



FACULDADE DE MEDICINA DA UNIVERSIDADE DE COIMBRA  
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***Prevalence of Dry Eye in Students of Faculty of Medicine of the  
University of Coimbra - Portugal***

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## **ABSTRACT**

**Background:** Dry eye disease is one of the most prevalent eye diseases, affecting quality of life and commonly motivating the search for medical care. However, prevalence in younger age groups is still not completely understood. We aim to assess the prevalence of subjective dry eye disease in student's population of the Faculty of Medicine, University of Coimbra, Portugal, as well as establishing some of its risk factors.

**Methods:** We applied an online questionnaire using the Ocular Surface Disease Index, validated to the Portuguese language. The presence of some risk factors associated with dry eye disease was also inquired. A modified OSDI score > 22 points was used as a cut-off value for the diagnosis of subjective dry eye disease. Chi-square test was used to test the association between variables and subjective dry eye disease. Logistic regression analysis was used to determine predictive factors of dry eye disease.

**Results:** A total of 142 students, with ages ranging from 19 to 34 years old, completed the online questionnaire, of which 108 (76.1%) were female. The mean OSDI score for all participants was  $13.72 \pm 13.76$  units. A prevalence of subjective dry eye disease of 20.4% was found. The use of ophthalmic drops was associated with higher OSDI scores, and was found to be a predictive factor of dry eye disease. Sex, age, medication, use of contact lenses and smoking status were not associated or were found to be a predictive factor.

**Discussion:** The prevalence of dry eye disease found is consistent with values reported in similar investigations. The role of ophthalmic drops in the development of dry eye disease, verified in our study, has also been reported in several studies. Our small sample size, narrow age range and predominance of female participants may have masked the effect of other risk factors inquired.

**Conclusion:** A prevalence of 20.4% of subjective dry eye disease was found in a student population of Faculty of Medicine, University of Coimbra, Portugal. The use of ophthalmic drops was associated with higher OSDI scores. Therefore, students should be warned about the risks of self-medication with over-the-counter eye drops.

**Keywords:** Dry eye syndromes; Questionnaire; Students; OSDI; Risk Factors.

## **ACRONYMS**

CI – Confidence Interval

DED – Dry Eye Disease

DEWS II – International Dry Eye WorkShop II

OR – Odds Ratio

OSDI – Ocular Surface Disease Index

## BACKGROUND

Dry eye disease (DED), also known as keratoconjunctivitis sicca, is one of the most prevalent eye diseases, affecting quality of life and commonly motivating the search for medical care.<sup>1</sup> In July of 2017, the International Dry Eye WorkShop II (DEWS II) defined dry eye as a “multifactorial disease of the ocular surface characterized by a loss of homeostasis of the tear film, in which ocular surface inflammation and damage, and neurosensory abnormalities play etiological roles”.<sup>2</sup>

Many risk factors were already involved in the development of DED, with age and female sex being two of the most relevant.<sup>1,3</sup> Low humidity environments, smoking, use of contact lenses and excessive computer use are also described as important risk factors.<sup>4</sup> In addition, postmenopausal estrogen therapy, previous corneal refractive surgery, vitamin A deficiency, antihistamines, Sjögren syndrome and other collagen vascular diseases, androgen insufficiency and low fatty acids intake are related to an increased risk of developing DED.<sup>5,6</sup>

The prevalence of symptomatic disease may range between 5 and 50%,<sup>6</sup> depending not only on the characteristics of the study population, such as age and sex, but also on the diagnosis methods used. In current literature, there are few publications in which the prevalence of dry eye in young populations is assessed. Moon JH *et al.* evaluated the association between cellphone use and dry eye in a pediatric population, between 7 and 12 years old, in a total of 912 children, reporting a prevalence of the disease of 6.6%.<sup>7</sup> Uchino *et al.* applied a questionnaire in a population of 3433 students between the ages of 15 and 18, obtaining a prevalence of DED symptoms of 21% in males and of 24% in females.<sup>8</sup>

Regarding the diagnosis of dry eye disease, the most recent guidelines published by DEWS II suggested, in addition to a complete clinical history, the use of symptom-oriented questionnaires.<sup>9</sup> The use of questionnaires allows an efficient and fast data collection,<sup>10</sup> as well as enables the detection of symptoms of DED and of the effect of potential therapies.<sup>6,10</sup>

