ASSOCIATIONS OF PREVENTIVE STRATEGIES WITH SYMPTOMS OF EYE STRAIN AMONG SUKHOTHAI THAMMATHIRAT OPEN UNIVERSITY STAFF IN THAILAND

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ABSTRACT:

Background: Eye strain or asthenopia is a public health problem that affects more than two thirds of all computer users globally. This cross-sectional study was designed to: (1) determine the prevalence of eye strain in computer user staff at Sukhothai Thammathirat Open University (STOU), (2) assess the extent to which strategies used by the computer user staff and whether they were associated with eye strain prevention.

Methods: Between January and February 2014, Proportional stratified random sampling was used to select 300 study participants in 11 offices of Sukhothai Thammathirat Open University, Thailand. A total of 295 (98.3% response rate) computer user staff completed a self-administered, validated questionnaire, including demographic characteristics, computer and work environment, strategies for eye care, and presence of eye strain symptoms. Data analysis was conducted to assess associations of adjusting computer and monitor, taking regular rest breaks, doing eye exercise, improving computer workstation, improving work environment, and reducing personal risk factors (i.e. get enough sleep, drink enough water, and regular eye exams), with symptoms of eye strain.

Results: (1) The prevalence of eye strain was very high, 84.7% (250 participants. Average age was 42 ± 9.31, and 231 (78.3%) were female. Worked with computer 3 or more hours per day were reported by 274 (92.9%) of the respondents. Majority of the respondents 261 (88.5%) used desktop computers. Nearly 70% of respondents (204) reported that their computer workstation were suitable, and 263 (89.2%) reported that lighting in work area were appropriate. (2) Binary logistic regression analysis indicated that taking regular rest breaks (OR = 0.37; 95% CI = 0.18-0.79) and doing eye exercise during computer use (OR = 0.07; 95% CI = 0.03 - 0.16) had a significant association with a lower rate of eye strain.

Conclusions: These findings indicate the need for awareness of eye strain, and for research to identify strategies to prevent/reduce eye strain in computer users, especially in educational institutions where computers are widely used.

Keywords: Preventive strategies, Eye strain, Computer user staff, Thailand

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INTRODUCTION

Computers have had tremendous influence on virtually all jobs including educational personnel. Computer technology has become an essential part of the educational system [1]. Sukhothai Thammathirat Open University (STOU) is one of two open universities in Thailand that has enabled the development of individuals and communities throughout Thailand and beyond. Students in all regions in the country study externally [2]. This heightened level of interest has led STOU to

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introduce a variety of educational technologies, including e-learning and webcast (e-tutorial), to provide learning opportunities to those students on a wide scale [3]. Almost all staff will be provided with personal computer. The increased use of computers in the workplace has brought about the development of a number of health problems especially eye strain.

Eye strain is an ophthalmological condition that becomes an increasingly common problem today. The medical term for eye strain is asthenopia [4]. The International Classification of Diseases (ICD), published by the World Health Organization (WHO), classifies eye strain under the general heading of subjective visual disturbances manifest by a degree of visual discomfort typically occurring after some kind of prolonged visual activity [5]. Eye strain is a symptom, not an eye disease. Eye strain is diagnosed on the basis of the symptoms that the patient provides with the absence of any serious eye diseases [4]. The important tool to diagnose ocular symptoms, especially dry eyes in population-based study, is by using a questionnaire of symptoms, since there is a weak association between ocular symptoms and their respective test results [6, 7]. Eye strain symptoms include smarting, itching, gritty feeling, aches, sensitivity to light, redness, teariness, and dryness. Eye strain will be defined as the reporting of three symptoms or more [8-10].

The main cause of eye strain is thought to be fatigue of the ciliary and extraocular muscles due to the prolonged accommodation and vergence required by near vision work [11]. Another causative factor that has been implicated in eye strain is dryness of the eyes resulting from an increased exposed surface area of the cornea when focusing straight ahead (rather than down at written text) and a decreased blink rate due to mental concentration [12]. Computer eye strain is also caused by a combination of factors such as low humidity, forgetting to take breaks, and using improper lighting. Although computer work has not yet proven to cause permanent damage to eyes, but temporary discomfort that may occur can reduce productivity. It can cause lost work time and reduce job satisfaction. This includes a reduction in work accuracy and a decrease in task volume [13].

