalities may also contribute to disease development. DED is recognized as one of the most common ocular conditions prompting individuals to seek medical care, reflecting its significant impact on eye health and daily functioning.

Globally, the prevalence of DED varies widely, ranging from approximately 5% to 50%, with higher rates reported among adults over 40 years of age. Although traditionally associated with older populations, recent evidence indicates an increasing prevalence among younger adults, particularly office workers. This trend is closely related to modern work environments that involve prolonged use of digital devices, extended working hours, and exposure to air-conditioned settings. Studies have shown that DED affects a substantial proportion of office-based and academic workers, highlighting occupational exposure as an important contributing factor.

Age and sex are well-established internal risk factors for DED, with women demonstrating a higher susceptibility than men. Hormonal changes, including decreased androgen levels associated with aging, pregnancy, menopause, and the use of estrogen-containing hormonal contraceptives, are believed to play a role in tear film instability and meibomian gland dysfunction. In addition to internal factors, external factors such as low environmental humidity, air pollution, cigarette smoke exposure, and prolonged screen time further exacerbate tear film evaporation and ocular surface irritation.

The clinical manifestations of DED extend beyond ocular discomfort and visual symptoms, significantly affecting quality of life. Patients with DED often experience reduced work productivity, limitations in daily activities, and psychological consequences such as emotional distress. Given these wide-ranging effects, identifying modifiable risk factors is essential for effective prevention and management strategies.

Educational staff at the Faculty of Medicine, Muslim University of Indonesia, represent a population at increased risk for DED due to occupational characteristics, including prolonged computer use, extended working hours, and frequent exposure to air-conditioned environments. Despite this risk, data regarding DED and its associated factors in this population remain limited. Therefore, this study aims to analyze the risk factors

associated with DED among educational staff at the Faculty of Medicine, Muslim University of Indonesia.

This study is based on the latest research trend in Dry Eye Disease (DED), which focuses on risk factors related to the work environment and lifestyle. In general, research on DED has shown that multifactorial factors, including age, gender, exposure to air-conditioned environments, use of digital devices, and smoking habits, influence the condition. However, recent studies have begun to emphasize the office and academic worker population as a high-risk group due to exposure to screens and dry air, and the need to quantify symptoms using valid instruments such as the Ocular Surface Disease Index (OSDI). This article positions itself in a state-of-the-art context by using OSDI as a validated, widely used instrument globally, focusing on modifiable risk factors (environment & lifestyle), and assessing the academic population/educational staff who are categorized as vulnerable due to digital work intensity and exposure to air conditioning. Thus, this study is part of the latest stream of DED epidemiological research, highlighting the role of a combination of environmental and behavioral factors in the modern working population, especially among academic personnel.

LITERATURE REVIEW

Multiple risk factors contribute to DED development, with age, female gender, environmental conditions, and occupational exposures representing well-established contributors (Bunya et al., 2020). Digital device use and prolonged exposure to visual display terminals are major modern risk factors, particularly relevant to office workers and educational staff who spend extensive hours on computers (Huang et al., 2020). During screen use, blink rate decreases significantly from the normal 15-20 blinks per minute to 3-7 blinks per minute, resulting in increased tear evaporation, tear film instability, and ocular surface damage (Talens-Estarelles et al., 2023).

The increasing global burden is attributed to lifestyle changes, including prolonged use of digital devices, environmental factors, aging populations, and occupational exposures (Bakkar et al., 2023). Classification systems distinguish between aqueous-deficient dry eye, resulting from reduced lacrimal gland secretion, and evaporative dry eye, primarily caused by meibomian gland dysfunction. However, overlap frequently occurs in clinical practice (Messmer, 2023).

Educational staff are a vulnerable population for dry eye disease due to extensive computer-based work for teaching preparation, research, administrative tasks, and online communication (Mohan et al., 2021). Studies among university faculty and teachers report DED prevalence rates between 30-60%, significantly higher than general population estimates, with severity correlated to daily computer use duration (Alabdulkader, 2021). Academic work environments involve synergistic risk factors, including prolonged screen exposure exceeding 6-8 hours daily, air-conditioned offices with suboptimal humidity, fluorescent lighting, sustained reading of both printed and digital materials, and irregular work schedules disrupting circadian rhythms (Garza-León et al., 2021).