Although there are currently more than 15 questionnaires to assess dry eye symptoms, only five of them allow the study of the impact of the disease on the quality of life.<sup>6</sup> The Ocular Surface Disease Index (OSDI), validated to the Portuguese language, is one of these questionnaires, and is currently one of the most used.<sup>11</sup>

The aim of this study is to assess the prevalence of subjective dry eye disease in a student population of the Faculty of Medicine, University of Coimbra, Portugal by applying the Portuguese validated translation of the OSDI questionnaire,<sup>12</sup> as well as accessing some of its risk factors in a young age group.

## **MATERIALS AND METHODS**

*Cross-sectional* study. Informed consent was implied when patients answered “Yes” to the question: “Do you agree to participate in this study?”. The study followed the tenets of the Declaration of Helsinki.

Study population was recruited at Faculty of Medicine, University of Coimbra, Portugal, between September and October 2017. We used the OSDI questionnaire<sup>12</sup> to perform a subjective assessment of dry eye symptoms in a young population, and to establish the role of potential risk factors.

### **Sample**

The target population of this study included all students registered in the Faculty of Medicine, University of Coimbra, Portugal in the academic year of 2017-2018. An online questionnaire was made available. A total of 142 students completed the questionnaire by self-administration.

### **The Ocular Surface Disease Index (OSDI) Questionnaire**

The OSDI is one of the currently validated dry eye specific questionnaires, being one of only five that assesses the effect of DED in quality of life.<sup>6</sup> It was originally developed in 1997 by the Outcomes Research Group at Allergan Inc. (Irvin, California)<sup>13</sup> and includes 12 questions that evaluate the frequency of dry eye symptoms and its effect on vision-related function for the previous week.<sup>6</sup>

The 12 questions form three subscales: ocular symptoms, vision-related functions and limitations, and environmental triggers. Each question is graded on a scale 0 to 4, on the basis of symptom frequency, where 0 indicates none of the time, 1 indicates some of the time, 2 indicates half of the time, 3 indicates most of the time and 4 indicates all of the time.

The questionnaire that was applied included a validated translation of the OSDI questionnaire to the Portuguese language.<sup>12</sup> Besides the OSDI questionnaire, information regarding known risk factors for dry eye disease (medication, use of ophthalmic drops, use of contact lenses and smoking status) and socio-demographic factors (such as age, sex and school year), were acquired. No specific exclusion criteria were imposed by the authors. An example of the online questionnaire applied can be found in the attachments section (Attachment 1).

The total OSDI score was calculated as recommended by Schiffman *et al.*<sup>13</sup> using the following formula:  $OSDI = [(sum\ of\ the\ scores\ for\ all\ questions\ answered) \times 100] / [(total\ number\ of\ questions\ answered) \times 4]$ . Thus, modified OSDI scores range from 0 to 100 points, and higher scores indicate greater discomfort due to dry eye disease. To be consistent with recent studies, a modified OSDI score  $> 22$  points was used as a cut-off value for the diagnosis of subjective DED.<sup>6,15</sup>

## **Procedures**

The prevalence of subjective dry eye disease was determined, as well as the relationship between the risk factors and subjective DED. The following risk factors were evaluated: sex, age, medication, use of ophthalmic drops, use of contact lenses and smoking status.

## **Statistical Analysis**

Data was analyzed using the Statistical Package for Social Sciences (SPSS) software (SPSS for Windows, version 21.0; SPSS, Inc., Chicago, IL, USA). Summary statistics were presented using frequency tables, charts, means and standard deviations, as appropriate. Chi-square test was used to test the association between the independent categorical variables and

subjective DED. Student's T-test was used for comparison of continuous variables. Logistic regression analysis was used to determine predictive factors of DED. Relative risks were estimated as odds ratios (OR) and 95% confidence intervals (CI).  $P \leq 0.05$  was the criteria for significance in the analysis.