The U.S. National Institute of Occupational Safety and Health reported that Computer eye strain may affect as many as 88% of office workers and will be the number one occupational hazard of the 21st century [13, 14]. Some studies indicate risk factors of eye strain. However, there is scarcity of studies on the prevalence of eye strain in Thailand, especially among computer user staff in open universities. Moreover previous findings leave key question unanswered: which of the eye care strategies that computer users commonly used is associated with the reduction of eye strain symptoms?

MATERIALS AND METHOD

A cross-sectional analytical study was conducted at Sukhothai Thammathirat Open University, Nonthaburi Province, Thailand. The target population was 850 staff that main characteristics of work are office working with computer. The sample size (n=284) was calculated by using G*Power 3.1.7 for Windows to reach a statistical power of 0.95, significance level (α = 0.05) and statistical power ($1-\beta$ = 0.80), and increased by 5% for nonresponse. Therefore, the total sample size was 300 participants. Proportional stratified random sampling was used to select computer user staff from 11 offices of the University.

Ethical view protocol no. 121.1/56 was approved by the Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University. Written informed consent was obtained from all participants. The self-administered questionnaire was validated by 5 experts prior to a tryout with a pilot group of 35 computer user staff of another university whose main characteristics were similar to the target. The value of IOC to find the content validity of the developed questionnaire was in the range of 0.80 – 1.00, and the value of the Cronbach's alpha was 0.81.

The participants had to answer 4 parts of the questionnaire: demographic characteristics, computer and work environment, strategies for eye care, and test for eye strain symptoms. Respondents were considered as having eye strain if they reported at least three of the following symptoms: smarting, itching, gritty feeling, aches, sensitivity to light, redness, teariness, and dryness. The preventive strategies included taking regular rest breaks, doing eye exercises, adjusting the position of computer and monitor, improving working environment, and reducing personal risk factors such as eating foods that nourish the eyes, get enough sleep and drink enough water.

The data were collected in February 2014. Statistical analysis was conducted to assess characteristics of the study population. Descriptive statistics presented as percentage, mean, median, and standard deviation (SD). Associations between the preventive strategies and eye strain symptoms were estimated using binary logistic regression models. Associations are presented as odd ratios (OR) with

Table 1 Characteristics of study populations, N = 295

Variables	Frequency	(%)
Age (years)	Mean 42.0 Min 21 Max 60 SD 9.31	
20-29	37	(12.5)
30-39	86	(29.2)
40-49	104	(35.3)
≥ 50	68	(23.0)
Gender		
Male	64	(21.7)
Female	231	(78.3)
Education		
Diploma of vocational education	56	(19.0)
Bachelor degree	195	(66.1)
Master degree	42	(14.2)
Doctoral degree	2	(0.7)
Years of working with computer	Mean 11.4 Min 1 Max 34 SD 6.87	
< 5	62	(21.3)
5-9	82	(27.8)
10-19	105	(35.6)
≥ 20	45	(15.3)
Days of working with computer per week	Mean 5.0 Min 3 Max 6 SD 1.19	
≤ 3	11	(3.7)
> 3	284	(96.3)
Hours of working with computer per day	Mean 6.0 Min 0.3 Max 15.0 SD 2.16	
< 3	21	(7.1)
3-5	88	(29.8)
> 5	186	(63.1)
Kind of work computer		
Desktop	261	(88.5)
Notebook	14	(4.7)
Both	20	(6.8)
Type of monitor		
LCD	268	(90.8)
CRT with filter	9	(3.1)
CRT no filter	18	(6.1)
Computer workstation		
Appropriate	204	(69.2)
Inappropriate	91	(30.8)
Lighting in work area		
Suitable	263	(89.2)
Too bright	21	(7.1)
Too dim	11	(3.7)
Thermal comfort		
Comfortable	229	(77.6)
Too hot	21	(7.1)
Too cold	45	(15.3)
Humidity of air		
Comfortable	212	(71.9)
Too dry	64	(21.7)
Too moist	19	(6.4)

95% confidence interval. All analyses were performed using statistical package software.

