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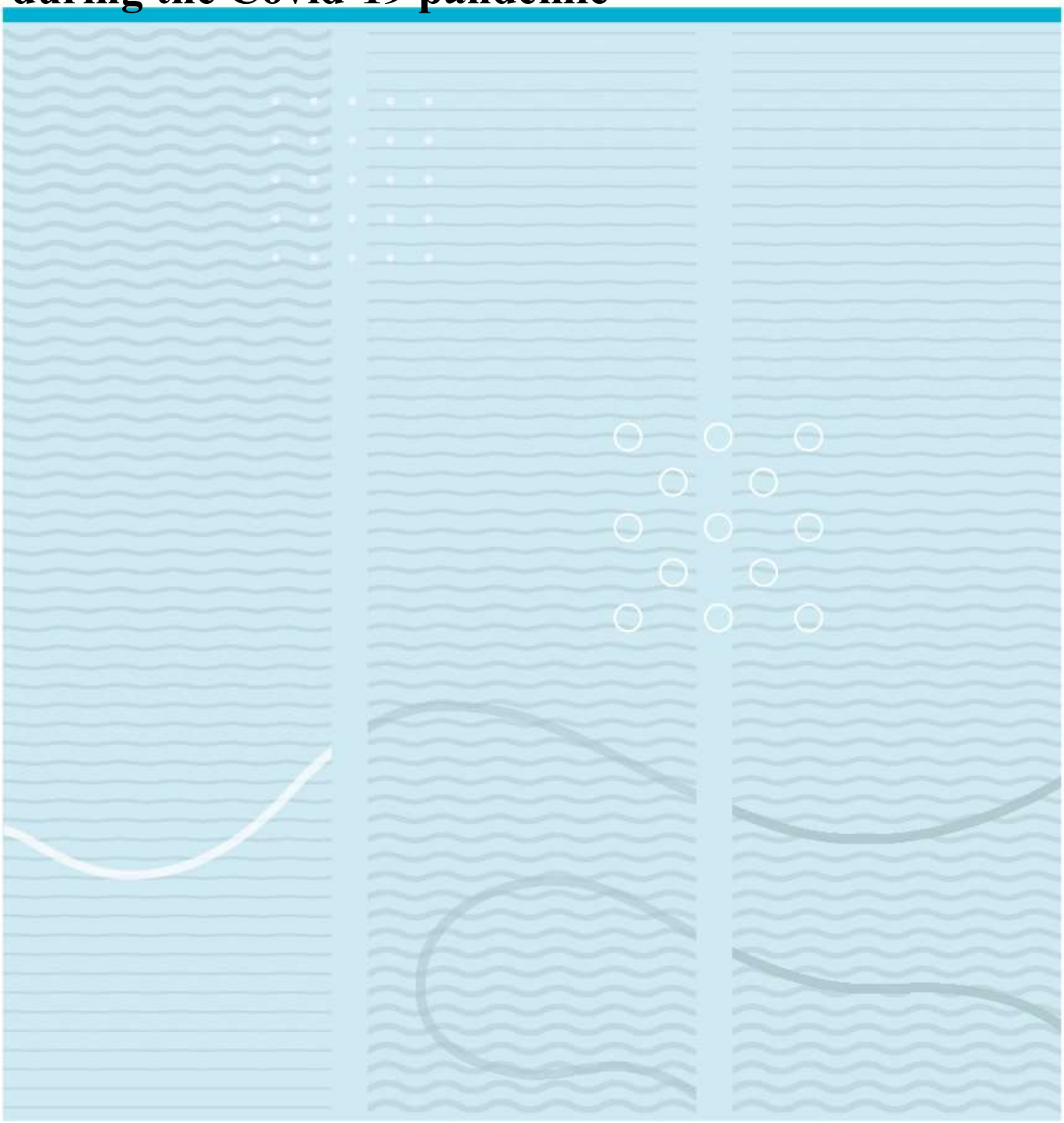
Dry eye symptoms among Finnish academic and non-academic university staff working at home during the Covid-19 pandemic



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This thesis is worth 30 study points

Summary

Purpose: Dry eye disease is common disorder and has an impact to people´s everyday life. It interferes vision and affects to work productivity. Many employees had to change to remote work during covid-19 pandemic and workload with computer increased. Using screens has shown to increase dry eye symptoms. Aim of this study was to describe the presence and the degree of dry eye symptoms and associated risk factors among academic and non-academic university staff in Finnish workplace.

Method: The data of dry eye symptoms and possible risk factors were collected with electronic questionnaire in the university´s intranet. Participants were staff members as lecturers and administrative persons. The Ocular Surface Disease Index (OSDI) was used to determine presence and severity of the dry eye. Considering the dry eye vs. non-dry eye, score of 13 or more was used. Subjects were grouped by age and by use of computer. Statistical methods were used to determine the differences by sex, age, using computer, contact lens wearing and having refractive surgery. Hypothesis tests were two-sided with the significance at 0.05 level and 95% confidence interval.

Results: 196 staff members completed the questionnaire. 53 (27%) of the subjects were men and 143 (73%) were women. The mean age of all participants was 49.5 ±10 with the range of 27-69 years. Eighteen (9.2%) reported to use contact lenses and 25 (12.8%) having refractive surgery. All participants used computer and mean daily time was 8.3 ±2.2 hours. Mean OSDI score was 24.8 ±15.9. In all, 73.0% (n=151) had score ≥13 indicating at least mild dry eye symptoms women (83.2%) having higher proportion than men (60.4%). Proportions dependent on sex was statistically significantly ($\chi 2$ (1) = 11.040, p < 0,001). In all 54% had score ≥23 indicating moderate or severe dry eye symptoms. Mean OSDI score were 18.5 sd. ±15.3 and 27.2 sd. ±15.6 for men and women respectively and the difference between sexes was significant (U=5073.5, p<0,001). Mean scores were statistically different within the six age groups (H=14.520, p=0,006). Youngest group (20-29 years) had statistically significantly lower score (p=0,013) comparing to oldest group and the age groups 30-39 years had statistically significant lower OSDI score than older three age groups 40-49 years, (p=0.017), 50-59 years (p=0.45) and 60-69 years (p<0.001).