## RESULTS

### Participants Demographics

Of the 142 students who started the questionnaire, 142 (100%) completed it, of which 108 (76.1%) were female and 34 (23.9%) were male. Demographic data is presented in Table 1. The mean age of the participants was  $23.1 \pm 2.3$  years old (range 19 to 34), without significant difference between sex (females mean aged  $22.9 \pm 2.1$  years and males mean aged  $23.2 \pm 2.4$ ) ( $p = 0.552$ ). Participants ages were categorized into two subcategories (19-24 years old and 25-34 years old) to aid the assessment of the results, with the majority of the students belonging in the 19-24 age group. The distribution of students throughout the school years is shown in Figure 1. The majority of the participants were enrolled in the sixth school year (56.5%). There was a predominance of participants not taking any regular medication (88%), or ophthalmic drops (82.4%), wearing contact lenses (52.1%) and of non-smokers (88%).

*Table 1 – Distribution of responses according to sex, age group, medication, drops, lenses and smoking.*

Variable	Frequency	Percentage (%)
<u>Sex</u>		
Male	34	23.9
Female	108	76.1
<u>Age Group</u>		
19-24	120	84.5
25-34	22	15.5
<u>Medication</u>		
Yes	17	12
No	125	88
<u>Ophthalmic Drops</u>		
Yes	25	17.6
No	117	82.4

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Contact Lenses

Yes	74	52.1
No	68	47.9

Smoking

Yes	9	6.3
No	125	88
Ex-smoker	8	5.6

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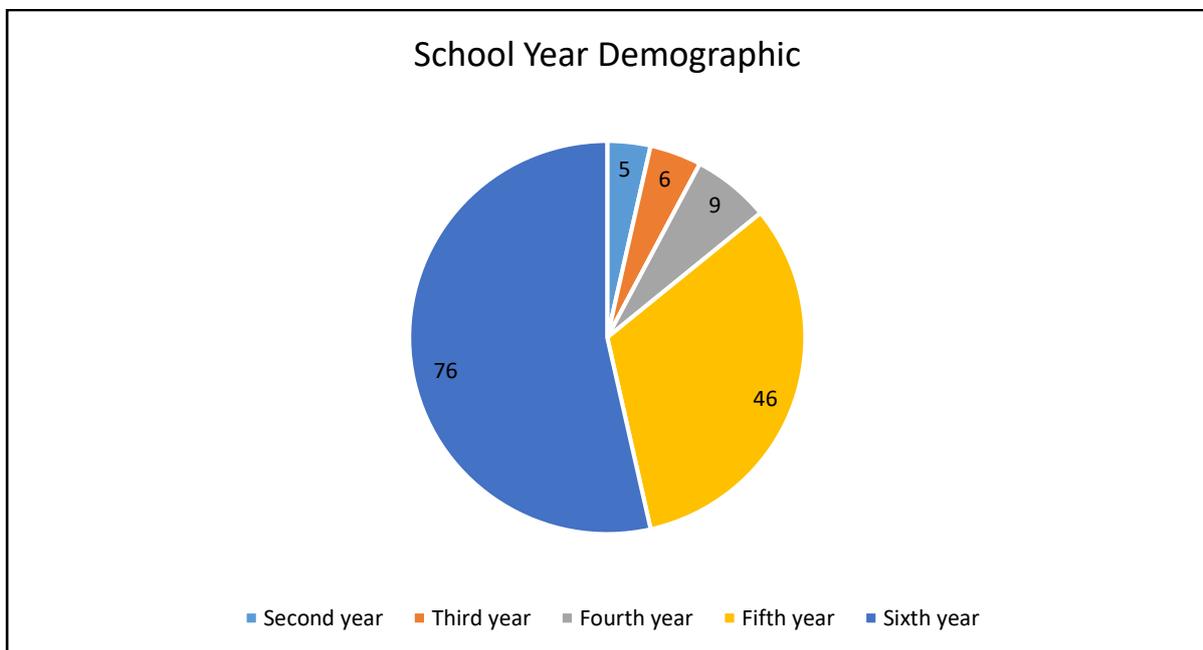


Figure 1 – School Year Demographic

Among the 142 participants, 12% (n = 17) were taking regular medication, including oral contraceptive pills, corticosteroids, antileukotrienes, antihistamines, immunotherapies, beta blockers, monoclonal antibodies, thyroid medication and chloroquine. Information regarding the number of participants taking each medication can be seen in Table 2.

