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Research Article

Prevalence and Association of Dry Eye Disease and Dry Skin Post COVID 19 Pandemic

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Abstract

Background: The COVID-19 pandemic has led to lifestyle changes such as increased screen time, which has been associated with various health issues. Dry eye disease (DED) and dry skin are associated with lifestyle changes. However, the association between DED and dry skin during the pandemic remains underexplored. This study aimed to investigate the prevalence of DED and its association with dry skin, along with identifying other risk factors for DED.

Methods: A cross-sectional survey was conducted from December 2020 to June 2021 using Google Forms distributed through social media platforms. The questionnaire included the Ocular Surface Disease Index (OSDI) and the Baumann skin-type questionnaire. Data on demographics, gadget usage, and other relevant factors were collected. The chi-square test and descriptive statistics were performed for analysis.

Results: Out of 510 participants who responded to the questionnaire, 342 (67%) subjects had dry eye disease (DED) based on OSDI scoring. Among the participants with DED, 135 (26.5%) had mild DED, 86 (16.9%) had moderate DED, and 121 (23.7%) had severe DED. We also found the prevalence of dry skin to be 36%. Among those with dry skin, 10 (2.0%) had very dry skin, and 173 (33.9%) had slightly dry skin. The chi-square test revealed a significant association between DED and dry skin ($\chi 2 = 4.90$; $p = 0.027$). Moreover, a significant association was observed between skin condition and DED severity ($\chi 2 = 43.47$; $p < 0.001$). However, there was no significant association between occupation and DED severity ($\chi 2 = 4.40$; $p = 0.62$). We found a significant association between the duration of gadget use and DED severity ($\chi 2 = 18.59$; $p = 0.02$).

Conclusion: This study revealed the alarming prevalence of DED. We also identified a significant association between DED and dry skin. DED severity also exhibited a significant association with skin condition and duration of gadget usage.

These findings indicate the importance of addressing DED and dry skin as interconnected health concerns, particularly concerning lifestyle changes induced by the COVID-19 pandemic. Early detection and management of DED and dry skin can improve the quality of life for affected individuals.

Keywords: Dry Eye; Dry Skin; OSDI; DED

Introduction

The COVID-19 pandemic has had a profound impact on people's lifestyles worldwide. The World Health Organization (WHO) declared COVID-19 as a disease, with the first case reported in China in December 2019. By March 2020, it had been recognized as a global pandemic, leading to widespread lockdown measures in many countries. Lifestyle changes such as the adoption of remote working, online education, and increased reliance on digital platforms for various activities, have resulted in a significant increase in screen time. Unfortunately, reduced physical activity and increased screen time contribute to much health issues [1]. Authorities had recommended implementing social distancing measures to prevent the spread of the infection. The lack of social interactions during the lockdown resulted in increased levels of stress and anxiety among individuals. Prolonged use of gadgets for work has increased the incidence of eye problems.

Dry eye disease (DED) is one of the most prevalent ophthalmic disorders that significantly affects quality of life. Nearly five million people aged ≥ 50 years' experience symptoms of DED [2]. The prevalence of DED has increased since the pandemic [3,5]. In India, the prevalence ranges from 18 to 54% [4]. A study conducted in Italy during the pandemic reported 57% of DED cases based on OSDI scores (2020). Ocular symptoms of dryness manifest before the onset of respiratory symptoms in patients infected with COVID-19 [6].

Similarly, societal changes caused by the pandemic, including altered mental states, social distancing, continuous mask usage, prolonged indoor hours, dietary habits, skincare product usage, weather conditions, and sleep patterns, influence changes in skin texture. The skin is the primary defense against environmental factors. The continuous use of personal protective equipment, such as masks, can disrupt the protective function of the skin because of repeated physical and chemical factors like friction, tension, pressure, moisture, humidity, and heat [7]. Hormonal fluctuations and emotional states also influence skin conditions.

For instance, stress can lead to dry skin, oily skin, itchiness, facial hair growth, and increased acne [8]. Reports from Italy have also indicated the occurrence of blepharitis in COVID-19 patients [9]. Additionally, the widespread practice of handwashing during the pandemic had caused hand dermatitis [10].