In different computer use groups prevalence of dry eye symptoms were 74.6% (≤7 hours), 76.5% (8-9 hours) and 80.1% (≥10 hours). Distributions were not dependent of computer using time ($\chi 2$ (2) = 0.627, p= 0.731). In contact lens users and participants with refractive surgery 77.85% and 72.0% had dry eye symptoms and prevalences were not statistically significant ($\chi 2$(1), 0.006, p= 0.938 and $\chi 2$ (1) 0.412, p= 0.514).

Conclusion: Dry eye symptoms was common among participants in Finnish workplace. Women and older persons reported higher severity of symptoms but unlike previous studies, using computer longer time was not affecting to symptoms.

Keywords: dry eye, symptoms, Covid -19, pandemic

Sammanfattning

Avsikt: Torra ögonsjukdomar är vanliga sjukdomar och påverkar människors vardag. Det stör synen och påverkar arbetsproduktiviteten. Många medarbetare fick byta till distansarbete under coronapandemin och arbetsbelastningen med datorn ökade. Användning av skärmar har visat sig öka torra ögonsymtom. Syftet med denna studie var att beskriva närvaron och graden av torra ögonsymtom och tillhörande riskfaktorer bland akademisk och icke-akademisk universitetspersonal på den finska arbetsplatsen.

Metod: Data om torra ögon symtom och möjliga riskfaktorer samlades in med elektronisk enkät i universitetets intranät. Deltagarna var anställda som föreläsare och administrativa personer. Ocular Surface Disease Index (OSDI) användes för att bestämma närvaro och svårighetsgrad av det torra ögat. Med tanke på det torra ögat jämfört med icke-torrt öga användes poäng på 13 eller mer. Ämnena grupperades efter ålder och med hjälp av dator. Statistiska metoder användes för att bestämma skillnaderna efter kön, ålder, med hjälp av dator, kontaktlinsbärande och brytningskirurgi. Hypotes tester var tvåsidiga med betydelsen på 0,05 nivå och 95% konfidensintervall.

Resultat: 196 anställda besvarade frågeformuläret. 53 (27%) av försökspersonerna var män och 143 (73%) var kvinnor. Medelåldern för alla deltagare var 49,5 ±10 med intervallet 27-69 år. Arton (9, 2%) rapporterade att använda kontaktlinser och 25 (12,8%) med brytning kirurgi. Alla deltagare använde dator och genomsnittlig daglig tid var 8,3 ±2,2 timmar. Genomsnittlig OSDI-poäng var 24,8 ±15,9. Totalt hade 73,0% (n=151) poäng ≥13 vilket indikerar att kvinnor med lindriga minst torra ögon (83,2%) hade högre förhållande än män (60,4%). Andelen som var beroende av kön var statistiskt signifikant ($\chi 2$ (1) = 11 040, $p < 0,001$). Totalt hade 54% poäng ≥23 vilket indikerar måttliga eller allvarliga torra ögonsymtom. Genomsnittlig OSDI-poäng var 18,5 sd. ±15,3 och 27,2 sd. ±15,6 för män respektive kvinnor och skillnaden mellan könen var betydande (U =5073,5, p p<0,001). Medelpoängen var statistiskt olika inom de sex åldersgrupperna (H=14,520, p=0,006). Den yngsta gruppen hade statistiskt signifikant skillnad (p=0,013) jämfört med äldsta gruppen och åldersgrupperna 30-39 år hade statistiskt signifikant skillnad i OSDI-poängen än äldre tre åldersgrupper 40-49 år, (p=0,017), 50-59 år (p=0,45) och 60-69 år (

(p<0.001).

I olika datoranvändningsgrupper var prevalensen av torra ögonsymtom 74,6% (≤7 timmar), 76,5% (8-9 timmar) och 80,1% (≥10 timmar). Distributionerna var inte beroende av datorns driftid (χ2 (2) = 0,627, p= 0,731). Vid kontaktlins hade användare och deltagare med brytningskirurgi 77,85% och 72,0% torra ögon symtom och prevalenser var inte statistiskt signifikanta (χ2(1), 0,006, p= 0,938 och χ2 (1) 0,412, p= 0, 514).

Slutsats: Torra ögon-symtom var vanliga bland deltagarna på den finska arbetsplatsen. Kvinnor och äldre personer rapporterade högre svårighetsgrad av symtom men till skillnad från tidigare studier påverkade användningen av datorn längre tid inte symtomen.

Nyckelord: dry eye, symptoms, Covid -19, pandemic

Contents

Foreword

The period of Covid-19 pandemic affected our lives and changed it enormously. This thesis is a child of that era. I would like to thank my supervisor Vibeke Sundling for her clear and encouraging advises.

29.10.2021

Satu Autio

1 Introduction

Dry eye disease (DED) is a common disorder of the tear film that can lead to damage of ocular surface accompanying many symptoms as ocular discomfort, sensitivity to light, redness, fatigue, and transient blurring of vision (Craig et al., 2017). It has been shown to affects quality of life (Paulsen et al., 2014) and work productivity by reducing both (Uchino et al., 2014). DED is a global problem and in large epidemiological studies, prevalence is reported to be about 5% to over 50% at various regions and ages (Stapleton et al., 2017).

