

Prevalence and Risk Factors of Dry Eye Disease at a General Hospital

ความชุกและปัจจัยเสี่ยงที่มีความสัมพันธ์กับการเกิดภาวะตาแห้ง
ในผู้ป่วยโรงพยาบาล



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Abstract

Objective: To study the prevalence and risk factors of dry eye syndrome in a hospital-based Thai population.

Background: Dry Eye Syndrome is a common and often chronic condition. Although, the symptoms are not in themselves life-threatening, they adversely affect the daily lives of all age groups around the world by decreasing the quality of sight. The prevalence of dry eye varies according to population, age, country, and diagnostic criteria. Until now, there has only been limited data on the prevalence of dry eye across Thailand, none of which has included any data reported from in Chonburi province in eastern Thailand, 120-kilometers away from Bangkok.

Design: Cross-sectional descriptive study.

Materials and Methods: New patients of the Outpatient Department at Queen Savang Vadhana Memorial Hospital (QSMH), Chonburi, Thailand in September 2021 were each given a two-part questionnaire. The first part gathered data on demographic characteristics and health determinants, while the second part collected data on dry eye symptoms and severity, with each respondent able to indicate their condition according to the Ocular Surface Disease Index (OSDI). Reliability was tested by Cronbach's alpha, and the result was 0.91.

The potential risk factors for dry eye disease were analyzed by binary logistic regression analysis. The outcomes were analyzed to determine the prevalence of dry eye disease and an association was determined by the adjusted odd ratio (OR) at the 95% confidence interval (95%CI) from binary logistic regression analysis.

Results: The participants were aged 18 – 85 years old (mean $\pm$ SD, 47.3 ± 13.3), with 65.8% being female. Out of 202 subjects, 116 subjects (57.4%) had dry eye disease. The significant risk factors of dry eye disease included history of pterygium - pinguecula (OR(95%CI) = 2.91(1.20 – 7.01)), female (OR(95%CI) = 2.09(1.14 - 3.83)), and symptoms of dry mouth (OR(95%CI) = 2.09(1.02 – 4.26)).

Conclusion: The prevalence of dry eye disease among Outpatient Department patients at QSMH was 57.4%. The risk factors of dry eye disease were history of pterygium-pinguecula, being female, and exhibiting symptoms of dry mouth.

Keywords: Dry eye prevalence, Thai population, Hospital-based survey, Risk factor

บทคัดย่อ:

วัตถุประสงค์: เพื่อศึกษาความชุกและปัจจัยเสี่ยงของภาวะตาแห้งในผู้ป่วยที่มาเข้ารับการรักษาศัลยกรรมโรคทั่วไป โรงพยาบาลสมเด็จพระบรมราชเทวี ณ ศรีราชา

รูปแบบงานวิจัย: Observational descriptive cross-sectional study

วิธีการศึกษา: กลุ่มตัวอย่างเป็นผู้ป่วยใหม่ที่มารับการตรวจโรคทั่วไปในเดือนกันยายน พ.ศ.2564 เก็บข้อมูลโดยใช้แบบประเมินอาการและความรุนแรงของภาวะตาแห้ง และแบบสอบถามข้อมูลปัจจัยที่ต้องการศึกษาซึ่งคาดว่าจะมีผลต่อภาวะตาแห้ง โดยคำนวณความชุกของการเกิดภาวะตาแห้งแสดงเป็นร้อยละ และวิเคราะห์ปัจจัยเสี่ยงของการเกิดภาวะตาแห้งโดยหาค่า Odd ratio จาก Univariate analysis และ Binary logistic regression

