

## Case Report

# Relationship between the Use of Video Terminals and Dry Eye Symptoms during the COVID-19 Pandemic: Assessments Based on a Meta-Analytical Approach

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**Received:** November 17, 2022; **Accepted:** January 03, 2023; **Published:** January 09, 2023

## Abstract

**Purpose:** The objective of this meta-analytical study is to consider the impact of the use of VDTs on the onset and/or worsening of the signs and symptoms of dry eye during the COVID-19 pandemic, but also to offer the best solutions to perform the various tasks in daily life in order to safeguard vision, with the aim of promoting a lifestyle that allows you to work and perform different activities more safely and efficiently. Patients should be encouraged to follow proper planning of visits.

**Methods:** Scientific articles chosen by the following inclusion criteria were analyzed: 1) Type of study (Primary); 2) Population (patients suffering from dry eye); 3) Study period (all studies carried out in the period between January 2020 and January 2022); 4) Result variables (correlation between increased use of VDTs during the pandemic and worsening of the symptoms of dry eye syndrome; correlation between autoimmune mechanism from Covid-19 and etiology of dry eye); 5) Language (English).

**Results:** The results of the various cross-sectional studies, obtained thanks to the administration of an online and anonymous questionnaire, have found a correlation between excessive use of VDTs and the onset of complications related to dry eye syndrome. The results suggest that in university students there is a higher incidence of problems related to dry eyes following the many hours spent in front of a screen to follow the lessons that were proposed to them remotely during the lockdown following the COVID-19 pandemic. Dry eye is the most commonly diagnosed pathology among eye disorders during the lockdown, as people spent much more time locked in the house, even 20-24h in the first months of lockdown in 2020.

**Conclusions:** In conclusion, the analysis of the data shows a correlation between prolonged use of VDTs (exacerbated during the COVID-19 era) and the onset or worsening of dry eye syndrome.

**Keywords:** Dry eye; Dry eye symptoms; Video terminal; COVID-19 pandemic

**Abbreviations:** VDT: Video Terminal; DED: Dry Eye Disease

## Introduction

Dry eye syndrome is a disorder that affects millions of people around the world. In 2017 the *TFOU Dry Eye Workshop II* (DEWS II) defined dry eye as a multifactorial pathology of the ocular surface, characterized by a loss of homeostasis of the tear film, and accompanied by ocular symptoms, in which the instability and hyperosmolarity of the tear film, inflammation and damage of the ocular surface, and neurosensory abnormalities play an etiological role. Dry eye is a complex functional disorder that cannot be reduced to a single process, sign or symptom [1].

The earliest symptoms are irritation, burning, foreign body sensation, fluctuations in visual quality, visual fatigue in prolonged reading or prolonged use of Video Terminals (VDT), excessive tearing, sensitivity to light, and discomfort with contact lenses. As dry eye syndrome worsens, symptoms can also degenerate. Over time, patients notice less of the effects of dry eye due to increasing damage to nerve endings, a consequence of chronic dry eye. Previously hyperlacrimal eyes can become totally tear-free. Fluctuation of vision leads to a constant visual reduction, which does not improve even with glasses. The eyes can become permanently roasted with recurrent abrasions, conjunctivitis and eye infections.

The era of technology and communication have completely revolutionized, within a few years, our lives and social relationships. With the spread of smart phones, tablets and computers, screens have become the most observed object during the day. To contribute has been added the pandemic situation, crossed in the last period, which has further meant that the passing of the days is alternated between hours of learning with distance learning and hours of leisure, always remaining with the gaze turned towards digital screens. In fact, the COVID-19 pandemic has affected many countries around the world by imposing a series of restrictive measures such as lockdown (mass quarantines), curfews or similar restrictions (e.g. order to stay at home). All these restrictions were set in order to reduce the spread of COVID-19. These restrictions were applied from early March 2020. During this lockdown period, some solutions have been proposed by experts to improve the manufacturability of remote work and school lessons, including smart working and online school lessons, and precisely these measures have contributed to the increase and abuse of the use of VDT, consequently leading to an increase in dry eye and the worsening of its symptoms. In addition to the classic risk factors that lead to the onset of dry eye syndrome, we can confirm that the period of the COVID-19 pandemic has been decisive in the increase in dry eye pathology in patients all over the world.

Students during the lockdown participated in the lessons in online mode and this showed a high frequency of dry eye symptoms, related to excessive use of VDT. Dry eye could be considered as an emerging health problem widespread mostly in young subjects, probably related to recent lifestyle changes.