There is a strong evidence about risk factors for the DED including female sex, older age, postmenopausal estrogen therapy, a diet that is low in omega 3 essential fatty acids or has a high ratio of omega 6 to omega 3 fatty acids, refractive surgery, and vitamin A deficiency (Stapleton et al., 2017). Contact lens wearers are more likely to report severe dryness symptoms (Dumbleton et al., 2013; Uchino et al., 2011) and computer users often complain symptoms as eye strain, burning, irritation, redness, blurred vision, and dry eyes (Rosenfield, 2011).

Dry eye disease (DED) is a common condition and in Nordic countries there are climatic factors that enhance probability to the dry eye symptoms and disease, e.g., low humidity and indoor central heating. Nevertheless, prevalence of DED has been reported to be 11%-16% Denmark and Sweden (Bjerrum, 1997; Jacobsson et al., 1989) and 46% in Norwegian optometric practices (Ystenæs, Sand, & Sundling, 2021). There is a lack of epidemiological studies about the dry eye symptoms in Finland so this study will give more information to this area.

The aim of this study is to increase the knowledge of the dry eye symptoms among Finnish academic and non-academic university staff working at home during the Covid-19 pandemic. The focus in this project is to investigate the prevalence of dry eye symptoms and investigate the association between dry eye and age, sex, and computer use.

2 Dry eye symptoms

2.1 Classification of dry eye disease

According to the International Dry Eye WorkShop II dry eye is defined as "a multifactorial disease of the ocular surface characterized by a loss of homeostasis of the tear film, and accompanied by ocular symptoms, in which tear film instability and hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities play etiological roles" (Craig et al., 2017). Dry eye disease (DED) is classified with two main types as aqueous tear-deficient dry eye and evaporative dry eye, but environmental aspects also influence like low humidity or systemic drugs. Two DED types needs a different kind of management, and it is therefore important to establish the exact diagnosis (DEWS, 2007). In aqueous tear-deficient dry eye there is a failure of lacrimal tear secretion and tear secretion is reduced. Sub types of aqueous tear-deficient dry eye are Sjögren syndrome and non-Sjögren syndrome dry eye. Sjögren syndrome is defined as dry eye and dry mouth associated with systemic immune dysfunction. Evaporative dry eye is due to excessive water loss from the exposed ocular surface in the presence of normal tear secretion. It may be intrinsic, where the regulation of evaporative loss from the tear film is directly affected e.g., by meibomian lipid deficiency, poor lid dynamics or low blink rate. Extrinsic causes include vitamin A deficiency, the action of toxic topical agents such as preservatives, contact lens wear and a range of ocular surface diseases, including allergic eye disease. Evaporative dry eye is more common, but both forms usually occur simultaneously in the most severe cases. Distinguishing between these two main types and determining if they exist individually or as a mixed is important for DED diagnosis and treatment. It is more likely that both types will become apparent clinically as the disease progresses (Craig et al., 2017).

The most common cause of evaporative dry eye is meibomian gland dysfunction (MGD). That is an abnormality of the meibomian glands, commonly characterized by terminal duct obstruction and qualitative and quantitative changes in the glandular secretion (Nelson et al., 2011). Terminal duct obstruction is due to hyperkeratinisation of the ductal epithelium and increased meibum viscosity. The obstruction causes pathologic alteration in meibum leading to degenerative dilation and atrophy of the glands. (Knop,

Knop, Millar, Obata, & Sullivan, 2011). The International Workshop on Meibomian Gland Dysfunction estimated the prevalence of the MGD is in Caucasians being from 3.5% to 19.9% (Nichols et al., 2011).

2.2 Ocular Surface Disease Index

There is no golden standard of questionnaires, and many has been developed. DEW II introduced in its report 17 questionnaires. They might include dichotomous questions (yes/no) if subject has dry eye or feeling eyes dry or ask specific DED symptoms as grittiness or burning sensation. Some questionnaires ask frequency or intensity of the symptoms and triggers as environmental aspect like wind or heat. Outcome can be also dichotomous, dry eye disease or not or the seriousness of DED is evaluated. Most used questionnaires that measure severity of DED are Impact of Dry Eye on Everyday Life (IDEEL) and the Ocular Surface Disease Index, OSDI. Both are multidimensional and assess the quality-of-life changes (Stapleton et al., 2017).

Ocular Surface Disease Index is developed by the Outcomes Research Group at Allergan Inc and has been extensively used in clinical trials. OSDI includes 12 questions assessing the frequency of the dry eye symptoms, effects on daily tasks and aggravation by environmental triggers over the past week (table 2-1). Subject rate their responses on a Likert-type 0 to 4 scale with 0 corresponding to “none of the time” and 4 corresponding to “all of the time.” A final score is calculated on the bases of formula [(sum of scores for all questions answered) x 100]/[(total number of questions answered) x 4]. Score ranges from 0 to 100 with scores 0 to 12 representing normal, 13 to 22 representing mild dry eye disease, 23 to 32 representing moderate dry eye disease, and greater than 33 representing severe dry eye disease (Schiffman, Christianson, Jacobsen, Hirsch, & Reis, 2000).

OSDI questionnaire is reliable, validated and translated to many languages. Schiffman et al. (2000) has reported the OSDI score demonstrating good specificity (0.83) and a moderate sensitivity (0.60) when distinguishing between patients with dry eye disease and normal subjects. The OSDI as a whole and its 3 subscales individually are all internally consistent and display good-to-excellent test–retest reliability. Although the

questionnaire is only weakly correlated with clinical dry eye tests, it is strongly correlated with several other dry eye questionnaires. Okumura et al. (2020) reviewed 25 questionnaires and reported OSDI having sufficient evaluated for psychometric properties and including health-related quality of life-related items.

