



## Comparison of the OSDI Questionnaire, the Tear Film Break-up Time and Schirmer Tests for the Evaluation of Tear Film in Computer users and Contact Lenses without Dry Eye Symptoms

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### Authors' contributions

This work was carried out in collaboration among all authors. Author TKG designed the study, wrote the protocol, wrote the first draft of the manuscript, managed the literature searches and managed the analyses of the study. Author AEM designed the study, wrote the protocol and managed the literature searches. Author MC performed the statistical analysis. All authors read and approved the final manuscript.

### Article Information

DOI: 10.9734/OR/2022/v17i230254

### Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/90332>

Original Research Article

Received 20 June 2022  
Accepted 08 August 2022  
Published 10 August 2022

### ABSTRACT

**Aims:** To compare the diagnostic values of the OSDI, the Schirmer's and tear film breakup time test to check for dry eye in healthy adult students using computers and contact lenses.

**Methodology:** Our sample consisted of hundred (100) eyes from fifty (50) healthy adults aged 18-24 years students at the University of West Attica (25 participants were contact lens wearers, while the remaining 25 were not). All participants were exposed to a computer screen or a mobile screen. Qualitative tear measurement was performed with Tear Break-Up Time Test (TBUT), quantitative measurement of tears with Schirmer Test and use of the Ocular Surface Disease Index (OSDI).

**Results:** During the analysis of the results, it was found that OSDI was inversely proportional to the TBUT test and the Schirmer test. 60% did not have dry eye, 34% had a mild dry eye, 4% had moderate dry eye and 2% had severe dry eye. A statistically significant relationship existed

between OSDI and the other variables as well as the TBUT test with Schirmer test (p-value <0.05).

**Conclusion:** The OSDI questionnaire, used in conjunction with the TBUT test, was easy to perform and could be helpful in supporting the diagnosis of dry eye syndrome.

*Keywords: OSDI; TBUT; Schirmer test; dry eye.*

## 1. INTRODUCTION

Dry eye is a multifactorial disease that affects the tears and the ocular surface and results in symptoms of discomfort, blurred vision and instability of the tear film with possible damage to the ocular surface.

Dry eye syndrome (DES) affects a significant proportion of the population. It can affect any gender, is more common in women and is one of the most common reasons for seeking eye care [1]. Extensive use of contact lenses and use of screens (mobile or computer) in everyday life seems to be an important factor contributing to the presence of dry eye.

Different studies have reported different prevalence rates of DES ranging from 5.5% to 37.7% [1,2]. Limitations in comparing these studies to different populations include different age divisions of the population, different dry eye definitions and different methodologies. Studies of tear function tests, including the Schirmer test and the Tear Break-Up Time Test (TBUT) test with fluorescein staining, have generally found lower prevalence rates than questionnaire-based studies [1].

The Ocular Surface Disease Index (OSDI) questionnaire consists of twelve questions that provide a rapid assessment of the symptoms of ocular irritation according to the DES and their impact on vision-related function [3].

In this study, we investigated the prevalence of DES in healthy adult students at University of West Attica, who were all computer users and half of them were contact lens users and compared the diagnostic values of the TBUT test, the Schirmer test and the OSDI.

## 2. MATERIAL AND METHODS

The study was conducted between October 2021 and February 2022 among students of the University of West Attica who were exposed to screens (computer or mobile) in their daily lives. Half of the participants are contact lens wearers and the other half are not.

The study protocol was explained to all participants.

The study included 50 young people (100 eyes from healthy adults aged 18-24 years students. Twenty-five participants were contact lens wearers, while the remaining twenty-five were not). All participants were exposed to a computer screen or a mobile screen. Qualitative tear measurement was performed with TBUT, quantitative measurement of tears with Schirmer Test and use of the OSDI.

Individuals previously diagnosed with DES were excluded from the study. We also excluded individuals who had a history of ocular or intraocular disorders, who used topical ophthalmic drugs and / or systemic medications.

The measurement conditions remained the same for all individuals. The study was according to the Helsinki Declaration.

### 2.1 TBUT Test

TBUT test was the first test. The purpose of the test was to determine the possible instability of the tear film [4]. Fluorescein was applied to the eye using fluorescein impregnated strips and the tear film is observed by biomicroscopy and illumination with cobalt blue light [5,6].

The subject was asked to blink three times and then look straight forward, without blinking.

The time between the last blink and the appearance of the first discontinuity or dry spot of the tear film was recorded with a stopwatch. This procedure was repeated three times in both eyes.

The normal value of the TBUT test was greater than 10 sec, values of 5 to 10 sec were considered marginal while values less than 5 sec were indicative of dry eye [7]. The TBUT test showed 75% sensitivity and 60% specificity for categorizing the symptoms of dry eye [8].

Mean TBUT test scores of the right and left eye were used for statistical analysis.

## 2.2 Schirmer Test [9]

Five minutes after the TBUT test, the Schirmer test was performed without anesthesia, where it evaluated the basic and reflex secretion of tears.