It has been shown that people who work long hours with VDTs complain more about eye discomfort.

The main risk factors are summarized as follows:

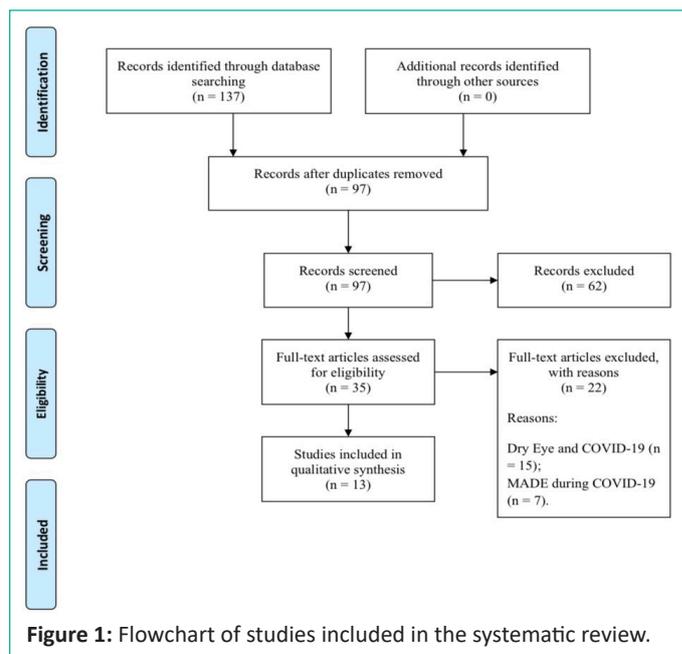
1. Gender: Women between the ages of 40 and 60 are more affected by dry eye, probably due to the new hormonal balances following menopause.
2. Age: aging is the cause of a progressive atrophy of the lacrimal glands.

3. Climatic-environmental factors: air conditioning, dry climate, cigarette smoke, wind, smog.
4. Use of certain drugs: immunosuppressants, hormones, antihistamines, anti hypertensives, antidepressants and others.
5. Prolonged use of VDT.
6. Nutritional deficits: insufficient intake of vitamin A.
7. Use of contact lenses.

Dry eye, which can give rise to chronic eye disorders and reduce the quality of life, is increasingly induced by environmental pollution and the frequent use of electronic devices [2].

On the one hand, the increase in *smart schooling/working* exposes to a greater use of VDT, a known risk factor for DED; excessive evaporation of tears is attributable to a prolonged interval of winking during fixation and is thought to be the main causal factor. On the other hand, the extensive use of the mask could represent an additional piece for the complex puzzle of dry eye syndrome during the COVID-19 period. In fact, moving the mask or wearing it incorrectly could disperse the air around the eyes and the infiltrating air could cause a rapid evaporation of tears [3].

## Materials and Methods



A protocol has been developed that includes inclusion criteria, research strategy and data analysis. Based on the analysis and robustness of the data, as there were no clinical trials, a systematic review was conducted following the guidelines of the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)* [4].

The literature was consulted via the PubMed database. The keywords "dry eye", "dry eye symptoms" combined with "Video terminals" and "COVID-19" were used in literature search. The flowchart showing the literature search and study selection is presented in (Figure 1). Initially, 97 items were identified. After conducting a skimming of the titles and abstracts, 35 articles with full texts were selected. Finally, 13 articles were included as they follow the inclusion criteria established in the research protocol.

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Articles are included if such studies follow the following inclusion criteria: 1) Type of study: cross-sectional; 2) Population: patients suffering from dry eye; 3) Study period: all studies carried out in the period from January 2020 to January 2022. 4) Result variables: correlation between increased use of display screens during the COVID-19 pandemic and worsening symptoms of dry eye syndrome. 5) Language: English. 6) *Full text*.

Abstracts (n = 8), letters to editors (n = 13), reviews (n = 19), 62 articles dealing with the etiology and worsening of dry eye symptoms linked to other causes, such as: vitreoretinal and corneal surgery, rheumatological diseases, complications related to anti-COVID-19 vaccination, use of contact lenses during the pandemic, respiratory diseases related to COVID-19 were excluded. In addition, *full text* that deals with dry eye related to the incorrect and / or excessive use of the mask to prevent COVID-19 infection (n = 7) and articles that deal with the correlation between the onset and symptomatic worsening of dry eye syndrome and COVID-19 infection (n = 15) have been excluded.