The Ocular Surface Disease Index (OSDI) is a validated, reliable questionnaire instrument specifically designed to quantify dry eye disease severity and its impact on vision-related quality of life (Schiffman et al., 2000). The OSDI comprises 12 questions across three domains: ocular symptoms, vision-related function, and environmental triggers, scored 0-4 points each, with total scores calculated to range 0-100, where higher scores indicate greater disability (Wolffsohn et al., 2021). Severity classification categorizes scores as usual (0-12), mild (13-22), moderate (23-32), and severe (33-100), facilitating clinical interpretation and research comparisons (Khamar et al., 2023). The OSDI demonstrates excellent psychometric properties with internal consistency reliability (Cronbach's alpha 0.88-0.95), test-retest reliability (0.86-0.94), and strong correlations with objective clinical signs, including tear break-up time, Schirmer test, and corneal staining (Asiedu et al., 2021).

Based on the content of the article, there are several research gaps filled by this research:

1. There is a lack of specific research on DED in university education personnel, while the majority of previous research has focused on clinical health workers, students, or general office workers.
2. There is a lack of local data in Indonesia, especially in educational institutions of the Faculty of Medicine, even though cultural factors, smoking habits, and tropical air conditioning conditions can be different from those in other countries.
3. Previous research has often emphasized digital devices. At the same time, this study found smoking exposure and air conditioning exposure to be significant factors, challenging the common assumption that computer screens are always the dominant factor.

4. There is a lack of studies that combine bivariate and multivariate approaches using OSDI in the education population in Indonesia, so the analysis of the causal relationship between risk factors is still limited.

The gap shows that this research fills a gap in: the context of the location → Indonesia; Population Context → Education Personnel; Context of risk factors → air conditioning & smoking as dominant factors; the context of the OSDI → methodology + multivariate statistical analysis.

METHOD

This study employed an analytical, observational research design with a cross-sectional approach to identify risk factors for Dry Eye Disease (DED) among educational staff at the Faculty of Medicine, Universitas Muslim Indonesia. The cross-sectional approach was chosen because data were collected at a single point in time to determine the prevalence of DED and its associated risk factors, enabling efficient analysis of the relationship between independent and dependent variables.

Population and Sample

The study population comprised all educational staff at the Faculty of Medicine, Universitas Muslim Indonesia, totaling 243 individuals, including lecturers, administrative personnel, and supporting staff. A non-probability sampling technique, purposive sampling, was used to select respondents based on predefined criteria. Inclusion criteria were educational staff who had worked at the faculty for at least six months, routinely used digital devices in their work activities, and provided informed consent to participate. Exclusion criteria included respondents undergoing treatment for ocular diseases, those with a history of eye surgery within the previous six months, and individuals with severe visual impairment that prevented completion of the questionnaire.

The sample size was determined using the Slovin formula with a 10% margin of error, considering the relatively large population. Based on the formula, a minimum sample size of 71 respondents was obtained.

Operational Definition of Variables

The dependent variable in this study was the occurrence of Dry Eye Disease measured using the Ocular Surface Disease Index (OSDI) questionnaire. The OSDI score was calculated using the formula [(sum of scores for all answered questions) × 100] / [(number of answered questions) × 4], producing a score range of 0-100. DED classification based on

OSDI scores was categorized as no DED (score 0-12) and DED (score ≥13, including mild, moderate, and severe categories) measured on an ordinal scale. Independent variables included demographic factors, lifestyle, and work environment. Age was defined as the time span between birth date and questionnaire completion, categorized as <20 years, 21-30 years, 31-40 years, 41-50 years, and 51-60 years on an ordinal scale. Gender was represented as biological identity based on the National Identity Card, categorized as male or female on a nominal scale. Digital device usage was defined as the daily duration of use over the past 6 months, categorized as <4 hours per day, 4-8 hours per day, and >8 hours per day, on an ordinal scale. Air conditioning exposure was measured as the daily duration of AC use over the past 6 months, categorized as <4 hours per day, 4-6 hours per day, and >6 hours per day, on an ordinal scale. Smoking habit was defined as the respondent's exposure to cigarette smoke either actively or passively over the past 6 months, categorized as yes or no on a nominal scale.