The Schirmer test evaluated the amount of tears produced. The examination is done with the Schirmer Strips where they are placed folded inside the lower eyelid, where the patient should look slightly upwards.

If the Schirmer Strips were soaked with tears over 10mm in 5 minutes then there is normal production of tears, at 5-10mm there was a suspicion of dry eye and below 5mm there was severe dry eye.

During the test, the patient may continue to blink normally or keep his eyes closed.

## 2.3 OSDI

OSDI is a twelve-item questionnaire that aims to assess the symptoms of DES-related eye irritation and their impact on vision-related functions, focusing on the last 7 days [3,10].

OSDI calibration is based on a 5-point Likert scale and consists of 3 sets of questions [11].

The first group is related to the frequency of ocular symptoms, the second group is concerned with questions about the difficulty of vision-related functions and the last group is concerned with the discomfort caused by environmental factors [12].

OSDI can take values from 0 to 100. The higher the score one has the more intense dry eye [3]. Normal values are 0 to 12, values 13 to 22 express mild DES, and values 23 to 32 express moderate DES and values above 33 express severe DES [13].

The OSDI, therefore, consists of an overall score derived from the 3 score subsections, which deal

with ocular symptoms, vision function and environmental factors [12]. In the questionnaire sections, their score was calculated by the same formula as the total questionnaire but taking into account only the questions of each section [3].

OSDI association with the use of artificial tears is moderate [13]. The use of the clinical trial questionnaire has been approved by the FDA (Food and Drug Administration, USA) after first undergoing psychometric testing as suitable for use in clinical trials [11].

The limitations of OSDI were that it did not include all the symptoms of dry eye such as tearing while it did include some of the symptoms of dry eye such as photosensitivity and pain. In addition, OSDI has focused only on some of the effects of DES on visual function, failing to capture the full effect of DES on the patient's daily life. In addition, it targeted responses to the frequency of symptoms while ignoring their severity [13].

Some other limitations of OSDI arose from the non-linear correlation of the results in relation to the severity of the symptoms, the difference in difficulty between the categories and more general issues of analysis from the use of the regular ranking. This led to an artificially increased final score when some difficult questions were not answered and were considered not valid by the patient [11].

## 3. RESULTS AND DISCUSSION

The STATA statistical package was used for data analysis. Due to the nature of the data, the inductive controls used were Spearman's Rho and Mann-Whitney U test. During the analysis of the results, it was found that OSDI was inversely proportional to the TBUT test and the Schirmer test. 60% did not have dry eye, 34% had a low dry eye, 4% had moderate dry eye and 2% had high dry eye (Table 1).

**Table 1. Mean TBUT and Schirmer by OSDI categories**

OSDI	% of N
Normal	60.0
Mild DES	34.0
Moderate DES	4.0
Severe DES	2.0

**Table 2. Correlation matrix. People who use contact lenses**

	No use of contact lenses				Use of contact lenses			
	OSDI	TBUT	Schirmer	Screen	OSDI	TBUT	Schirmer	Screen
OSDI	1.0	-	-	-	1.0	-	-	-
TBUT	-0.05	1.0	-	-	-0.49*	1.0	-	-
Schirmer	0.28	-0.29	1.0	-	-0.69*	0.65*	1.0	-
Screen	0.01	-0.24	0.24	1.0	-0.40*	-0.09	0.09	1.0

\* *p-value*<0.05, \*screen: Computer Screen

### 3.1 People who use Contact Lenses

Existence of a statistically significant relationship between OSDI and the other variables as well as the TBUT test with Schirmer test ( $p$ -value <0.05). In particular, OSDI showed a negative correlation with the examined variables with the largest being recorded by the Schirmer test (-0.69) (Table 2).

## 4. DISCUSSION

“Dry eye is a common, complex and multifactorial disease of the ocular surface and the tear film that results in discomfort and visual disturbances. Prevalence rates vary and rely heavily on studies mainly in older populations” [14].

This study was performed to study the presence of DES in healthy adult students using screens and contact lenses and without contact lenses, by comparing: OSDI, which is a rapid and non-invasive test with two tests, the TBUT test and Schirmer's test, in the diagnosis of dry eye.

“DES is a common public health problem. However, the diagnosis is not simple. Symptoms, which include redness of the eyes, burning, itching, blurred vision, foreign body sensation and eye strain, can also occur in other eye conditions” [15].

“The ocular symptoms may also not appear despite the reduction of tear production” [15].

Nichols et al., 2004 refer that “there was a poor relationship between symptoms and diagnostic test results in patients with DES. A person may have no symptoms other than eye strain, even though the result of a Schirmer test is less than 5 mm or even zero” [15].

According to Ünlü et al., 2012, “dry eye is a common problem among computer users. The OSDI questionnaire, used in conjunction with the TBUT test, is easy to perform and can be helpful in supporting the diagnosis of dry eye syndrome” [1].

Bhinder et al. 2005 support that “only the Schirmer does not appear to be a good test for the diagnosis of DES, because reflex tear secretion can lead to misdiagnosis of patients with dry eye as normal. Bhinder et al., 2005 further report that the results of the Schirmer test changed according to the reflex secretion of tears, therefore, there was no correlation with symptoms in DES” [16].