ผลการศึกษา: ผู้ป่วยเข้าร่วมงานวิจัยทั้งหมด 202 ราย อายุเฉลี่ย 47.3 ± 13.3 ปี เป็นเพศหญิงร้อยละ 65.4 พบความชุกของภาวะตาแห้งร้อยละ 57.4 ปัจจัยเสี่ยงที่มีผลต่อภาวะตาแห้ง ได้แก่ การมีต้อลมหรือต้อเนื้อมีโอกาสพบภาวะตาแห้ง 2.54 เท่า (95% CI 1.082 – 5.981) และ เพศหญิงมีโอกาสพบภาวะตาแห้งมากกว่าเพศชายเป็น 1.98 เท่า (95% CI 1.099-3.575)

สรุป: ผู้ป่วยใหม่ที่มารับการตรวจโรคทั่วไปมีความชุกของภาวะตาแห้งร้อยละ 57.4 ปัจจัยเสี่ยงที่มีผลต่อภาวะตาแห้ง คือ การมีต้อลมหรือต้อเนื้อและเพศหญิง

Introduction

Dry eye disease is a common complaint from all ages among the general population of the world. Symptoms vary, and can include: discomfort, dryness, itching, burning, eye soreness, grittiness, tearing, photophobia, and temporary blurred vision. Although the above-referred symptoms are not fatal, they could be responsible for disturbing the vision, and decreasing the quality of life. The problems of dry eye have been defined as follows.

The National Eye Institute (NEI) industry workshop provided a global definition in 1995 that dry eye disease is a disorder of the tear film resulting from a lack tears or excessive evaporation of the tears, which could break the ocular surface and is related to symptoms of eye discomfort.¹ Subsequently, the Dry Eye Workshop (DEWS) defined dry eye disease a multifactorial problem of tears and ocular surface that results in symptoms of eye discomfort, visual disturbance, and tear film instability.

According to the Journal of Global Health, the prevalence of dry eye is varies. Several research studies have been conducted to investigate the prevalence of dry eyes via questionnaire-based survey, with reported results of the condition ranging from 5.5% to 50.1%.²⁻¹¹ Nevertheless, very few research studies have been conducted in Thailand, with most Thai surveys having taken place among the Bangkok-based population. Moreover, no previous Thai studies report a correlation between the screen-watching time and dry eye disease. Regarding the factors associated with dry eye disease, the previous Thai study revealed that the risk factors include female, dry mouth symptoms, allergic history, and previous eye surgery.¹¹ The purpose of this study was to estimate the prevalence of dry eyes among

patients in the Outpatient Department at Queen Savang Vadhana Memorial Hospital and to identify the risk factors associated with it.

Materials and Methods

Ethical Approval

This study was approved by the Institutional Review Board of Queen Savang Vadhana Memorial Hospital (IRB No 040/2564). Informed consents was obtained from all participants who willingly completed the survey.

Study design

The researcher conducted a cross-sectional descriptive study which retrieved and reviewed questionnaires that were assigned to the participants.

Participants

The participants were the patients visiting the Outpatient Department of QSMH in September 2021, Chonburi, Thailand.

Inclusion criteria

Participants who are literate and filled the questionnaires completely.

Exclusion criteria

Patients at risk of having COVID-19 infection.

Sample size and sampling

From the previous 2012 study in Thailand, the prevalence of dry eye disease was as 14.2%.¹¹ A type I error of 0.05 and a power at 0.80 were used to calculate the sample size. As a result, the sample size required in

this study was 185 cases. The 10% of the sample sized was added to prevent for missing data. Eventually, 202 participants completed the questionnaires completely. Those participants in this study were selected by the convenience sampling method.

Collecting data

The case record form consisted of two parts. The first part addressed the potential associated factors with dry eye disease, demographic information, and health determinants including age, gender, underlying disease, history of allergies, history of dry mouth, history of glaucoma, history of pterygium-pinguecula, history of any type of eye surgery, history of smoke exposure (smoker and second-handed smoker), history of regular contact lens use, and screen-watching time per day (including smartphone, tablet, and computer screen).