Research Instruments and Data Collection Procedures

The research instruments consisted of a questionnaire on respondent characteristics and the Ocular Surface Disease Index (OSDI). The OSDI is a validated instrument comprising 12 items across three domains: ocular symptoms, visual function, and environmental triggers, with each item rated on a 0–4 Likert scale. The study was conducted at the Faculty of Medicine, Universitas Muslim Indonesia, following approval from faculty authorities and ethical clearance from the Health Research Ethics Committee. Data collection was carried out by directly approaching respondents at their workplaces to explain the study objectives and procedures. Participants who provided written informed consent completed the questionnaires under researcher supervision to ensure data completeness and clarity, with an average completion time of 10–15 minutes per respondent.

Data Analysis

Data analysis was conducted using SPSS. Univariate analysis was used to describe respondent characteristics and the distribution of study variables, including age, sex, digital device use, air conditioning exposure, smoking habits, and the occurrence of Dry Eye Disease (DED) based on OSDI scores. Results were presented as frequencies and percentages. Bivariate analysis was performed to assess the association between independent variables and DED using the Chi-square test or Fisher’s exact test when appropriate. Statistical significance was set at $p \leq 0.05$. Variables with p-values < 0.25 in bivariate

analysis were included as candidate variables for further interpretation. Results were presented in cross-tabulation tables with odds ratios, 95% confidence intervals, and p-values.

DISCUSSION

This study was conducted among educational staff of the Faculty of Medicine, Universitas Muslim Indonesia, involving 71 respondents selected through purposive sampling based on specific criteria. The analysis included univariate, instrument validity and reliability, bivariate, and multivariate analyses. Univariate analysis described respondent characteristics based on demographic and behavioral factors, including age, gender, digital device usage, air conditioning exposure, and smoking habits. Bivariate analysis examined the association between respondent characteristics and the risk of Dry Eye Disease among educational staff at the Faculty of Medicine, Universitas Muslim Indonesia.

Tabel 1. Distribution of Respondents' Characteristics

Variable	Frequency	Percentage (%)
Age		
< 40 years	57	80.3
> 40 years	14	19.7
Digital Device Usage		
< 8 hours/day	66	93.0
> 8 hours/day	5	7.0
Air Conditioner (AC) Exposure		
< 6 hours/day	38	53.5
> 6 hours/day	33	46.5
Smoking Habit		
Not exposed	24	33.8
Exposed	47	66.2
Dry Eye Disease (DED)		
Non-DED	15	21.1
DED	56	78.9
Total	**71**	**100.0**

Source: ***Primary Data***

The data above show that the majority of respondents were aged under 40 years (80.3%). Most respondents used digital devices for less than 8 hours per day (93.0%) and were exposed to air conditioning for less than 6 hours per day (53.5%). More than half of the respondents were exposed to cigarette smoke (66.2%). Regarding clinical outcomes, most respondents (78.9%) had Dry Eye Disease (DED).