Table 2-1 The 12 items of OSDI with three subscale

Ocular symptoms	1. Eyes that are sensitive to light? 2. Eyes that feel gritty? 3. Painful or sore eyes? 4. Blurred vision? 5. Poor vision?
Vision-related functions	6. Problems with reading? 7. Problems with driving at night? 8. Problems with working with a computer or bank machine? 9. Problems with watching television?
Environmental triggers	10. Problems in windy conditions? 11. Problems in places or areas with low humidity (very dry)? 12. Areas that are air-conditioned?

2.3 Prevalence of the dry eye disease diagnosed by symptoms

Stapleton et al. (2017) reported large epidemiological studies having prevalence of the dry eye disease being about 5% to over 50% in general, independent of diagnostic criteria. The proportion of DED varied partly because of different population sampling techniques or diagnostic criteria. Dry Eye WorkShop II 2017 reviewed 14 studies of DED diagnosed by symptoms published between 2005-2015 years. Most studies concerned Asian populations, but it included three studies from Europe and two from USA among Caucasians population. If excluding one study because of the older age cohort, the estimation of prevalence of dry eye disease diagnosed by symptoms appears to be 15%-22%, and female having increasing risk. Latest population studies in Canada (Caffery et al., 2019) and Netherlands (Vehof, Snieder, Jansonius, & Hammond, 2021) estimated the

prevalence been 21% and 9% respectively. Table 2-2 summarise the prevalence studies of dry eye based on symptoms among Caucasian population.

Table 2-2 Prevalence of dry eye disease based on symptoms

Authors	Country, N	Age	Preval. all (%)	Preval. women (%)	Preval. men (%)	Diagnostic criteria
Moss 2008	USA 2414	48-91	21.6	25.0	17.2	One or more symptoms of dry eye often or all the time.
Viso 2009/11	Spain 654	40-96	18.4	21.8	12.5	Symptoms often or all the time.
Paulsen 2014	USA 3275	21-84	14,5	17.9	10.5	Symptoms sometimes or more often and were moderately bothersome or greater, or reported currently using eye drops at least once a day.
Vehof 2014	England 3824	20-87		20.8		Dry eyes in the past 3 months or longer, foreign body sensation with itching and burning or sandy feeling lately not related to allergy.
Caffery 2019	Canada 5163	≥18	21.3	24.7	18.0	DEQ-5 >6/22
Vehof 2020	Netherlands 79866	20-96	9.1	11.9		Symptoms constantly or often of feeling dry eyes and/or irritation and/or previous clinical diagnosis.

2.4 Risk factors of the dry eye disease

Epidemiology studies has shown that the dry eye disease is more prevalent among female and older subjects (Caffery et al., 2019; Moss, Klein, & Klein, 2000; Paulsen et al., 2014; Uchino et al., 2011; Vehof et al., 2021). Subcommittee of DEWS II reviewed studies during the last decade and reported an age being one of the strongest risk factors in dry eye disease showing linear association (Stapleton et al., 2017). Later studies confirmed the association but not the linearity. Symptomatic DED was particularly common in an age

category of 20-30 years in Netherland (Vehof et al., 2021) and in age category 18-24 years in Canada (Caffery et al., 2019). DEWS II reported that sex was not so clear risk factor in younger age but after 50 years of age it is more consistent (Stapleton et al., 2017). Similarly, Verhof (2021) and Caffery (2019) reported sex difference being lowest under the age of 40 years.

DEWS II reported in its review also an Asian race, Meibomian gland dysfunction, connective tissue disease and Sjögren syndrome, androgen deficiency, computer use, contact lens wear, hormone replacement therapy, hematopoietic stem cell transplantation, few medications and environment factor as consistent risks. Prevalence of DED is up to four time higher among contact lens user compared to non-users. Refractive surgery is a probable risk factor of DED according to DEW II (Stapleton et al., 2017). Limbal or corneal incisions related to refractive surgery as PRK, LASIK and cataract surgery might cause reflex block and ADDE but also meibomian gland function may be altered after cataract surgery (Han et al., 2014).

Computer users often have symptoms as eye strain, burning, irritation, redness, blurred vision, and dry eyes. Sustained visual attention to a computer monitor leads to decreased blink rate and incomplete lid closure or high monitor position might lead to dry eye symptoms that appears to be a major reason for the computer vision syndrome (Rosenfield, 2011). According to the meta-analysis prevalence of the dry eye among video display terminal (VDT) workers was 11.6% if using two criteria and 54.0% if studies use three criteria (Courtin et al., 2016). Among office workers in eight European countries, 34% had dry eye symptoms during the past four weeks (de Kluizenaar et al., 2016). DED prevalence of 50.9%-72.3% (Hernandez-Llamas, Paz-Ramos, Marcos-Gonzalez, Amparo, & Garza-Leon, 2020; Portello, Rosenfield, Bababekova, Estrada, & Leon, 2012) were reported among VDT users when defining DED as a OSDI score 13 or more.