We have come to consider 13 articles that deal with the use of VDT and the onset of dry eye, which will be analyzed in detail. The following data were extracted from each study: first author, type of study, year of publication, number of patients involved in the experimental study and clinical characteristics, percentage of dry eye linked to excessive use of VDT during the COVID-19 pandemic.

## Results

This review included 13 articles, 12 cross-sectional and 1 retrospective. The selected studies were published between 2020 and 2022 and involved a total of 19283 subjects, including students, children and adults of various ethnicities (Caucasian, Asian, North and South America, Africa). No subjects were positive for COVID-19 at the time of the study.

Four studies have been conducted with pediatric patients [5-8], two studies have been conducted with both pediatric and adult patients [9-10], seven studies only adults [11-17]. The mean age of participants in adult studies is 29.06 years (range 19 to > 80 years), while the mean age in children is 14.08 years (range 10 to 18 years). Of the four pediatric studies, three studies were conducted on 8 primary and secondary school children,

7 secondary school children and 6 on high school students. Five studies were conducted on college students [10,12,13,15,16], one study conducted on both high school students and [8] children, two studies conducted on teachers [11,6], one study conducted on children, college students and adults [9].

All 13 studies used an online questionnaire to carry out the study. Each questionnaire contained the following information: age, sex, ethnicity, clinical history, presence or absence of symptoms of dry eye syndrome, specify the picture of dry eye (mild, moderate, severe), use or not of lubricants, duration of daily exposure to VDT, motivation for the use of VDT, type of device used most, discomforts found after the use of VDT. In a questionnaire of the 13 studies, it was also requested to specify the school grade [8].

The results of the various cross-sectional studies, obtained thanks to the administration of an online and anonymous questionnaire, have found a correlation between excessive use of VDT and the onset of complications related to dry eye syndrome. The results suggest that in university students there is a higher incidence of problems related to dry eyes following the many hours spent in front of a screen to follow the lessons that were proposed to them remotely during the lockdown following the COVID-19 pandemic. Dry eye is the most commonly diagnosed pathology among eye disorders during the lockdown, as people spent much more time locked in the house, even 20-24h in the first months of lockdown in 2020. Students, both university and high school and also primary and secondary school children, were forced to study remotely following the lessons in DAD, carrying out tasks in virtual classes, but not only students. Teachers and other workers have also been forced to carry out their duties remotely through smart working, using different devices such as tablets, smart phones, computers, and iPads. VDTs are to be considered one of the risk factors of dry eye because spending many hours in front of a screen winks less and less frequently and this leads to a greater dryness of the ocular surface.

The study conducted by Ekemiri K. Et al. on secondary school children, who studied remotely during the lockdown, shows that 55% of children have dry eye as they were exposed for more than two hours to VDT to follow lessons remotely. Equally interesting is the fact that the prevalence of ocular surface disorders increased with increasing age. The time of use of VDT increased since children and especially young people were not limited to using the computer to follow the lessons in DAD, but once out of the virtual classes they used mobile phones, tablets to play, stay on social media, spent more than two hours in front of the TV, so all this negatively affected the health of vision. Therefore, the prolonged use over the years of VDT has led to a change in the function of the lacrimal gland and finally to a reduction in tear secretion.

The results reported by the various questionnaires in the 13 studies indicate a high incidence of the use of VDT for work and educational reasons during the lockdown period.

The following table (Table 1) shows the data for each study considered in this work.

**Table 1:** Data relating to scientific articles considered for meta-analytical purposes.

First Author	Type of study	Year	No. pz	% Dry eye	P
Gupta P.C.	Cross sectional study	2021	547	87.2	0.6818
Elhousseiny A.M.	Cross sectional study	2021	403		<0.001
Gupta R.	Cross sectional study	2021	654	92.8	<0.001
Cartes C.	Cross sectional study	2021	1450	80.6	0.001
Wang Y.	Retrospective cross sectional study	2021	30		< 0.05
Neti N.	Cross sectional study	2021	535		<0.001
Tangmonkongvoragul C.	Cross sectional study	2022	528	70.8	0.033
Ekemiri K.	Cross sectional study	2022	435	55	
Abdulmannan D.M.	Cross sectional study	2022	1431		
Dossari S. F.	Cross sectional study	2022	301		
Al-dolat W.	Cross sectional study	2022	1219	71.7	
Lin F.	Cross sectional study	2022	4825	70.5	<0.001
Q. Fan	Cross sectional study	2022	6925		<0.001