Studies by Asadi., *et al*. have provided sufficient evidence linking psychological factors to skin diseases [11].

Similarly, Bin Saif., *et al*. also showed subcutaneous lesions are associated with psychological stress [12].

A study conducted in Germany reported a 29% prevalence of dry skin, with conditions like dermatitis, atopic eczema, and psoriasis often being predicted by the occurrence of dry skin [13].

The COVID-19 pandemic has had a significant impact on mental health, particularly in terms of depression. Individuals infected with COVID-19 are at a greater risk of developing anxiety and depression, and those who already have these disorders experienced worsened symptoms [14].

Additionally, the lockdowns during the pandemic have negatively affected the mental health of patients with a significant proportion reporting depressive symptoms and distress [15].

A survey among 145 patients with chronic ocular diseases during COVID-19 lockdown revealed nearly 20% experiencing moderate to severe depressive symptoms, with 19% reporting mild to severe distress. Lockdowns notably impacted mental health negatively [16].

Furthermore, similar to the impact observed during the COVID-19 lockdown, psychological factors have been identified as significantly influencing individuals with dermatological conditions.

Patients with dermatological diseases often experience symptoms such as anxiety, depression, and personality disorders [17].

Mask-wearing during the COVID-19 pandemic has led to an increase in various skin conditions. These include acne in the mask distribution area, as well as worsening of pre-existing dermatologic conditions.

Studies have shown that many healthcare workers have experienced mask-related skin changes, with symptoms such as itching, pain, and embarrassment. Prolonged use of masks, mask type, and previously existing conditions are factors that contribute to the occurrence of facial cutaneous symptoms or diseases. Masks have been associated with the emergence of various cutaneous diseases, including acne, itching, and skin redness [18-22].

The mind-skin connection involves complex interactions between the immune system, central nervous system, and various signaling pathways, highlighting the bidirectional communication between the mind and the skin [23].

Mind skin connection indicates that the impact of COVID-19 on mental health will also impact skin health [24].

Various studies report the impact of COVID-19 on skin health. Cutaneous manifestations have been reported in COVID-19 patients, including maculopapular rash, urticaria, chilblain-like lesions, vesicular lesions, livedo reticularis, and petechiae [25,26].

Dry skin was found to be associated with COVID-19 due to frequent handwashing and the use of alcohol-based hand sanitizers [27].

Older patients, who are more vulnerable to the COVID-19 virus, were particularly found to have dry skin and irritation [28].

There is evidence to show that the prevalence of dry skin increased after COVID-19[29-31].

Pandemic-induced lifestyle changes, including increased reliance on digital gadgets and resulting mental depression, have caused dry skin. However, literature exploring the relationship between DED and dry skin remains scarce. Therefore, our study aims to determine the prevalence of DED among the general population and investigate its association with dry skin during the pandemic.

Methods

It is a cross-sectional survey-based study conducted in 2020-2021.

Participants completed the survey on Google Forms circulated through WhatsApp groups. The survey consisted of questions from both the Ocular Surface Disease Index (OSDI) questionnaire and the Baumann skin-type questionnaire. We created a single Google Form using both the questionnaires. Digital consent was obtained from all participants. This study was conducted in accordance with the tenets of the Declaration of Helsinki.

The Ocular Surface Disease Index (OSDI) is a validated DED questionnaire used to assess DED symptoms and the impact of DED on lifestyle. The OSDI questionnaire consists of 12 questions which comprises three sections. In each section, there were a set of five questions pertaining to Dry Eye Disease (DED), four related to visual functions, and three regarding environmental triggers.

OSDI scoring was performed based on the response of the participants in each category. The final scores were calculated using the formula:

The scores for DED symptoms ranged from 0 to 100, classifying them as none (0-12), mild (13-22), moderate (23-32), or severe (33). To identify DED, we used a cut off value of ≥22. The Baumann skin-type questionnaire assessed the skin type (oily or dry) based on nine questions (Figure 1). Skin types were classified as very dry skin (9-15), slightly dry skin (16-22), slightly oily skin (23-29), and very oily skin (30-36) based on the scores. (Figure 2). The survey also asked about use of artificial tears, contact lenses, gadgets, masks, air conditioners, history of refractive surgery, and skin conditions.