3 Methods

3.1 Study population and study sample

Study was the cross-sectional study. Study population was the academic and non-academic workers of the Helsinki Metropolia University of Applied Sciences. Total number of the population was 941 including 555 academic and 386 non-academic workers. Total cohort consist of 61% of female and 39% of male and mean age was 49,8 years (Jäkälä et al., 2020). All workers were invited to answer the questionnaire by intranet announcements. Study sample was 196 participants from the study population. For the required sample size formula was counted using 95% confidence interval and precision of 0,05 (Charan & Biswas, 2013). Expected proportion is 15% base of the previously published studies of dry eye prevalence. Required sample size was 196.

$$n = \frac{Z^2 P(1-P)}{d^2} = \frac{1{,}96^2 \times 0{,}15(1-0{,}15)}{0{,}05^2} = 196$$

3.2 The questionnaire

Dry eye symptoms was collected by the Ocular Surface Disease Index (OSDI) questionnaire. Age was recorded in years on a continuous numerical scale and sex was recorded in dichotomous scale where female=0 and male=1. Computer use was recorded average hours per day as a continuous numerical scale. Refractive surgery was recorded in dichotomous scale where yes=0 and no=1 and contact lens (CL) wear was recorded average hours per day as a continuous numerical scale.

Questionnaire was linked to the intranet of the Metropolia University of Applied Sciences in December 2020 and January 2021. In the intranet OMA there was an announcement and link to the electronic-form (E-lomake). The announcement was published three times altogether. OSDI questionnaire was available in Finnish and English translation is attached as Annex 1. There was possibility to leave name if subject wanted to have feedback. Score 13 was considered to indicate dry eye symptoms if categorized non-DED symptoms and DED symptoms. Severity of dry eye symptoms was classified using the following criteria:

No symptoms is score 0-12, mild symptoms is 13-22, moderate symptoms is score 23-32 and severe is score 33-100.

3.3 Statistical analysis

The data was analysed using IBM SPSS Statistics 27 Version 27.0.1. package software. Descriptive analyses consist of frequencies, proportions, means and standard deviations of participants including sex, age by years, using computer by hours, contact lens using and having refractive surgery. Grouping was done for statistical analysing. Age was grouped to 20-29 years, 30-39 years, 40-49 years, 50-59 years, and 60-69 years. Computer use was grouped as using ≤7 hours, 8-9 hours and ≥10 hours. OSDI score was calculated and means, and standard deviations was described. Inferential statistics included chi-square test for categorical variables and to compare the means of OSDI score. Spearman correlation test was used to measure correlation between age and OSDI score. Kruskal-Wallis H -test was used to test OSDI means dependency of different age and computer use groups. Mann-Whitney U-test was used to test dependency in case of categorical variables as contact lens users and non-users and subjects with refractive surgery and non-surgery. Hypothesis tests were two-sided with the significance at 0.05 level and 95% confidence interval.

3.4 Ethical considerations

OSDI questionnaire was valid for testing dry eye according to the international Dry Eye WorkShop (Wolffsohn et al., 2017). Symptom questionnaire included information about the study, purpose of it and how the information was handled (Annex 2). They were informed that they can drop out whenever they want, without giving any reason why. The participants were identified by an ID-number instead of using name or birth date to assure anonymity. This ID-number was used in the analysis. Electronic data was handled in accordance with the Personal Data Act (523/1999) and the EU general data protection regulation 2016/679 (GDPR).

Research director manager approved the study in November 2018 at the Helsinki Metropolia University of Applied Sciences. Ethical evaluation of the study protocol was executed in Finland by the Ethics Committee of the Hospital District of Helsinki and Uusimaa (HUS) in 9.9. 2020. The Regional Committees for Medical and Health Research Ethics (REC) have evaluated and approved of the project in 20.3.2019 in accordance with The Health Research Act § 10, reference 2019/376 REK sør-øst B. NSD assessed the personal data collecting and handling and approved the protocol in 27.8.2020.

4 Results

The study was conducted between December 2020 and January 2021. Total of 196 participants answered the questionnaire. 53 (27%) of the subjects were males and 143 (73%) were females. The mean age of all participants was 49.5 ±10.0 with the range of 27-69 years. Male participants were a bit younger, mean ages were 48.1 ±10,7 and 50.0 ± 9.6 with male and female respectively but was not statistically significant (t (194)= -1.163, p=0.246). Study sample was stratified to five age groups by decades and distributions are seen in Table 4-1.

Of the study sample, 18 (9.2%) reported to use contact lenses and 8 of that group use lenses 6 hours or more during a day. Off all participants 25 (12.8%) reported to having refractive surgery. All participants used computer and mean daily time was 8.3 ±2.2 hours with the range of 2-20 hours.

Table 4-1 Demographic characteristics of participants

Variable	Male (n=53)	Female (n=143)	All (n=196)
Age group			
20-29 years, n, (%)	5 (9.4%)	1 (0.7%)	6 (3.1%)
30-39 years, n, (%)	7 (13.2%)	20 (14.0%)	27 (13.8%)
40-49 years, n, (%)	13 (24.5%)	49 (34.3%)	62 (31.6%)
50-59 years, n, (%)	20 (37.7%)	39 (27.3%)	59 (30.1%)
60-69 years, n, (%)	8 (15.1%)	36 (25.2%)	42 (21.4%)
Contact lens users, n, (%)	3 (5.7%)	15 (10.5%)	18 (9.2%)
Refractive surgery, n, (%)	7 (13.2%)	18 (9.1%)	25 (12.8%)
Computer use, mean hours (sd)	7.7±2.6	8.5±2.0	8.3±2.2

4.1 Dry eye symptoms

Mean OSDI score for all participants was 24,9 ±15,9. Based on OSDI -criteria ≥13 overall prevalence of dry eye symptoms was 73.0% (n=151). Subgroups of dry eye symptoms

severity was normal, mild, moderate and severe. Among all participants proportions were 23%, 23%, 25% and 29% respectively and are described in (Table 4-2).