Questionnaires

The ocular surface disease index (OSDI) questionnaire was validated by Aizhu Tao, Fan Lu, Yinu Hu, Weiwei Tao, and Ping Lu in 2018 and its reliability was 0.74.¹² The Thai version was translated by Allergan, Inc. The questionnaire consisted of contained 12 questions to evaluate ocular surface disturbance. Those 12 questions include the frequency of the following eye symptoms, sensitivity to light, grittiness, soreness, blurred vision, and poor vision and the effects on daily life such as while reading, driving at night, working with a computer, and watching TV. The questionnaire also asked for the frequency of eye irritation when staring in windy conditions, in areas with low humidity, and areas that are air-conditioned. Each question used a 5-point scale, ranging from 0

for none of the time, 1 for sometimes, 2 for half of the time, 3 for most of the time, and 4 for all of the time. In this study, the reliability of the Thai-version of the OSDI after being tested by 30 thirty nurses was 0.91 by Chronbach's alpha.

The OSDI was interpreted by using the following formula: $OSDI = [(sum\ of\ scores\ for\ all\ questions\ answered) \times 100] / (total\ number\ of\ questions\ answered) \times 4$.¹¹ In this study, the dry eye disease was diagnosed when the calculated OSDI score was 33-100 points.

Outcome measures

The primary outcome of this study was to illustrate the prevalence of dry eye disease as a percentage. The secondary outcome was to reflect upon the association between dry eye disease and its risk factors that were demonstrated by OR (95%CI) from the multivariable analysis using binary logistic regression.

Data analysis

The descriptive statistics employed include frequency, percentage, and mean with standard deviation (mean $\pm$ SD). According to the factors analyses, the univariate analysis and binary logistic regression were used to analyze the OR(95%CI) and adjusted OR(95%CI), respectively. P values less than 0.05 were regarded as statistically significant. All of the statistical analyses were performed using IBM SPSS statistics software version 28.0.

Results

Characteristics of the participants

A total of 202 people participated in this study, with 133 (65.8%) females and 69 (34.2%) males. Their

mean age was 47.3 years (SD = 13.3). The age varied between 18-83 years. Elderly participants (≥ 60 years) totaled 38 cases (18.8%). The number and percentage of possible risk factors for dry eye disease are listed in Table 1. History of smoke exposure (43.1%), dry mouth (23.3%), history of allergy (19.3%), and history of Pterygium-Pinguecula (15.8%) were common in the population. Surprisingly, 16.8% of the participants reported regularly watching screens for more than eight hours per day. Meanwhile, few of the participants regularly used contact lenses, had glaucoma, or had received eye surgery.

Table 1 Number and percentage of potential risk factors for dry eye disease among all participants (n = 202).

Potential risk factors for dry eye disease	Number (%)
Female	133 (65.8)
Age ≥ 60 years	38 (18.8)
Smoke exposure	87 (43.1)
Dry mouth	47 (23.3)
History of allergy	39 (19.3)
Screen time ≥ 8 hours per day	34 (16.8)
Pterygium - Pinguecula	32 (15.8)
History of eye surgery	14 (6.9)
Glaucoma	4 (2.0)
Contact lens wearing	3 (1.5)

Prevalence of dry eye disease

In this study, 116 participants were diagnosed with dry eye disease, so the prevalence of dry eyes was 57.4%. The prevalence of dry eye disease in males and females was 46.4% and 63.2%, respectively. The prevalence of dry eye disease in the elderly (age ≥ 60 years) was 52.6%.

The prevalence of dry eye disease for each potential risk factors is demonstrated in Table 2, and the results were as follows. Dry eye disease was present in 75% of participants with pterygium-pinguecula, 71.4% of participants who had received eye surgery, 68.1% of participants who had dry mouth, 64.7% of participants who watched a screen for more than eight hours per day, 63.2% of participants who were female, 60.9% of participants who had a history of smoke exposure, 56.4% of participants who had a history of allergy, 52.6% of participants who were elderly (≥ 60 years), 33.3% of participants who usually wore contact lenses, and 25% of participants who had glaucoma.