RESULTS

The 295 computer user staffs from 11 offices were recruited in this study. Table 1 shows characteristics of the study populations, the majority of the participants were female (78.3%). The overall mean age was 42 years with a standard deviation of 9.3 years, Bachelor degree (66.1%), worked with computers for over 5 years (78.7%). Almost all participants (96.3%) currently work with computer over 3 days a week, and 5 or more hours per day (63.1%). Regarding computer and work environment, most staff use desktop computers (90.0%), and LCD monitor (90.8%). More than

Table 2 The prevalence of eye strain of 295 respondents

Symptoms	Frequency	(%)
Eye strain	250	(84.7)
Smarting	224	(75.9)
Itching	158	(53.6)
Gritty feeling	164	(55.6)
Aching	202	(68.5)
Sensitivity to light	112	(38.0)
Redness	63	(21.4)
Teariness	139	(47.1)
Dryness	175	(59.3)
Other related symptoms		
Eye fatigue	197	(66.8)
Blurred vision	170	(57.6)
Headache	181	(61.4)

Table 3 Associations of preventive strategies with eye strain among staff computer users in STOU (p<0.05) (n=295)

Preventive strategies	n (%)	Eye strain (%)	*OR (95% CI)*	*p-value*
Take regular rest breaks	88 (29.8)	66 (75.0)	0.37 (0.18, 0.79)	**0.010***
Adjustment of computer and monitor	73 (24.7)	64 (87.7)	1.68 (0.67, 4.21)	0.272
Improve computer workstation	45 (15.3)	40 (88.9)	2.31 (0.73, 7.26)	0.154
Improve work environment	42 (14.2)	35 (83.3)	0.62 (0.21, 1.83)	0.384
Do eye exercises	81 (27.5)	56 (69.1)	0.74 (0.03, 0.16)	**0.000***
Reduce personal risk factors	69 (23.4)	58 (84.4)	0.96 (0.40, 2.31)	0.919
Used other strategies	7 (2.4)	6 (85.7)	1.91 (0.17, 21.78)	0.601

Total population (%) = 295 (100), Eye strain (%) = 250 (85), p < 0.05*

half of participants (69.2%) reported that computer workstation is appropriate, and majority of them reported proper lighting in work area (89.2%), proper temperature (71.6%), and proper humidity (77.9%).

Symptoms of eye strain were found to be quite common, 84.7% of the respondents reported three or more of eight symptoms. Smarting was the symptom most frequently reported – (75.9%), aching (68.5%) and dryness (59.3%). Other related symptoms, the most frequent of which was eye fatigue (66.8%), followed by headache (61.4%) of the respondents (Table 2).

The distributions of selected strategies among 295 respondents are shown in Table 3. Nearly 30% of respondents reported taking regular rest breaks, followed by doing eye exercises (27.5%; Table 3). Smaller percentages reported adjustment of computer and monitor (24.7%), reduce personal risk factors (23.4%), and improve computer workstation (14.2%). Eye strain was associated inversely with each of the adaptive strategies and particularly with reported do eye exercises (OR = 0.07; 95% CI = 0.03 - 0.16), and take regular rest breaks (OR = 0.37; 95% CI = 0.18-0.79) that had a significant association with a lower rate of eye strain.

DISCUSSION

This study illustrates the prevalence of eye strain of 84.7% of the surveyed population that is still very high comparable to the previous surveys conducted between 2006 and 2014. In Thailand eye strain and ocular complaints ranged from 24.4 to 96.4% [15-17], in worldwide; 51.0-81.9 % [18-20]. Three – fourths of the subjects who participated in this study were female. Mean age of all respondents were 42 years with a range of 21 to 60. These contributing factors may provide the opportunity to develop eye strain, in accordance a report by the National Institute of Occupational Health and Safety (NIOSH) [21, 22] indicated that workers over 40 years of age are predisposed to eye strain (headache, eye fatigue, and irritation). A review by Bhanderi [23] also found that eye strain was to be higher in the older group of computer users and in females. However, some studies by Bhanderi [23] and Agarwal [18] did not find any significant with the age and gender of the subjects with these ocular complaints.

The majority of the respondents (92.9%) reported working with computer for three or more hours a day that was a considerable factor leading to eye strain in accordance with the report by NIOSH in 1994 which indicated that 88% of 66 million people who work at computers for more than three hours a day were suffering from eye strain [24]. Similarly, periodic studies by others also reported that duration of computer work is directly related to

eye symptoms, and longer duration tends to result in long-lasting complaints [18, 23, 25-27].