Figure 1: Skin types: Slightly dry skin, very dry skin, slightly oily skin, very oily skin.

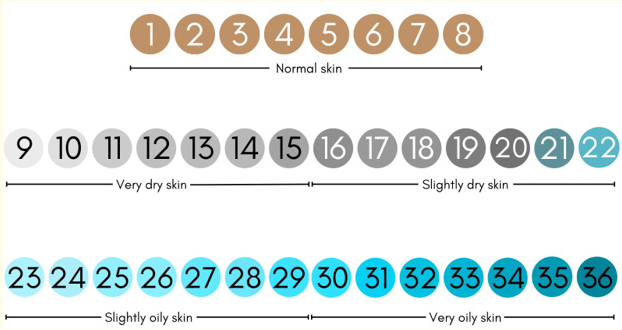

Figure 2: Dry Skin scoring.

The Baumann skin-type questionnaire assessed the skin type (oily or dry) based on nine questions. Skin types were classified as very dry skin (9-15), slightly dry skin (16-22), slightly oily skin (23-29), and very oily skin (30-36) based on the scores.

Results

In total 510 participants responded to the questionnaire. Among them, 168 were male, and 342 were female (Figure 3). The age groups ranged from 15 to 50 years. The prevalence of DED was 67% (95% CI 71% to 63%) (Figure 4). The mean OSDI score was 22.29 (95% CI of 20.73 to 23.85).

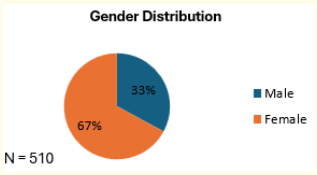

Figure 3: Gender distribution.

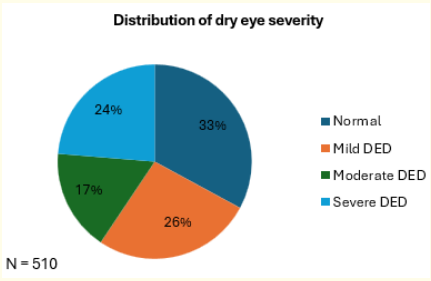

Figure 4: Distribution of Dry Eye Severity.

The odds ratio showed the risk of DED in both sexes.. Females had 1.19 times higher odds of developing DED than males (95% CI:0.802,1.775), but this difference was not statistically significant (p = 0.77).

Based on age, we divided the population into four categories: under 20 years, between 21 and 30 years, between 31 and 40 years, and between 41 and 50 years (Table 1). Based on their OSDI scores, we further divided the participants into those with normal, mild, moderate, and severe DEDs.

	Frequency (n)	Percentage (%)
Less than 20 years	124	24.3
21 to 30 years	356	69.8
31 to 40 years	18	3.5
41 to 50 years	12	2.4
Total	510	100.0

Table 1: Frequency of age group.

A chi-square association test showed no significant association between age and OSDI scores (Table 2). However, a mean value of OSDI scores increased with the increase in age as shown in the figure (Figure 5). The population was divided based on DED severity which is presented in (Table 3).

Age (Years)	Dry Eye Count				Total	chi-Square (p-value)
	Normal	Mild	Moderate	Severe		
	n (%)					
<20	36 (21.4)	31 (23.0)	23 (26.7)	34 (28.1)	124 (24.3)	
21-30	120 (71.4)	100 (74.1)	57 (66.3)	79 (65.3)	356 (69.8)	
31-40	8 (4.8)	3 (2.2)	4 (4.7)	3 (2.5)	18 (3.5)	7.703
41-50	4 (2.4)	1 (0.7)	2 (2.3)	5 (4.1)	12 (2.4)	
Total	168 (100.0)	135 (100.0)	86 (100.0)	121 (100.0)	510 (100.0)	(0.564)

Table 2: Association of Dry eye count with age.