Table 2 - Medication usage by participants

Medication	Number of participants
Oral contraceptive pills	12
Corticosteroids	4
Antileukotrienes	3
Antihistamines	2
Immunotherapies	1
Beta blockers	1
Monoclonal antibodies	1
Thyroid medication	1
Chloroquine	1

### OSDI Scores

The mean OSDI score for all participants was  $13.7 \pm 13.8$  units (range 0.0 to 95.8 units) and 20.4% of the participants ( $n = 29$ ) had an OSDI score higher than 22 units. Figure 2 shows the distribution of the OSDI score, with a red line marking the cut-off value of 22 units.

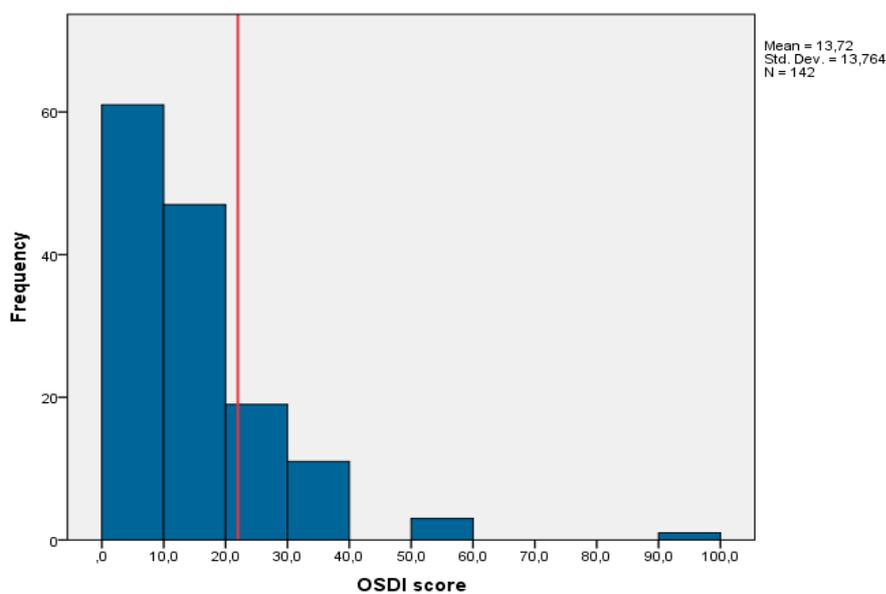


Figure 2 – Distribution of OSDI score

Most of the possible risk factors assessed (sex, age, contact lens use, smoking, and regular medication) showed no association with the OSDI score. However, students who reported the use of ophthalmic drops, obtained OSDI scores significantly higher than those who did not ( $p = 0.016$ ), as shown in Table 3.

Table 3 – Association between study variables and OSDI score > 22

<b>Variable</b>	<b>% of students with OSDI &gt; 22</b>	<b>p-Value</b>
<u>Sex</u>		
Male	17.6	0.829
Female	21.3	
<u>Age</u>		
19-24	21.7	**0.567
25-34	13.6	
<u>Medication</u>		
Yes	11.8	**0.524
No	21.6	
<u>Ophthalmic Drops</u>		
Yes	40.0	<b>*0.016</b>
No	16.2	
<u>Contact Lenses</u>		
Yes	24.3	0.320
No	16.2	
<u>Smoking</u>		
Yes	22.2	0.845
No	20.8	
Ex-smoker	12.5	

\*p-value < 0.05; \*\*Fishers Exact Test

Table 4 shows the multivariate analysis of risk factors associated with DED, using logistic regression analysis. An OSDI score greater than 22 was, once again, significantly associated with use of ocular drops (odds ratio = 3.111; 95% IC: 1.092 – 8.862; p-value = 0.034).