Smarting was the symptom most frequently reported – (75.9%), aching (68.5%) and dryness (59.3%). Other related symptoms including eye fatigue, blurred vision, and headache were reported by 66.8%, 57.6% and 61.4% of the respondents respectively. These symptoms are grouped together under the term "computer vision syndrome" which is a complex of eye and vision-related problems that resulted from prolonged computer use [28, 29].

Around 30% of the respondents reported taking regular rest breaks, smaller percentages reported improving workstation (15.3%), and improving work environment (14.2%), which can be explained by the fact that the majority of the respondents indicated that computer workstation, lighting, thermal comfort , and humidity of air were suitable – 69.2%, 89.2%, 77.6% respectively.

Taking regular rest breaks and doing eye exercise had a significant association with a lower rate of eye strain in accordance with the study by Galinsky and colleagues [28] reported that supplementary breaks reliably minimized discomfort and eye strain without impairing productivity. The main cause of eye strain is fatigue of the ciliary and extra ocularmuscles due to the prolonged accommodation and vergence required by near vision work [11]. Doing eye exercise may help relieve tension accumulated in the ciliary muscles of the eye.

The noticeable finding of this study was that the respondents who reported that they improve computer workstation to reduce the discomfort of the eyes had symptom of eye strain as much as 88.9%. Similarly, 87.7% of the respondents who reported "adjustment of computer and monitor" were suffered from eye strain. The reason they use these strategies was probably resulted from inappropriate computer workstation and working environment which may be contributing factors causing eye strain. According to the studies of Mocci in 2001[30] and Han in 2013 [31], some part of the complaints about visual health reported by computer user staff are likely indirect expressions of psychological discomfort related to working conditions, including uncomfortable room temperature, poor air quality and noise.

The present study had some limitations that should be considered in future studies. The evaluation of work environment was self-reported that may lead to self-reporting bias and subjectivity. Future research may use industrial hygiene instruments for work environment assessment.

CONCLUSIONS

Based on the results of the analysis, the high proportion of eye strain makes it necessary to raise awareness of eye strain in computer user staff especially in educational institutions which currently, computers are used extensively to support the educational academic services. In addition, the majority of participants are trying to use a variety of eye care strategies by themselves; these findings suggest the need for rigorous research for the development of suitable program to prevent/reduce eye strain.

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REFERRENCES

1. Kendall O. Uses of computers in the educational field 2014 [cited 2014 Dec 15]. Available from: http://www.ehow.com/about_5432548_uses-computers-educational-field.html.
2. Pachanee C-a, Lim L, Bain C, Wibulpolprasert S, Seubsman S-a, Sleigh A. Smoking behavior among 84 315 open-university students in Thailand. Asia-Pacific Journal of Public Health. 2011; 23(4): 544-54.
3. Siritarungsri B, Suwansumrit C. Evaluation of the use of webcasting to support nursing learning. Journal of Nursing Science. 2011; 29(3): 36-41.
4. Dahl AA. Eye Strain. 2014 [cited 2014 December 18]. Available from: http://www.medicinenet.com/eye_strain/article.htm.
5. Sullivan JM. Visual fatigue and the driver. Ann Arbor, MI.: The University of Michigan Transportation Research Institute; 2008. Report number UMTRI-2008-50.
6. Kasetsuwan N, Gorvanich S, Erjongmanee S, Thienprasiddhi P, Jitapunkul S. Prevalence of dry eyes in elderly Thai population (the Romklao eye study). Asian Biomedicine. 2012; 6(6): 875-82.
7. Hay EM, Thomas E, Pal B, Hajeer A, Chambers H, Silman AJ. Weak association between subjective symptoms of and objective testing for dry eyes and dry mouth: results from a population based study. Annals of the Rheumatic Diseases. 1998; 57(1): 20-4.
8. Knave BG, Wibom RI, Voss M, Hedstrom LD, Bergqvist UO. Work with video display terminals among office employees. I. Subjective symptoms and discomfort. candinavian Journal of Work Environment & Health. 1985; 11(6): 457-66.
9. Hemphälä HL, Johansson GL, Odenrick PL, Åkerman K, Larsson P. Lighting recommendations in operating theatres. Proceedings of the 17th World Congress on Ergonomics 2009. Sweden: Lund University Publications; 2009.
10. Aronsson K. Visual ergonomics and eye strain in eye

careprofessionals. In: Antonsson AB, Hägg GM, editors. NES2012 Proceedings: Ergonomics for sustainability and growth; Sweden; August 19-22, 2012.