Table 4-2 Prevalence and severity of dry eye symptoms

Variable	Normal 0-13	Mild 13-22	Moderate 23-32	Severe 33-100	Mean, std. OSDI score
All n,(%)	45(23.0%)	45(23.0%)	49(25.0%)	57(29.1%)	**24.9 ±15.9**
Male n,(%)	21(39.6%)	12(22.6%)	13(24.5%)	7(13.2%)	**18.5±15.3**
Female n,(%)	24(16.8%)	33(23.1%)	36(25.2%)	50(35.0%)	**27.2±15.6**

Table 4-3 OSDI score in various subgroups

Age group	OSDI score
All	**24.9 ±15.9**
27-29 years	13.4±9.0
30-39 years	18.1±15.3
40-49 years	25.9±16.1
50-59 years	24.1±14.1
60-69 years	30.5±17.2

Contact lens users	OSDI score
No	25.1±16.1
Yes	23.0±14.8
Refractive surgery	**OSDI score**
No	25.0±15.7
Yes	24.0±17.7
Computer use	**OSDI score**
≤7 hours, n=59	22.7±16.2
8-9 hours, n=85	25.4±15.4
≥10 hours, n=52	26.5±16.5

4.2 Sex

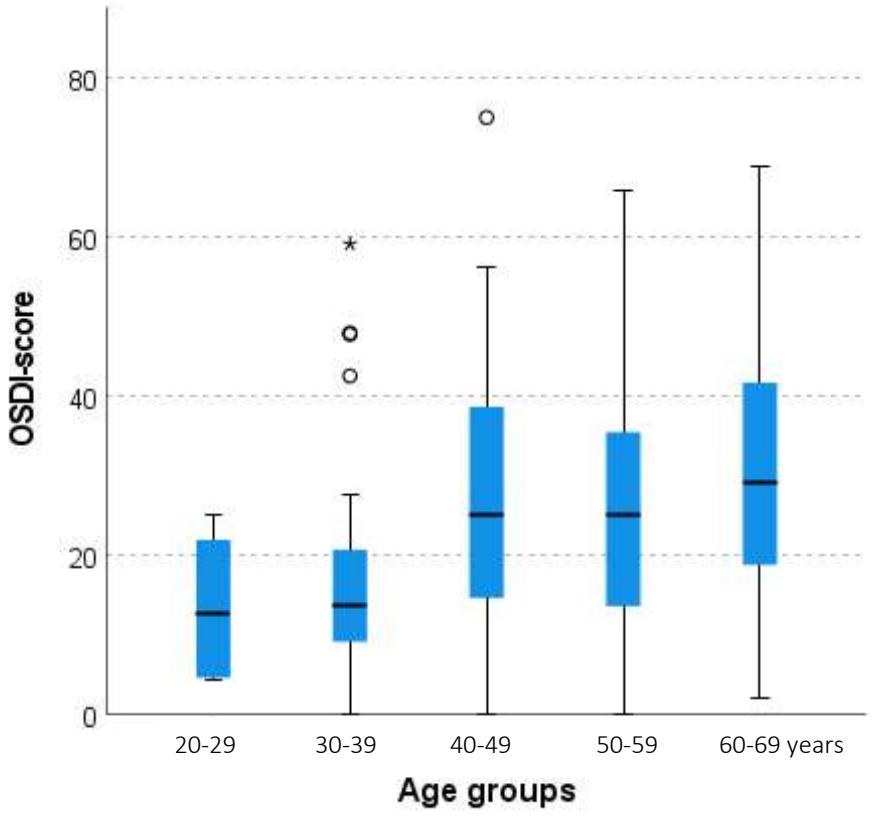
Based on criteria OSDI score ≥13, prevalence of dry eye symptoms by sex was 60.4% (n=32) with men and 83.2% (n=119) for women. Proportions was dependent on sex statistically significantly ($\chi 2$ (1) = 11.040, $p < 0{,}001$). Mean OSDI scores were 18,5 sd. ±15,3 and 27,2 sd. ±15,6 for men and women respectively. The difference between mean OSDI scores were statistically significant according to Mann-Whitney U test (U=5073.5, p<0,001). Subgroups of dry eye severity were normal, mild, moderate, and severe. Proportions of "normal situation" was higher with men comparing to women being 40%

and 17% respectively. “Severe DED” proportion were 29% and 13% women having higher frequency (Table 4-2).

4.3 Age

Linear correlation between age by year and OSDI score was positive and very weak according to Spearman Correlation Coefficient (**r_s**=0.217, p=0,02). Age was grouped to six groups and mean OSDI scores were calculated and described in Table 4-3 and Figure 4-1. The youngest age groups 27-29 years and 30-39 years had lower mean OSDI scores (13.4±9.0 and 18.1±15.3) than the older groups. Age groups 40-49 years (25.9±16.1) and 50-59 years (24.1±14.1) had nearly same mean scores and age group 60-69 years had highest mean score of 30.5±1.2. Mean scores were statistically different within the six age groups (H=14.520, p=0,006). According to pairwise comparison test the youngest group had statistically significantly lower score (p=0,013) comparing to oldest group and the age groups 30-39 years had statistically significantly lower score than older three age groups 40-49 years, (p<0.017), 50-59 years (0.45) and 60-69 years (<0.001).

Figure 4-1 OSDI score in six age groups



4.4 Computer use, contact lens use and refractive surgery

Computer use was grouped as ≤7 hours, 8-9 hours and ≥10 hours and the prevalence of dry eye symptoms among users were 74.6% (n=44), 76.5% (n=65) and 80.1% (n=42). Distributions were not dependent of computer use ($\chi 2$ (2) = 0.627, p= 0.731). Mean OSDI scores were 22.65±16.18, 25.42±15.38 and 26.47±16.54 respectively. There was not a statistically significant difference in OSDI score between the different computer users (H (2) = 1.641, p = 0.440).