Table 4 – Logistic regression analysis of study variables with OSDI score > 22

Variable	Odds Ratio	95% Confidence Interval	p-value
<u>Sex</u>			
Male			
Female	1.143	0.395 – 3.302	0.805
<u>Age</u>			
19 -24			
25 -34	0.648	0.172 – 2.440	0.521
<u>Medication</u>			
No			
Yes	0.515	0.106 – 2.488	0.409
<u>Ophthalmic Drops</u>			
No			
Yes	3.111	1.092 – 8.862	<b>*0.034</b>
<u>Contact Lenses</u>			
No			
Yes	1.064	0.409 – 2.767	0.898
<u>Smoker</u>			
No			
Ex-smoker	0.746	0.084 – 6.585	0.792
Yes	0.864	0.147 – 5.056	0.871

\*p-value < 0.05

## Frequency of Ocular Symptoms

The most commonly reported ocular symptom was sensitivity to light, with a prevalence of 59.9%. All the other ocular symptoms included in the questionnaire were reported, with gritty sensation being the less frequent (26.1%). Table 5 shows the frequency of the different ocular symptoms that have been reported to happen at least 1 to 2 days in a week period.

*Table 5 – Frequency of ocular symptoms*

Ocular Symptom	No. (%) of students
Sensitivity to light	85 (59.9%)
Gritty sensation	37 (26.1%)
Painful eyes	72 (50.7%)
Blurred vision	64 (45.1%)
Poor vision	59 (41.5%)

## Effect on Daily Activities

Daily activities, and thus vision-related quality of life, were affected in a small group of students, especially when compared with the higher frequency of ocular symptoms reported. The most affected daily activity was working with computers and ATMs, with 18.3% of the students reporting some kind of limitation on this activity at least 1 to 2 days in a week period. The other daily activities inquired (reading, driving at night and watching TV) were also affected, but to a smaller degree, as shown in Table 6, where minimum frequency of 1 to 2 days in a week period was considered.

Table 6 – Effect on daily activities

<b>Daily Activity</b>	<b>No. (%) of students</b>
Reading	20 (14.1%)
Driving at night	20 (14.1%)
Working with a computer or ATM	26 (18.3%)
Watching TV	21 (14.8%)

### **Role of Environmental Triggers**

All three environmental triggers described in the questionnaire were reported by students as being responsible, to some extent, for the ocular discomfort at least 1 to 2 days in a week period. Table 7 shows the frequency of these situations, from which it appears that ocular discomfort was predominately triggered by environments with air conditioner, with 47.2% of the students reporting the role of this trigger at least 1 to 2 days in a week period.

Table 7 – Role of environmental triggers

<b>Environmental Trigger</b>	<b>No. (%) of students</b>
Windy conditions	48 (33.8%)
Low humidity	45 (31.7%)
Air conditioner	67 (47.2%)

## DISCUSSION

Despite the increased rate in DED publications, to this date, and to the best of our knowledge, there are no population-based studies among any population in Portugal on DED prevalence and its risk factors. This *cross-sectional* study was based on DED symptomatology and on the presence of risk factors in the student's population of Faculty of Medicine, University of Coimbra, Portugal.

The prevalence of subjective DED was 20.4%, which is within the range of worldwide reported prevalence of 5 and 50%.<sup>6</sup> This shows a wide disparity of values, which has been explained by the fact that there are different disease definitions and no standardized diagnostic criteria,<sup>16</sup> which may confound comparisons. Additionally, the rates of prevalence based on symptoms reported by patients, showed to be more consistent than those based on signs, which supports the hypothesis that dry eye is a symptomatic disease.<sup>6,17</sup>

Seeing that age is one of the most important risk factors for DED and that our study primarily evaluated young individuals (mean age of  $23.1 \pm 2.3$  years old), comparisons should be made with studies that also focused on younger age groups. A study of university undergraduate students in Ghana,<sup>18</sup> with a age range similar to the one used in this study, evaluated the prevalence of symptomatic DED using two questionnaires, including the OSDI questionnaire. They reported a prevalence of 44.3% of the disease, when information of both questionnaires was combined, and a prevalence of 48.1% when only information from the OSDI questionnaire was used. The higher prevalence compared to the current study is most probably due to the cut-off value chosen: Asiedu K. *et al.* used  $OSDI \geq 13$  to define symptomatic DED. Garza-León M. *et al.*<sup>4</sup> studied a group of university students in Monterrey, Mexico with a mean age of  $21.38 \pm 1.79$  years and reported an OSDI average score of  $26.85 \pm 20.79$  points, a value higher than the one obtained in our study ( $13.7 \pm 13.8$  units). In this Mexico investigation a statistically significant effect on the OSDI score caused by the use of

ophthalmic drops was reported, a finding that we also described. However, statistically significant associations with sex and smoking status were not verified in our population.