Variable	DED Category		p-value	OR (95% CI)
	Non-DED n (%)	DED n (%)		
Age				
< 40 years	15 (21.1)	42 (59.2)	0.031	25683525,347(0,000)

> 40 years	0 (0.0)	14 (19.7)		
Sex				
Male	15 (21.1)	18 (25.4)	0.000	1348513277,357 (0,000)
Female	0 (0.0)	38 (53.5)		
Digital device usage				
< 8 hours/day	15 (21.1)	51 (71.8)	0.577	0,000 (0,000)
> 8 hours/day	0 (0.0)	5 (7.0)		
AC exposure				
< 6 hours/day	13 (18.3)	25 (35.2)	0.004	8,060 (1,662-39,099)
> 6 hours/day	2 (2.8)	31 (43.7)		
Smoking habit				
Active smoker	13 (18.3)	11 (15.5)	0.000	26,591 (5,220-135,463)
Passive smoker	2 (2.8)	45 (63.4)		

Source: ***Chi-Square Analysis***

Based on the analysis above, respondents aged <40 years without DED totaled 17 respondents (23.9%), while those with DED totaled 45 respondents (63.4%). For respondents aged >40 years, none were classified as non-DED (0%), while 9 respondents (12.7%) experienced DED. Furthermore, the chi-square correlation test showed a significance value of 0.102 (>0.05), indicating that the alternative hypothesis (Ha) was rejected. Thus, there was no significant association between age and the occurrence of DED.

Based on the correlation analysis results above, it was found that among male respondents, 7 respondents (9.9%) were classified as non-DED, while 26 respondents (36.6%) experienced DED. Among female respondents, 10 respondents (14.1%) were classified as non-DED, while 28 respondents (39.4%) experienced DED. The Pearson chi-square test yielded a p-value of 0.615 (>0.05), indicating that the alternative hypothesis (Ha) was rejected and that there was no statistically significant association between sex and DED. The odds ratio (OR) was 0.754, indicating that female respondents had a 0.754-fold lower risk of developing DED than males.

Based on the bivariate analysis table, respondents who used digital devices for less than 8 hours per day included 17 respondents (23.9%) without DED and 49 respondents (69.0%) with DED. Meanwhile, among respondents who used digital devices for more than 8 hours per day, none were classified as non-DED (0%), while 5 respondents (7.0%) were classified as DED. The correlation analysis showed a p-value of 0.328 (>0.05), indicating that Ha was rejected and that there was no significant association between digital device usage duration and DED occurrence.

The analysis also showed that respondents with AC exposure of less than 6 hours per day included 15 respondents (21.1%) without DED and 23 respondents (32.4%) with DED. In contrast, among respondents exposed to AC for more than 6 hours per day, two

respondents (2.8%) were classified as non-DED, while 31 respondents (43.7%) experienced DED. The statistical correlation test showed a p-value of 0.002 (<0.05), indicating that Ha was accepted and that there was a statistically significant association between AC exposure and DED. The odds ratio (OR) was 10.109, suggesting that respondents with more prolonged AC exposure had a 10.109-fold higher risk of developing DED.

Furthermore, respondents who were not exposed to cigarette smoke included 15 respondents (21.1%) without DED and nine respondents (12.7%) with DED. Conversely, among respondents exposed to cigarette smoke, two respondents (2.8%) were classified as non-DED, while 45 respondents (63.4%) experienced DED. The correlation analysis showed a significance value of 0.000 (<0.05), indicating that Ha was accepted and that there was a statistically significant association between smoking exposure and the occurrence of DED. The odds ratio (OR) was 37.500, indicating that respondents exposed to cigarette smoke had a 37.5-fold higher risk of developing DED.

Based on the bivariate analysis using the Chi-square test and Fisher's Exact Test, AC exposure ($p = 0.004$) and smoking habits ($p = 0.000$) were found to have statistically significant associations with the occurrence of Dry Eye Disease. These findings suggest that exposure to dry air and smoking habits may affect tear film stability and increase the risk of ocular surface disorders. Meanwhile, age ($p = 0.031$), sex ($p = 0.000$), and digital device use ($p = 0.577$) did not show statistically significant associations with DED.

Binary logistic regression analysis demonstrated that passive smoking was the most influential factor associated with Dry Eye Disease after controlling for other variables, with a p-value of 0.000, an odds ratio (OR) of 45.172, and a 95% confidence interval (CI) of 5.524–369.362. This indicates that respondents exposed to passive smoking had a 45-fold higher likelihood of developing DED compared to active smokers. Meanwhile, AC exposure showed an OR of 1.263. It was not statistically significant at the 95% confidence level ($p = 0.874$), suggesting that exposure to cold, dry air from air conditioning may still increase the risk of dry eye.