There were 18 contact lens users. Prevalence of dry eye symptoms among contact lens users was 77.85% (n=14) not dependent on wearing lenses ($\chi 2$(1), 0.006, p= 0.938). They had lower mean OSDI score of 22.99±14.83 comparing to no-users of score 25.05±16.05 and that was not statistically significant (U=1484, p=0.607)

There were 25 participants with refractive surgery. Prevalence of dry eye symptoms among them was 72.0%. Prevalence of symptoms was not dependent on refractive surgery ($\chi 2$ (1) 0.412, p= 0.514). Participants with refractive surgery (n=25) had mean OSDI score of 24.00±17.69 and without surgery mean score was 24.99±15.70. That was not statistically significant (U=2032.5, p=0,692).

5 Discussion

Study was cross-sectional cohort study and purpose of this study was to describe dry eye symptoms in Finnish workplace.

Based on OSDI -criteria ≥13, overall prevalence of symptoms was 73,0% among participants. Prevalence of dry eye disease and symptoms varies depending on the criteria and sample population. Proportion in this study was higher comparing to DED prevalence of 9%-22% reported in large studies (Table 2-2) but criteria were different. There is more consistency if compared to computer screen users 51%-72% and defining DED as a OSDI score 13 or more (Hernandez-Llamas et al., 2020; Portello et al., 2012). Also using same criteria as this study (OSDI ≥13) and similar working conditions, higher level of prevalence have been found among university lecturers (Köksoy Vayısoğlu, Öncü, Dursun, & Dinç, 2019) and among patient in Norwegian optometric practices (Ystenæs et al., 2021) being 72% and 59%.

One aspect that might explain the high prevalence of symptoms was restrictions and guidelines for Covid-19 pandemic. Metropolia's instructions for staff were based on the regulations or recommendations of the authorities and legislation. It was likely that most of the participants worked at home during the study. Working in campus was not allowed unless it was necessary and face masks were always used in campuses. Teaching and meetings were online, and stuff had to use computer more than in normal situation. Screens were laptops instead of conventional large ones and a presbyopic staff might have problems with their vision because of longer period of exposure time. During covid -19 pandemic acceleration of using digital devices has increased the dry eye symptoms (Saldanha, Petris, Makara, Channa, & Akpek, 2021; Usgaonkar, Shet Parkar, & Shetty, 2021). Wearing mask might have also increased the dry eye symptoms as has reported (Boccardo, 2021; Krolo et al., 2021).

Some other factors than variation of dry eye criteria might explain the high proportion if considering subjects and environment aspects. Complaints in offices may be explained by office building characteristics (de Kluizenaar et al., 2016). Previous data was collected in wintertime in Finland and mean temperatures were 1,9°C in December 2020 and -3,4

°C in January 2021. (FinnishMeteorologicalInstitut). Because of cold weather the central heating was used, which caused decreasing humidity that might have effect to sensory irritation symptoms in eyes and airways, work performance, sleep quality, virus survival, and voice disruption (Wolkoff, 2018). Even it has been reported relatively low frequency of DED in persons in Copenhagen (Bjerrum, 1997) and in Sweden (Jacobsson et al., 1989) being 11% and 15,9% respectively, in Nordic countries there are climatic factors that increase probability to the dry eye disease. Swedish study reported participants stated seasonal condition having high impact on their DED symptoms as wind was the most trigged condition and winter and summer being two seasons to associated with dry eye complaints. (van Setten, Labetoulle, Baudouin, & Rolando, 2016).

Consistent of the literature female sex was a risk factor of symptoms in present study sample. Mean OSDI score was 1,5 times higher being 18,54 and 27,21 for male and female respectively and prevalence of symptoms was 60.4% and 83.2%. DEWS II summarised the differences between the sex and highlighted role of sex hormones, pain sensations and comorbidities in dry eye disease (Sullivan et al.). Vehof et al. find women having more symptoms when comparing severity of signs especially when mild and moderate signs are present (Vehof, Sillevis Smitt-Kamminga, Nibourg, & Hammond, 2018). Considering that female´s higher score in present study might suggest different pain perception in ocular surface or as generally. It doesn´t diminish seriousness of the conditions and main treatment´s goal is to decrease the symptoms. In this study age was also related to dry eye symptoms and was consistent with other studies reviewed by Subcommittee of DEWS II (Stapleton et al., 2017). Age of 40 years and more the symptom score was higher.

In this study subjects were grouped to those who used computer ≤7, 8-9 and ≥10 hours and mean OSDI scores were 22.7±16.2, 25.4±15.4 and 26.5±16.5 respectively. There were slight differences in scores between groups, but it was not statistically significant (p=0.440) and the prevalence of symptoms were similar. In this study all participants reported to used computer and mean daily time was 8.3 ±2.2 hours. Indoor occupations had shown to have higher prevalence of dry eye disease although teaching professionals showed no increased risk. (Bazeer, Jansonius, Snieder, Hammond, & Vehof, 2019). Meta-

analysis of Courtin et al (2016) reported variations of prevalence from 9.5%-87.5% among visual display terminal workers and office workers has shown to have four times greater risk of presenting dry eye symptoms than construction workers. (Hernandez-Llamas et al., 2020). Computer work has been reported to be risk factor of DED (Yazici et al., 2015) and Uchino et al (2013) reported increased risk of DED those workers using computers ≥8 hours per day. Reason to high incidence of eye related symptoms among office workers and computer users has been debated. Asthenopia might present similar symptoms as dry eyes. Symptoms as blurred vision and poor vision and problems with working with a computer, seeing television or reading might reflect more uncorrected refractive error, binocular vision disorders or appropriate spectacles.