The above are in line with our study, as those who did not use artificial tears result in increased prices at Schirmer.

Moss et al., 2000 report that “DES increases with age in many population-based studies” [17].

“However, there has been a dramatic increase in workload in front of computer screens and this has resulted in an increase in DES in the younger population” [13].

“Uchino et al., 2008 observe that longer screen time is associated with a significant trend toward higher prevalence of DES in VDT monitors” [18].

According to Akib et al. 2021, the higher the degree of smartphone use, the higher the OSDI score and the lower the abnormal blink rate scores, the TBUT and Schirmer tests [19].

The Akib et al. 2021 conclusions were contrary to our research, as no statistically significant relationship was found between the existence of dry eye and the use of screens. This may be due to the small sample and the age of the participants [19].

Fonn 2009, also report that discomfort and dryness are closely related and appear to affect approximately 75% of contact lens wearers. Fonn refer that most patients did not experience these symptoms when they did not wear contact lenses. The use of contact lenses destabilizes the tear film. This can be easily observed and measured using the Tear Break Up Time test technique and the tear breaking time on the

contact lens surface is about half of the same measurement on the corneal surface [20].

In our research we did not observe a statistically significant relationship between TBUT test and the use of contact lenses, in contrast to the Schirmer test which had lower values in people who used contact lenses.

Finally, another limitation that we have, apart from the small sample, is that we did not exclude people who have undergone refractive surgery.

According to Gialelis et al. 2021, people who have undergone refractive surgery report that they may have the conversion of biomechanics of the cornea and dry eye, which we do not know what results with OSDI, TBUT and Schirmer test [21].

## 5. CONCLUSION

Traditional diagnostic tests for DES, such as the TBUT test and the Schirmer test, are often associated with low reproducibility and reliability, making it difficult to diagnose and manage the disease.

Advances in ocular imaging technology enable the objective and reproducible measurement of changes in ocular surface, tear film, and visual quality associated with DES.

The OSDI together with the TBUT test can be easily performed and used for the existence or not of DES. Further studies may be needed to improve the understanding and diagnosis of DES.

## CONSENT

All authors declare that 'written informed consent was obtained from the patient. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal.

## ETHICAL APPROVAL

The study is according to the Helsinki Declaration.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

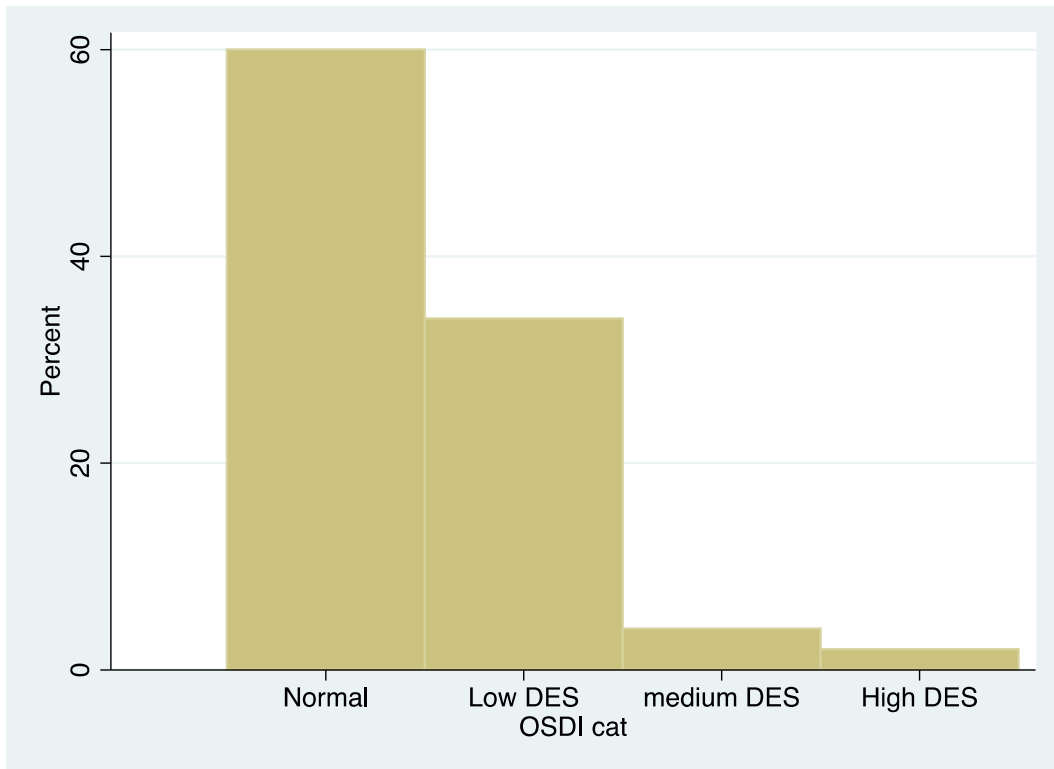
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## APPENDIX

**Histogram: Distribution of OsdI Categories**



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