Original Article

Risk Factors of Dry Eye Syndrome in the Soekarno-Hatta Airport's Air Traffic Controllers

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Abstract

Objective: The prevalence of dry eye syndrome (DES) in air traffic controllers (ATCs) was 60.3%, according to one study conducted in 2017. The aim of this study is to identify risk factors of DES in ATCs of Soekarno Hatta International Airport (SHIA). **Materials and Methods:** A cross-sectional study was conducted among ATCs of SHIA who met inclusion and exclusion criteria. Data collected featured several demographic and health characteristics by questionnaire. Participants were classified as DES according to an Ocular Surface Disease Index questionnaire performed after the participants completed their work. The data were processed and analyzed using the SPSS version 20.0. Multivariate analysis was performed using Cox regression. **Results:** Variables that were associated with DES were an age of over 30 years (relative risk [RR], 2.04; confidence interval [CI], 1.30–3.19), and length of work over 10 years (RR, 2.00; CI, 1.25–3.20). After adjusting for all significant variables, the dominant risk factor for DES is age over 30 years ($P = 0.002$; RR, 3.33; CI, 1.58–7.01). Nonsignificant variables included sex, smoking habits, and use of contact lenses. **Conclusion:** The results suggest that employment conditions for ATCs with a 10-year-plus work history should be studied further to identify preventive measures, with age over 30 years as a dominant factor.

Keywords: Air traffic controllers, dry eye syndrome, risk factors

Introduction

In 2015, SoekarnoHatta International Airport (SHIA) was ranked 12th out of the 20 busiest airports in the world, with 57 million passengers per year.[1] The number of aircraft movements at SHIA amounted to 386,615 in 2015, with an average number of aircraft movements of 32,217/month and 1072/day.[2] Air traffic controllers (ATCs) have a very large workload, with an increase in the number of flight traffic one of the causes. It is possible in this case that an error may occur when guiding aircraft, especially if accompanied by eye function impairment like dry eye syndrome (DES). From this study can be concluded that length of work over 10 years found to be significant factor of DES and age over 30 years as a dominant factor.

Materials and Methods

This was a cross-sectional study with purposive sampling at Jakarta Air Traffic Service Centre (JATSC) AirNav Indonesia of SHIA on June 2017. Data collections were obtained during working hours on ATCs duty. There are three units of ATCs duty: the Aerodrome Control, Area Control (ACC), and Approach Control (APP) units. We conducted this study on the ACC and APP units. This study specifically assesses DES in the ACC and APP units. It is expected that the influence of work environment factors (temperature, humidity, and video display terminal [VDT] specifications) was the same among the participants. The nonwork environmental that could influence DES, such as age, the use of systemic drugs, autoimmune disease, trauma and surgery on eyes, eye infection, smoking habit, and the use of contact lenses.[3]

Data regarding age, sex, length of work, smoking habit, and the use of contact lenses were obtained from a questionnaire created for this study. The exclusion criteria were autoimmune diseases, eye infections, history of eyes trauma, history of eye surgery, and the consumption of systemic drugs such as antihypertensive, antiparkinsonian, antidepressant, diuretic, anticholinergic, and antihistamine medications. The age

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distribution is based on references from the study in Japan[4] and length of work divide based on the ROC curve based on our data. DES was assessed using the Ocular Surface Disease Index (OSDI) questionnaire, as mentioned in Table 1. It consists of 12 questions divided into three groups: vision-related function, ocular symptoms, and environmental triggers. If the participants answers all the questions, the sum of scores calculated using the OSDI formula on a scale of 0–100 determines whether the participant's score indicates normal function (score 0–20.8) or mild (score 31.3–41.7), moderate (score 52.1–72.9), or severe (score 83.3–100) DES. The OSDI questionnaire is a valid and reliable instrument for measuring the severity of DES.[5] The study was carried out by a team with one person as chairman and four surveyors. The surveyor explains the intent of the study to the participantsand anyone who has signed the informed consent form. The participants were given a general research data questionnaire in the Indonesian language and an OSDI questionnaire in the English language, which were completed in the company of the surveyor. Research data were processed and analyzed using the SPSS version 20.0, (IBM Corp, Armonk, New York, United States). The questions posed to identify DES risk factors were multivariate analytic questions, analyzed using Cox regression.[6] To identify the relation between two risk factors variables, the Chi-square test and Fisher's test were used, with the statistical significance level of $P < 0.05$.[7]

To comply with the Declaration of Helsinki, this study was submitted to the Ethics Committee of the Faculty of Medicine, Universitas Indonesia, and has obtained ethical agreement. This research has also obtained approval from the head of research at JATSC AirNav, Indonesia.