11. Vertinsky T, Forster B. Prevalence of eye strain among radiologists: Influence of viewing variables on symptoms. American Journal of Roentgenology. 2005; 184(2): 681-6.
12. Thomson WD. Eye problems and visual display terminals - the facts and the fallacies. Ophthalmic and Physiological Optics. 1998; 18(2): 111-9.
13. Charpe N, Kaushik V. Computer Vision Syndrome (CVS): Recognition and control in software professionals. Journal of Human Ecology. 2009; 28(1): 67-9.
14. Radtke A. How to treat tired eyes 2014 [updated 2014 January 2014; cited 2015 January 7]. Available from: http://www.opticgallerysummerlin.com/category/eye-care/
15. Sirikul T, Kampitak K. Prevalence of Computer vision syndrome in computer users. Thai J Ophthalmol. 2006; 4: 21-8.
16. Sornboot J, Phakthongsuk P, Thangtrison S. Prevalence of visual fatigue and its determinants among computer users in the Faculty of Medicine, Prince of Songkla University. Songkla Med J. 2009; 27(2): 91-104.
17. Chitnayee C, Charuchart W, Chitnayee S. The relationship between visual fatigue and occupational vision test among computer users in Uttaradit Hospital. Journal of Health Science Research. 2013; 7(2): 47-54.
18. Agarwal S, Goel D, Sharma A. Evaluation of the factors which contribute to the ocular complaints in computer users. Journal of Clinical and Diagnostic Research 2013; 7(2): 331-5.
19. Fenga C, Di PR, Fenga P, Di NC, Spinella R, Cacciola A, et al. Asthenopia in VDT users: our experience. G Ital Med Lav Ergon. 2007; 29(3 Suppl): 500-1.
20. Logaraj M, Madhupriya V, Hedge s. Computer vision syndrome and associated factors among medical and engineering students in Chennai. Ann Med Health CCi Res. 2014; 4(2): 179-85.
21. Moss E, Roegner K. Hazard evaluation and technical assistance report. Atlanta, GA: Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health; 1998. (Health Hazard Evaluation Report 97-0245-2696)
22. Musolin K. Assessment of visual and neurologic effects among video hub employees ─ New York. Atlanta, GA: Department of Health and Human Services, Centers for Disease Control and Prevention ; 2012. (Health Hazard Evaluation Report 2011-0149-3165)
23. Bhanderi DJ, Choudhary S, Doshi VG. A community-based study of asthenopia in computer operators. Indian Journal of Ophthalmology. 2008; 56(1): 51-5.
24. Anshel J. Visual ergonomics handbook. Boca Raton, FL: CRC Press - Taylor & Francis; 2005. p. 3-24.
25. Bergqvist UO, Knave BG. Eye discomfort and work with visual-display terminals. Scandinavian Journal of Work Environment & Health. 1994; 20(1): 27-33.
26. Hanne W, Brewitt H. Changes in visual function caused by work at a data display termina. Ophthalmologe. 1994; 91(1): 107-12.
27. Kanitkar K, Carlson A, Richard Y. Ocular problems associated with computer use: the ever-increasing hours spent in front of video display terminals have led to a corresponding increase in visual and physical ills. Review of Ophthalmology E-Newsletter. 2005.
28. Galinsky T, Swanson N, Sauter S, Dunkin R, Hurrell J, Schleifer L. Supplementary breaks and stretching exercises for data entry operators: a follow-up field study. American Journal of Industrial Medicine. 2007; 50(7): 519-27.
29. American Optometric Association [AOA]. Computer vision syndrome: American Optometric Association; [cited 2015 January 7]. Available from: http://www.aoa.org/patients-and-public/caring-for-your-vision/protecting-your-vision/computer-vision-syndrome?sso=y
30. Mocci F, Serra A, Corrias GA. Psychological factors and visual fatigue in working with video display terminals. Occupational and Environmental Medicine. 2001; 58(4): 267-71.
31. Han C-C, Liu R, Liu R-R, Zhu Z-H, Yu R-B, Ma L. Prevalence of asthenopia and its risk factors in Chinese college students. International Journal of Ophthalmology. 2013; 6(5): 718-22.