## Discussion

The advent of the COVID-19 pandemic has disrupted the lifestyle, activities and behaviors of people around the world. Until the vaccine was put on the market, restrictions were applied to slow down and counteract the spread of the Coronavirus. The lockdown has forced people all over the world to confine themselves to their homes, while continuing to work remotely, thanks to *smart working*, and to study, following remote lessons, using VDT including computers, tablets and smart phones. An increase in the use of these devices has therefore been observed both for professional and social reasons, coming to use VDT for a time exceeding 6 hours a day and this situation has generated negative consequences on vision, especially on that of children with refractive defects who have come out of quarantine with greater fatigue and accentuation of visual disturbances. It is demonstrated by the scientific literature that both the activities carried out inside one's own homes and the prolonged use of video terminals are among the main risk factors of dry eye. The development but also the aggravations of the symptoms of dry eye are linked to the type of microenvironment, think of the percentage of humidity that can be inside the houses.

Dry eye is a disease that even before recent times had a high prevalence; in fact, it represents the main cause for which a patient turns to the ophthalmologist and also directly to the pharmacy to ask for an over-the-counter treatment, so we are talking about a pathology that already in the last decade has seen an extreme increase in its prevalence. The studies cited in this systematic review have found that the exacerbation of dry eye is linked to the increase in the use of VDT, now to be considered "normal" today. The application to VDT affects both children and adults. The prolonged use over the years of VDT has led to a change in the function of the lacrimal gland and finally to a reduction in tear secretion particularly accentuated in adults. Dry eye symptoms worsened more during the lockdown than in the period before the pandemic. VDTs create eye strain and visual attention alters eyelid statics, reducing blinking, and therefore lubrication. This can further favor the development but above all the aggravation of dry eye syndrome. It

was recommended, in fact, during telematic schooling, to respect rest times to reduce the impact on visual fatigue. During the pandemic, not only laptops and televisions were used, but there was also a massive use of mobile phones because social activity in that period increased a lot, because everyone writes or reads news on the mobile phone. The problem is that every time we pay attention to something we wink less, normally we have involuntary winks every three to four seconds, but if there is special attention such winks also come every seven to ten seconds. This leads to dry eyes, as well as symptoms of eye pain, periorbital headache and burning eyes.

While in the office we tend to take breaks and socialize, this does not happen at home. So, devices have become our virtual windows on the world from which we hardly detach. The impossibility of leaving the house made us jump from cell phone to television, from television to iPad, greatly lengthening the exposure time in front of VDT.

In the results of the various questionnaires, administered to the different population samples, it is clear that the use of VDT has doubled during the lockdown period. Participants also suffered from dry eye (they had mild, moderate or severe pictures) and this resulted in a reduction in work efficiency. The reasons for the increase in the use of VDTs most frequently reported by participants are the work and the need to follow the lessons remotely. However, to these two needs are added other motivations, namely many more hours spent in front of the television, video-games, smart phones, probably a consequence of the impossibility of carrying out leisure activities outside the home due to the anti-COVID-19 restrictions. The limitations of this systematic review refer to the heterogeneity from a methodological point of view of the studies that appeared in the literature during the COVID-19 era. Many of these are letters or comments that have been excluded from this analysis. In addition, Randomized Clinical Trials (RCTs) that we know represent the highest form of scientific evidence do not appear available in the literature to date.

In conclusion, the analysis of the data shows a correlation between prolonged use of VDT (exacerbated during the COVID-19 era) and the onset or worsening of dry eye syndrome.

To limit the risk of harmful effects on the ocular surface, it may be useful to introduce some precautions, such as:

1. Keep your computer screen clean
2. Position the screen so that it does not reflect light, below the operator's eye level and slightly tilted backwards
3. At the desk adjust the height of the seat so that the shoulders remain relaxed.
4. Prefer gray backgrounds to light or white ones, because the view will be strained less
5. A lower screen of the eyes allows for greater eyelid closure, which helps limit dry eyes.
6. Adjust the brightness of the monitor according to the ambient brightness (can change in the day)
7. Keep the right distance from the screen, more or less equivalent to the length of the arm
8. Remember to wink, a fundamental action to maintain the right lubrication of the eyes.

9. Use the appropriate glasses when working on the display screen. Check if there is a need for corrections even to read.
10. Every twenty minutes of work at the video terminal it is good to take a break of 20 seconds, possibly moving from the workstation, every two hours take a break of 15 minutes.
11. Regularly use tear substitutes while using VDU [18].

Prospective studies conducted on large case studies will confirm whether the implementation of such behaviors can actually mitigate the harmful effects of VDT use on the signs and symptoms of dry eye.

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