Similar to other studies of DED and ocular surface disease,<sup>4, 16, 18</sup> we found that students who reported the use of ophthalmic drops had higher OSDI scores, with an OR of 3.111 (95% IC: 1.092 – 8.862). Twenty-five students (17.6%) reported the use of some type of ophthalmic drop. Its relationship with DED has already been reported,<sup>19</sup> and seems to be explained by the effect of some of the preservative components of eye drop formulations in the ocular surface. The most frequently implied component is Benzalkonium chloride, a widely used preservative, which causes surface epithelial cell damage and punctate epithelial keratitis.<sup>19</sup> Use of nonpreserved preparations is, thus, preferred.

Although in this study regular medication was not linked to higher OSDI scores, some of the medication reported in the questionnaire is described as a potential risk factor for the development of DED. Reports show consistent evidence in the role of antihistamines as a risk factor and suggestive role of beta-blockers.<sup>5,6</sup> There is unclear evidence regarding the role of oral contraceptive pills as a risk factor for DED, which is, in part, due to the small number of reports focused on this relationship.<sup>5,6</sup> The absence of a statistically significant relationship between the use of these type of medications and OSDI scores in our study may be due to the small sample size, underestimating the effect of medication in the development of symptomatic DED.

Contact lenses are a known risk factor for the development of DED, as they impact the normal ocular surface homeostasis.<sup>6</sup> Consequently, many reports frequently identify a greater risk of DED symptoms in contact lenses users.<sup>8</sup> This association was not significant in our population, however, taking into account that more than half of our participants were contact lenses users, awareness of DED and its relationship with contact lenses materials and care should be provided.

The Beaver Dam study related active smoking and smoking history with a higher prevalence of dry eye,<sup>20</sup> but conflicting results in the literature have been reported on the association of DED and smoking, with the DEWS II Epidemiology report<sup>6</sup> revealing inconclusive evidences. As previously mentioned, smoking status did not showed to have an association with OSDI scores in our study, probably given the small number of participants who reported to be smokers or ex-smokers. Nevertheless, as smoking is a modifiable factor, and given all the effects it has on ocular and systemic health, wakefulness to its effects should always be encouraged.

Additionally, neither age nor sex were associated with a higher OSDI score in our study, although both older populations and females are two well known risk groups for DED. The first might be due to the narrow age range of the sample, which can mask the effect of age. The second may be explained by the fact that sex difference was related to the dual action of low levels of estrogens and androgen deficiency in menopause,<sup>21</sup> which does not apply to our population, seeing the age of the participants. However, the predominance of females in our study (76.1% of the participants) can also be a bias when evaluating the association between sex and OSDI scores.

Regarding the frequency of ocular symptoms, the effect on daily activities and the role of environmental triggers reported by students, sensitivity to light, working with computers and ATMs and environments with air conditioner where the most reported factors, respectively. In a cross-sectional non-clinical population-based study made in Jordan, sensitivity to light and working with computers and ATMs were also the most reported in their categories. However, about the role of environmental triggers, they found that dryness symptoms were predominately triggered during windy conditions.<sup>14</sup>

The fact that our study was conducted during the school year could potentially have an effect in the scores obtained, as computer equipment, previously linked to DED,<sup>6</sup> is in

continuous use in college students. Besides, excessive or incorrect use of computer equipment may lead to the development of Computer Vision Syndrome, a complex of visual problems which are experienced in relation to or during the use of computers.<sup>22</sup> As Computer Vision Syndrome is a public health problem, with an increasing prevalence, students must be aware of its symptoms, in order to prevent the effect that it has on daily and professional activities, and, thus, quality of life.

The present study has some limitations. First, we did not correlate the presence of DED symptoms with objective clinical tests. Besides the OSDI being one of the most used questionnaires and being a valid and reliable instrument for measuring the severity of dry eye disease,<sup>13</sup> some poor correlations between symptoms measured by questionnaires and signs obtained by clinical tests have been related.<sup>6</sup> Second, some risk factors that could play a role in the development of DED in students were not investigated, such as race, autoimmune diseases, environmental conditions and computer use.