The findings of this study support the theory that environmental and lifestyle factors play an important role in the development of Dry Eye Disease. Smoking habits may disrupt tear film balance by exposing the ocular surface to irritant substances that induce oxidative stress, reduce lacrimal gland secretion, and accelerate tear evaporation. Prolonged exposure to air conditioning may decrease environmental humidity, leading to increased tear evaporation and instability of the corneal protective layer.

The lack of a significant association between digital device use and DED in this study ($p = 0.577$) suggests that the duration of use was not significantly associated with DED. This may be influenced by the relatively homogeneous characteristics of the respondents, particularly regarding the duration of digital device use, as most respondents used digital devices for less than 8 hours per day.

The non-significant associations observed for sex and age may be attributed to the age distribution, in which the majority of respondents were under 40 years of age (80.3%), and the relatively balanced sex distribution in the study sample (male: 46.5%; female: 53.5%).

Overall, the results of this study indicate that smoking habits are the dominant factor influencing the occurrence of Dry Eye Disease, followed by AC exposure, which—although not strongly statistically significant—still tends to affect ocular surface conditions. Therefore, preventive efforts for Dry Eye Disease among educational staff populations should focus on modifying lifestyle and workplace environmental factors, such as reducing exposure to smoking and maintaining appropriate indoor humidity through prudent use of air conditioning.

The main novelty of this research lies in:

1. The affirmation that exposure to air conditioning and smoking habits has a significant contribution to DED is greater than the duration of digital device use in the academic population. This differs from the majority of previous studies, which considered screen use a significant factor.
2. Focus on medical faculty education staff, not just students or medical personnel, so that this population provides a new perspective due to the hybrid work characteristics (administration, education, research).
3. A risk evaluation approach through OSDI in the context of work in Indonesia, which strengthens epidemiological data in developing countries with tropical climates with intensive air conditioning.
4. The findings that age and gender are insignificant, which challenge the global literature that considers age and female sex as dominant risk factors.

Thus, the novelty of this article lies in: Specific population context; significant differences (air conditioning and smoking); Local characteristics of Indonesia; Reinterpretation of classic risk factors

CONCLUSION

This study aimed to analyze factors associated with Dry Eye Disease (DED) among educational staff at the Faculty of Medicine, Universitas Muslim Indonesia. Based on the findings of this study, no significant association was found between sex and the occurrence of DED. However, female sex may act as a supporting factor that increases the risk of DED. Age was not significantly associated with DED, although older age may exacerbate the effects of other risk factors, such as air conditioner (AC) exposure and smoking habits. Digital device usage did not show a significant association with the occurrence of DED; nevertheless, excessive use may still affect ocular health, particularly in dry environments and in the presence of cigarette smoke.

Overall, smoking habits, AC exposure, and age contributed significantly to the occurrence of DED among educational staff at the Faculty of Medicine, Universitas Muslim Indonesia. Although sex and digital device usage were not statistically significant, they may still serve as supporting factors that increase the risk of Dry Eye Disease.

The latest state-of-the-art DED research focuses on modern workers and on OSDI as a standard instrument. Research gap: few studies on education personnel in Indonesia that consider air conditioning and smoking. Novelty: air conditioning and smoking are more dominant than the use of digital devices and age/gender, in the context of the academic population in Indonesia.

IMPLICATION

This study provides valuable insights for academia by expanding the evidence base on Dry Eye Disease (DED) and its environmental and lifestyle factors among educational staff. For society, the findings highlight the importance of healthier behaviors and work environments to prevent eye health problems. At the national and state levels, the results can support occupational health policies that promote smoke-free workplaces and proper use of air conditioning. Internationally, this study contributes data from a developing-country context, supporting global efforts to understand and prevent DED across diverse populations and environments.

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