Table 2 Prevalence of dry eye disease for each potential risk factor.

Potential risk factors for dry eye disease	Prevalence of dry eye disease for each factors (%)
Demographic	
Female	84/133 (63.2)
Age ≥ 60 years	20/38 (52.6)
Clinical	
Pterygium – pinguecula	24/32 (75.0)
History of eye surgery	10/14 (71.4)
Dry mouth	32/47 (68.1)
Screen time ≥ 8 hours per day	22/34 (64.7)
Smoke exposure	53/87 (60.9)
History of allergy	22/39 (56.4)
Glaucoma	1/4 (25.0)
Contact lens wearing	1/3 (33.3)

Risk factors for dry eye disease

From the univariate analysis, the most significant risk factors with dry eye disease were history of pterygium (OR (95% CI) = 2.54 (1.08 -5.98), $p = 0.028$) and female (OR (95%CI) = 1.98 (95% CI = 1.10 - 3.58,

$p = 0.038$). The other factors were not associated with dry eye disease, including age, smoke exposure, history of dry mouth, history of allergy, watch screens for more than eight hours per day, glaucoma, and use of contact lenses. The p -value and adjusted odds ratio for each risk factor are shown in Table 3.

From the multivariable analysis using binary logistic regression analysis with backward method, history of pterygium, female, and symptoms of dry

mouth were significantly associated with dry eyes.

History of pterygium was most strongly associated with dry eyes, with an adjusted odd ratio of 2.910 (95% CI = 1.20 to 7.01, $p = 0.017$). Females were more likely to have dry eyes, with an adjusted odd ratio of 2.091 (95% CI = 1.14 to 3.83, $p = 0.02$). While symptom of dry mouth was also significantly associated with dry eyes with an adjusted odd ratio of 2.088 (95% CI = 1.02 to 4.26, $p = 0.04$), as presented in Table 4.

Table 3 OR (95%CI) and p-value of risk factors of dry eye disease by univariate analysis.

Risk factors	Univariate analysis			
	OR	95% CI		p -value
		Lower	Upper	
Female	1.98	1.10	3.58	0.022*
Age $\geq$ 60 years	0.79	0.39	1.60	0.507
History of allergy	0.95	0.47	1.92	0.886
Dry mouth	1.80	0.91	3.69	0.092
Glaucoma	0.24	0.03	2.35	0.185
Pterygium - Pinguecula	2.54	1.08	5.98	0.028*
History of eye surgery	1.93	0.59	6.39	0.272
Smoke exposure	1.29	0.73	2.27	0.382
Contact lens wearing	0.37	0.03	4.10	0.395
Screen time $\geq$ 8 hours per day	1.44	0.67	3.11	0.347

* $p < 0.05$

Table 4 Adjusted OR (95%CI) and p-value of risk factors of dry eye disease from multivariable analysis using binary logistic regression analysis with backward method.

Risk factors	Multivariable analysis			
	Adjusted OR	95% CI		p -value
		Lower	Upper	
Female	2.09	1.14	3.83	0.020*
Dry mouth	2.09	1.02	4.26	0.040*
Pterygium - pinguecula	2.91	1.20	7.01	0.017*

* $p < 0.05$

Discussion

There are no definite diagnostic criteria of “dry eye disease.” Several studies have used various diagnostic criteria. For instance, some studies used only symptoms whereas others used both symptoms and physical examination to diagnose the dry eyes. Certain studies in the last 15 years have shown that there was a poor association between symptoms and clinical signs for dry eyes.¹³⁻¹⁵ However, most population-based studies report the prevalence of dry eyes based only on symptoms that dramatically ranged from 5.5% to 50.1% depending on the study population and diagnostic criteria used.^{2-11,16} The present study defined dry eye disease when an individual has an OSDI score of 33-100 points, which indicates severe dry eye in the interpretation of the OSDI score assessment. This was because the authors assumed that the severe dry eye group would be more plausible in this current study which diagnosed dry eye disease by ocular symptoms-without clinical signs or tests. Consequently, the prevalence of dry eye was found to be 54.7%.