## **CONCLUSION**

Dry eye syndrome is one of the most prevalent eye diseases and can have a substantial impact in quality of life. Prevalence in younger populations is poorly studied, as well as risk factors implied in these age groups.

A prevalence of 20.4% of subjective DED was found in a student population of Faculty of Medicine, University of Coimbra, Portugal. The use of ophthalmic drops was associated with higher OSDI scores. Therefore, students should be warned about the risks of self-medication with over-the-counter eye drops.

Further work involving clinical tests to determinate the prevalence of objective DED in younger populations and the role of other risk factors is required. As dry eye disease may have a significant impact in public health, awareness to this problem must be raised in the population studied and proper measures should be taken in terms of occupational medicine.

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## ATTACHMENTS

### Attachment 1 – Online questionnaire applied

## Prevalência de Olho Seco nos Estudantes da FMUC Portugal

O presente questionário está integrado na realização de uma Tese de Mestrado em Medicina da Faculdade de Medicina da Universidade de Coimbra. Pretende-se conhecer a prevalência de olho seco e detetar a presença de fatores de risco nos estudantes da FMUC. Apenas proceda à realização deste questionário se for aluno da FMUC.

A sua participação é de elevada importância para que possamos atingir os nossos objetivos de investigação.

Sublinha-se que todos os dados são confidenciais.

Muito obrigada pela sua participação.

### \*Obrigatório

1. Aceita participar neste questionário? Marcar apenas uma oval.

Sim      Passe para a pergunta 2.

Não      Pare de preencher este formulário.

2. Sexo \*

Marcar apenas uma oval.

Feminino

Masculino

3. Idade \*

---

4. Ano que frequenta: \* Marcar apenas uma oval.

1º

2º

3º

4º

5º

6º

5. Patologia do foro oftalmológico conhecida? \* Marcar apenas uma oval.

Sim

Não

6. Se respondeu "Sim" à pergunta anterior, especifique a patologia.

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7. Realiza toma de medicação habitual? \* Marcar apenas uma oval.

Sim

Não

8. Se respondeu "Sim" à pergunta anterior, especifique a medicação.

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9. Realiza aplicação de gotas oculares regularmente? \* Marcar apenas uma oval.

Sim

Não

10. É utilizador de lentes de contacto? \* Marcar apenas uma oval.

Sim

Não

11. Já realizou alguma cirurgia oftalmológica? \* Marcar apenas uma oval.

Sim

Não

12. Se respondeu "Sim" à pergunta anterior, especifique qual.

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13. É fumador(a)? \* Marcar apenas uma oval.

Sim

Não

Ex-fumador

14. Na semana passada você já sentiu algum desses sintomas? \*

Marcar apenas uma oval por linha.

	Os 7 dias da semana	5 a 6 dias na semana	3 a 4 dias na semana	1 a 2 dias na semana	Nenhum dia na semana
Clareza incomoda os olhos	<input type="radio"/>				
Sensação de areia nos olhos	<input type="radio"/>				
Ardência nos olhos	<input type="radio"/>				
Visão embaçada	<input type="radio"/>				
Visão ruim	<input type="radio"/>				

15. Você deixou de fazer, ou não conseguiu fazer direito alguma das coisas abaixo por causa dos olhos? \*

Marcar apenas uma oval por linha.

	Os 7 dias na semana	5 a 6 dias na semana	3 a 4 dias na semana	1 a 2 dias na semana	Nenhum dia na semana	N/A
Ler	<input type="radio"/>					
Dirigir à noite	<input type="radio"/>					
Usar o computador ou caixa eletrônico	<input type="radio"/>					
Assistir televisão	<input type="radio"/>					

16. Você já sentiu incômodo ou desconforto em alguma dessas situações na semana passada? \*

Marcar apenas uma oval por linha.

	Os 7 dias na semana	5 a 6 dias na semana	3 a 4 dias na semana	1 a 2 dias na semana	Nenhum dia na semana	N/A
O vento incomoda os olhos	<input type="radio"/>					
Lugares secos incomodam os olhos	<input type="radio"/>					
Lugares com ar condicionado incomodam os olhos	<input type="radio"/>					