Results

Out of 316 ATCs of the ACC and APP units of JATSC SHIA, 134 participated in this study. Eight ATCs were excluded, leaving 126 participants for this analysis.

Table 2 shows that age over 30 years and length of work over 10 years are significantly associated with DES, while smoking habits and sex were not significantly related. The use of contact lenses has no effect on the incidence or severity of DES. The variables selected for multivariate analysis are age and length of work. In the final model [Table 3], it is seen that age is the dominant risk factor associated with DES.

Discussion

In a study in Jakarta in 2017, it was found that the prevalence of DES in ATCs was 60.3%.[8] Another study in Indonesia showed that the prevalence of DES in general populations was 27.5%.[9] In the Shihpai Eye Study in Taiwan, it was found that DES prevalence was 33.7%.[10] Based on the Canada Dry Eye Epidemiology Study, the prevalence of DES in Canada was 28.7%.[11] The Beijing Eye Study reported the prevalence of DES was 21% in the adult population in China.[12] Based on Physicians' Health Studies and Women's Health Study in US, showed that 4.34% or 1.68 million men and 7.8% or 3.23 million women over 50 years have DES.[13,14] The prevalence of DES in ATC is higher than the prevalence in the general population.

Age was the dominant risk factor that caused DES in the study population. ATCs over 30 years old were 3.3 times more likely to suffer from DES than those under 30 years. This result is different than the study held in the general population in Indonesia, which the dominant risk factor was pterygium.[9] DES is a multifactorial disease of the tears and eye surface that results in discomfort, visual disturbances, and instability of the tear layer with potential damage to the eye surface. This can be accompanied by an increase in the osmolarity of the tear layer and inflammation of the surface of the eye. Symptoms that can arise are a sense of dryness in the eye, burning, stinging, and itching, or a feeling of blocked or blurred vision, and sensitivity to light.[3]

The results of this study are consistent with a study of 561 office workers in Japan in 2013. That study stated that age over 30 years caused DES at a rate 2.22 times greater compared with an age below 30 years.[4] The incidence of DES in our study was higher than that of the research conducted in Japan. However, there are differences in these two studies, such as the subject numbers (126 vs. 561) and the assessment method of DES (the Japan study using the Japanese Dry Eye Diagnostic Criteria). As we get older, the body's cellular structure undergoes a progressive apoptosis process. Apoptosis in the conjunctival, corneal, and lacrimal glands causes the secretion of the lacrimal gland to decrease.[15] Lacrimal gland secretion begins to decrease after the age of 30, but complaints begin to arise from the age of 60 when glandular secretion is insufficient to meet normal needs. Damage to the lacrimal gland will cause a further decrease in aqueous humor production,[16] which can lead to the condition of aqueous tear-deficient dry eye.[3]

This study also found a relationship that was statistically significant in bivariate analysis between the length of work history and the incidence of DES. This relationship is in line with ATCs' working conditions. An ATCs, while concentrating to guide the aircraft, will extend the interblink interval. This event will increase evaporation on the eye surface.[17] Evaporation on the eye surface will lead to tear hyperosmolarity. This condition will stimulate an inflammation cascade on the eye surface cells, contribute to apoptosis of the goblet cells that produce mucin, worsen the tear instability, and cause DES.[3,15] DES is characterized by a decrease in tear production and/or changes in tear composition. Symptoms range from mild ocular discomfort to severe ocular pain.[18] Symptoms caused by DES have a significant impact on a person's best-corrected visual acuity that can reduce the quality of daily life and work productivity. DES in ATCs can interfere with their ability to guide aircraft, a task that needs good visual concentration, and incapacitation of eye function can endanger flight safety. Therefore, it is necessary to identify the risk factors of DES so that early prevention and proper management can be carried out. The potential limitations