The prevalence of dry eyes varies because different questionnaires can be used by researchers. The lowest prevalence of dry eyes was reported by McCarty et al. which used a six-item questionnaire to diagnose dry eye disease, with a reported prevalence of 5.5% in Australia,⁴ which is likely due to the strict diagnostic criteria used in the study. Meanwhile, the highest prevalence was reported by Bo Guo et al. among Mongolians living at high altitude in China, with found a prevalence of 50.1% using a six-item questionnaire.⁹

In Thailand, Ngamjit et al. reported the prevalence of dry eye disease in Romklao district of 14.2% using

an eight-item questionnaire.¹¹ In addition, Lekhanont et al. used a six-item questionnaire and found the prevalence of dry eye disease among a hospital-based elderly Thai population to be 34.0%.¹⁷

In this study, the prevalence of dry eye disease was 54.7%. This prevalence is higher than those of the previous studies.²⁻¹¹ Although the participants in this study did not visit the hospital for an annual eye check-up, they were hospital-bound persons similar to the previous study.¹⁷ However, the differences between this study and the previous studies¹⁷ are the questionnaire, year of survey, and area.

In this current study, the prevalence of dry eye disease was higher among females (63.2%) than males (46.4%), which corroborates the findings from the previous studies that showed females were significantly more likely to develop dry eye symptoms.^{4-7,17} Likewise, Lamberts et al. showed that women had significantly less tear production compared to men around 60 years old.¹⁸ Moreover, Jing-Wen Hu et al. mentioned relatively severe symptom scores and worse tear film instability for females compared with their male counterparts. Another risk factor associated with females may be the application of cosmetics around the eyes which could both directly and indirectly disrupt the homeostasis of the ocular surface and tear film.¹⁶

In some studies, age was also reported to be correlated with dry eyes^{4,7,16,19} in terms of the aging process affecting the immune system, cellular metabolic metabolism, and inflammation of the ocular tissue.²⁰ However, the reason why some studies did not find any correlation between age and dry eyes^{2,11,21-23} could be due to the narrow age range of the study samples. This study also did not find any correlation

between age and dry eyes, with one potential reason for this being that 18.8% of the sample was elderly.

The present study demonstrated the relationship between pterygium and dry eye disease which corroborates with findings from previous studies.²⁴⁻²⁵ Additionally, the larger size pterygium tended to increase the level of severity of dry eye symptoms.²⁵ Patients with severe pterygium can suffer from blurred vision caused by astigmatism which was the most significant interference factor in their daily lives. However, the authors note that pterygium can often cause symptoms similar to dry eyes and this may have resulted in a misdiagnosis.

Regarding dry mouth as a risk factor for dry eyes, previous studies also present a significant association of it with dry eye symptoms.¹¹ However, the Melbourne VIP eye study[4] did not find this to be significant, while Hay et al. showed a weak association between dry eyes and dry mouth and objective measures said to define Sjögrens syndrome.²⁶ Additionally, the presence of dry eyes and dry mouth could be diagnosed as Sjögrens syndrome. In this study, dry mouth was not a significant risk factor for dry eye disease in univariate analysis. In contrast to binary logistic regression analysis, dry mouth was found to be another significant risk factor when compared to other possible risk factors. Consequently, symptoms of dry mouth would be an interesting risk factor for further study.

In some studies, allergic disease was reported to be correlated with dry eye disease,¹¹ but the findings from the present study do not support this. the Melbourne VIP Study and the Beaver Dam Eye Study found that allergic diseases could often cause symptoms similar to dry eyes and this may have caused misdiagnosis.^{4,7}

In previous studies, smoking was reported to be

significantly associated with dry eyes symptoms in the Beaver Dam Eye Study and the Riau Eye Study in Indonesia.^{6,25} They proposed that smoking acted as a direct irritant for the eyes. The present study did not find a significant association between smoke-exposure and dry eye, even though it included both smokers and second-handed smokers. This could be because the definition of smoke-exposure did not define the distance from a smoker or how long they stayed with the smoker while they smoked.