196 completed the Ocular Surface Disease Index (OSDI) questionnaire which was 20.8% of the whole cohort. Subjects were 27-69 years old teaching or other stuff, and mean age was 49.5 ±10. Age reflects well to whole cohort´s age, mean being 49.8 years. 73% of participants were female which was more that female proportion of the staff (61%) in a whole.

Weakness of this study was subjects selective method; participants were not randomly selected, and results might not reflect the whole cohort. Female were more active to answer the questionnaire and that might also affect to results. Those who has dry eye symptoms might answer more eagerly even it was stated that it was important that all answer to the questionnaire. Clinical dry eye tests or past diagnosis was not included, and prevalence was initiated based on symptoms, which can underestimate or overestimate dry eye prevalence. Previous study was powered to do analysis for prevalence of symptoms not stratified groups and that could decrease the statistical significance.

6 Conclusion

Dry eye symptoms were common among participants in Finnish workplace. Women and older persons reported higher severity of symptoms but unlike previous studies, using computer longer time was not affecting to symptoms.

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List of tables and charts

Annexes

Annex 1: Questionnaire in English

Answer following questions choosing the most reliable answer.

Have you experienced any of the following during the last week:

1. Eyes that are sensitive to light?
    a. All of the time
    b. Most of the time
    c. Half of the time
    d. Some of the time
    e. None of the time

2. Eyes that feel gritty?
    a. All of the time
    b. Most of the time
    c. Half of the time
    d. Some of the time
    e. None of the time

3. Painful or sore eyes?
    a. All of the time
    b. Most of the time
    c. Half of the time
    d. Some of the time
    e. None of the time

4. Blurred vision?
    a. All of the time
    b. Most of the time
    c. Half of the time
    d. Some of the time
    e. None of the time

5. Poor vision?
    a. All of the time
    b. Most of the time
    c. Half of the time
    d. Some of the time
    e. None of the time

Have problems with your eyes limited you in performing any of the following during the last week:

1. Reading?
    a. All of the time
    b. Most of the time
    c. Half of the time
    d. Some of the time
    e. None of the time

2. Driving at night?
    a. All of the time
    b. Most of the time
    c. Half of the time
    d. Some of the time
    e. None of the time

3. Working with a computer or bank machine (ATM)?
    a. All of the time
    b. Most of the time
    c. Half of the time
    d. Some of the time
    e. None of the time

4. Watching TV?
    a. All of the time
    b. Most of the time
    c. Half of the time
    d. Some of the time
    e. None of the time

Have your eyes felt uncomfortable in any of the following situations during the last week:

1. Windy conditions?
    a. All of the time
    b. Most of the time
    c. Half of the time
    d. Some of the time
    e. None of the time

2. Places or areas with low humidity (very dry)?
    a. All of the time
    b. Most of the time

c. Half of the time
d. Some of the time
e. None of the time

3. Areas that are air conditioned?
   a. All of the time
   b. Most of the time
   c. Half of the time
   d. Some of the time
   e. None of the time

1. Your ages:_____years.

2. Sex
   a. male
   b. female

3. Estimate the number of hours you spend on average during the day on the display screen._____hours.

4.Do you use contact lenses? _____no _____ yes

How many hours do you use contact lenses on average during the day? _____

5. Have you gone through the cataract surgery, refactive surgery or other refraction correction surgery? yes_____no_____

Thank you for answering!

If you want personal feedback, write your name here: _____

Information for the Participant

Prevalence of symptomatic dry eye in Finnish workplace

We invite you to participate in a research directed at the staff of the Helsinki Metropolia of University of Applied Sciences. The study includes a dry eye questionnaire and clinical studies conducted at the university campus.

The purpose of this study is to find out more about dry eye, its frequency and risk factors. The respondents are surveyed by the questionnaire of the disability coursed by ocular surface defect through the link sent by the intranet. The questionnaire has 12 questions about the frequency of symptoms and five questions about factors that may be related to symptoms of dry eye. The survey takes about 5 minutes. The questionnaire has been validated and has been found to provide reliable values for detecting a dry eye. The result of the questionnaire is an index that describes the severity of a dry eye.

If the index number exceeds a certain value, you will be classified as dry eye. You will get feedback on the severity of the dry eye and treatment recommendations by leaving your name at the end of the questionnaire. The researcher sends a written feedback via the secured e-mail or gives it in person. You can also participate anonymously without any feedback.

It is voluntary to participate in the project. If you choose to participate, you may leave the studies at any stage without any special reason. We process your personal data based on your consent. University of South-Eastern Norway and Metropolia University of Applied Sciences are share data controllers.

All material and results will be collected, stored and processed confidentially, as required by the Personal Data Act. A participant is assigned a numeric code and all data is stored in encoded study files. Your name and contact information with a code will be stored on my own list of names separate from other data. The results are analyzed as encoded, and no individual participant can be identified without the code key. Results are presented as percentages and group mean values, so a single participant can´t be identified. Information on research is not going to transform to a third party and is not used for anything other than this master's thesis. Two supervisers of the thesis and Satu Autio will have the access to analyse the data. The stored data will be kept at the Metropolia University of Applied Sciences premises using a good research method in a locked cabinet. The collected material will be stored until 31 December 2025 and disposed of no later than 6 months after that. The results of the study will be published as a master thesis in Clinical Optometry at the University of South-Eastern Norway.

Your rights: As long as you can identify the information material, you have the right:

- Access to personal data
- The right to give and withdraw consent
- Right to correct information
- Right to remove your personal data
- Right to limit processing
- Right to be forgotten

Thank you for your participation, Satu Autio, lecturer, MSc. in Health Care in Optometry

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