Table 1: Ocular surface disease index questionnaire

	All of the time	Most of the time	Half of the time	Some of the time	None of the time
A. Have you experienced any of the following during the last week					
1. Eyes that are sensitive to light?	4	3	2	1	0
2. Eyes that feel gritty?	4	3	2	1	0
3. Painful or sore eyes?	4	3	2	1	0
4. Blurred vision?	4	3	2	1	0
5. Poor vision?	4	3	2	1	0
Subtotal score for answer 1-5 _____					
B. Have your eyes limited you in performing any of the following during the last week					
6. Reading?	4	3	2	1	0
7. Driving at night?	4	3	2	1	0
8. Working with a computer or ATM?	4	3	2	1	0
9. Watching TV?	4	3	2	1	0
Subtotal score for answer 6-9 _____					
C. Have your eyes felt uncomfortable in any of the following situations during the last week					
10. Windy conditions?	4	3	2	1	0
11. Places or areas with low humidity (very dry)?	4	3	2	1	0
12. Areas that are air conditioned?	4	3	2	1	0
Subtotal score for answer 10-12 _____					
Subtotals of A, B, and C (sum of scores from all questions answered) _____					

ATM: Automatic Teller Machine

Table 2: Relationship between characteristics of air traffic controllers and dry eye syndrome (n=126)

	DES		RR	CI	*P*
	No (n=50), *n* (%)	Yes (n=76), *n* (%)			
Age (years)					
≤30	31 (55.4)	25 (44.6)	1.00	Reference	
>30	19 (27.1)	51 (72.9)	2.04	1.30-3.19	0.001 (CS)
Sex					
Man	40 (39.2)	62 (60.8)	1.00	Reference	
Woman	10 (41.7)	14 (58.3)	0.94	0.55-1.60	0.825 (CS)
Length of work (years)					
≤10	33 (53.2)	29 (46.8)	1.00	Reference	
>10	17 (26.6)	47 (73.4)	2.00	1.25-3.20	0.002 (CS)
Smoking habits					
No	30 (36.1)	53 (63.9)	1.00	Reference	
Yes	20 (46.5)	23 (53.5)	0.78	0.51-1.19	0.259 (CS)
Contact lens					
No	49 (39.8)	74 (60.2)	1.00	Reference	
Yes	1 (33.3)	2 (66.7)	1.19	0.24-6.01	1.000 (*F*)

CS: Chi-square test, *F*: Fisher's test, CI: Confidence interval, RR: Relative Risk, DES: Dry eye syndrome

Table 3: Age as dominant risk factor of dry eye syndrome among air traffic controllers

Age (years)	DES		Adjusted RR	CI	*P*
	No (n=50), *n* (%)	Yes (n=76), *n* (%)			
≤30	31 (55.4)	25 (44.6)	1.00	Reference	
>30	19 (27.1)	51 (72.9)	3.33	1.58-7.01	0.002

CI: Confidence interval, RR: Relative Risk, DES: Dry eye syndrome

of this study include, assessment of DES through the OSDI questionnaire is still subjective; the possibility of recall bias in filling out the OSDI questionnaire exists, given that the survey is based on retrospective memory; and information on confounding factors for DES was not obtained in this study (e.g., work environment, lifestyle, hormonal status) because of technical measurements and tools limitations. However, the strengths of this study were as follows: first, a study about risk factors related to DES in aviation populations, especially in air traffic control, does not yet exist, especially in Indonesia. Second, this study specifically assesses DES in the ACC and APP units. It is expected that the influence of work environment factors (temperature, humidity, and VDT specifications) was the same among the subjects. Factors

examined such as gender, smoking habits, and contact lens uses do not relate to DES.

Conclusion

From this study we can conclude that from several factors examined as possible cause of DES, two-age over 30 years and length of work over 10 years were found to be significant, with age over 30 years being the dominant factors.

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Conflicts of interest

There are no conflicts of interest.

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