This study reported no association between a history of eye surgery and dry eye symptoms as the Beaver Dam Study and the Blue Mountains Eye Study reported.^{7,22} In contrast, Ngamjit et al. found that previous eye surgery was significantly associated with dry eyes symptoms after use of topical anti-inflammatory or other medications after eye surgery that can disrupt the neural feedback loop and cause insufficient tear production, which in turn can cause people to develop symptoms of dry eye. Nevertheless, this study did not collect information about topical eye drop medications currently being applied.

According to a large epidemiological study of office workers in Japan, contact lens wearers were found to be 2.38 times more likely to have a diagnosis of dry eyes.²⁷ In the 2007 report of the TFOS Dry Eye Workshop, contact lens use was categorized as a consistent risk factor of dry eye disease.²⁸ The simplified scheme for the mechanism of contact lens-associated dry eye disease is insufficient tear distribution, when a contact lens is inserted on the ocular surface, the tear film becomes separated into pre-lens and post-lens tear film. As the tear film becomes separated, the volume of the aqueous layer at the pre-lens tear film is decreased and there is increased friction between the

contact lens and the corneal/conjunctival surface. This friction between the contact lens and the ocular surface may cause foreign body, dryness, and discomfort sensations.²⁹ In this study, there was no association between contact lens use and dry eye disease, but this could be due to the low prevalence (1.5%) of regular contact lens use among the study participants.

In this study, no association between glaucoma and dry eye disease was found. This is in contrast to some previous studies that found a proportion of dry-eye patients have a coexisting glaucoma.³⁰ In Baudouin et al., it was suggested that chronic use of topical glaucoma treatments with preservatives may actually have permanent effects on the ocular surface.³¹

The results of the present study reveal that screen-time of longer than 8 hours per day has no bearing on the presence of dry eye disease. This finding is consistent with the findings of an earlier study which took into account all mortality and morbidity associated with COVID-19, which assumed that periods of lockdown resulted in people spending much more time viewing tablet, phone, and computer screens. The study found that despite 'an increase in ocular surface disease caused by greater screen time, this finding was insignificant. Cited by Moon et al. which studied children in South Korea, smartphone use and dry eye signs and symptoms resolved after 4 weeks of screen time cessation.³² In contrast with several previous studies, prolonged daily use of digital screens or visual display terminals may represent a significant risk factor for dry eye disease in both children³³ and adults,³⁴ due to decreased blink rate which is likely the primary mechanism by which electronic device use worsens dry eyes.

The authors expect that the results of this study

will raise concerns about the high prevalence of the dry eye disease and its long-term impact being underestimated. Hence, healthcare education and health policy will play an important role in dealing with modifiable risk factors both for prevention and also to promote appropriate treatment for dry eye patients and the general population.

Since the present study was limited to literate Thai respondents, this could have been a selection bias which limits the generalizability of the results. As a result of social-distancing issues, we could not have a translator explain all of the questionnaire to illiterate patients. Furthermore, the small sample size in some determinants, including glaucoma, history of eye surgery, and use of contact lenses, is another limitation. In addition, since the study was conducted at a general clinic, there were few patients with eye conditions in the sample. Moreover, this study relied entirely on the OSDI questionnaire to diagnose dry eye disease and did not conduct clinical tests as a confirmatory measure. The survey was also based on the participants' recall of recent symptoms, which contributes to recall bias.

Conclusion

In summary, this descriptive cross-sectional study performed in QSMH, a general hospital located at Chonburi province, eastern Thailand, found a high prevalence of dry eye disease among a hospital-based population by OSDI questionnaire. The risk factors for dry eye disease were female, dry mouth, and pterygium.

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