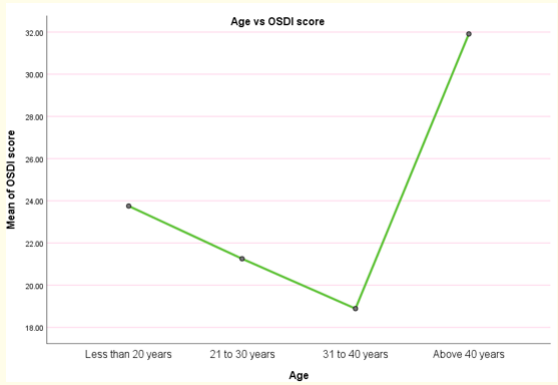

Figure 5: Line graph of OSDI score with age.

DED from OSDI scores	Frequency (n)	Percentage (%)
Normal	168	32.9
Mild	135	26.5
Moderate	86	16.9
Severe	121	23.7
Total	510	100.0

Table 3: DED severity.

The prevalence of dry skin conditions, categorized as very dry skin, slightly dry skin, very oily skin, and slightly oily skin based on the Baumann skin-type questionnaire scores are presented in (Table 4).

	Frequency (n)	Percentage (%)
Very dry skin	10	2.0
Slightly dry skin	173	33.9
Very oily skin	13	2.5
Slightly oily skin	314	61.6
Total	510	100.0

Table 4: Frequency of dry skin score.

A significant association was found between DED severity and dry skin using the chi-squared test ($\chi2(1) = 4.90$, $p = 0.027$). Number of patients who had dry skin are more among DED patients than in patients with normal eyes. (Figure 6) and similarly number of patients who had DED are more among dry skin patients than the normal skin patients (Figure 7).

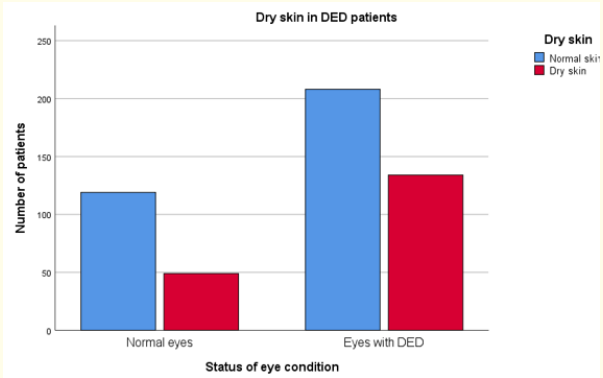

Figure 6: Bar graph of Dry eye and Dry skin.

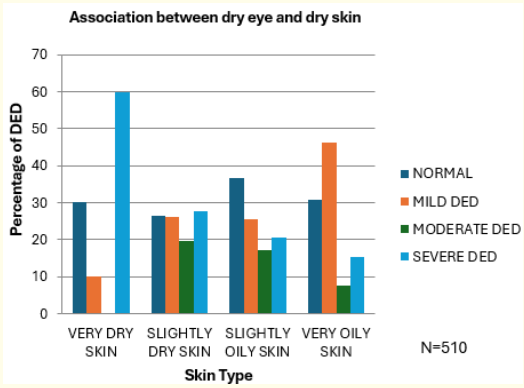

Figure 7: Association between dry eye and dry skin.

The association between skin conditions (rosacea, atopic dermatitis, lupus erythematosus, seborrheic dermatitis, and normal skin (Figure 8) and DED severity was examined using a chi-square test. The results showed a statistically significant association ($\chi2(4) = 43.47$, $p < 0.001$), which showed maximum dryness in atopic dermatitis.

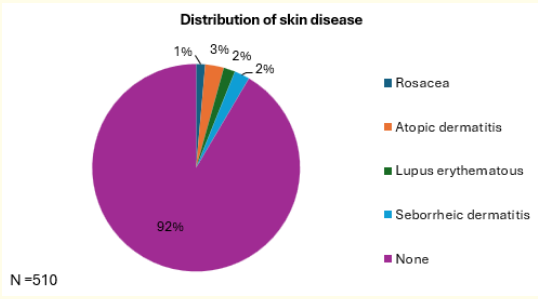

Figure 8: Distribution of skin disease.

We classified gadget usage hours as less than 5 hours, 5-10 hours, 11-15 hours, and > 15 hours per day. The chi-square association test showed a significant association between hours of gadget usage and DED($\chi2(3) = 18.591$, $p = 0.029$) (Figure 9).

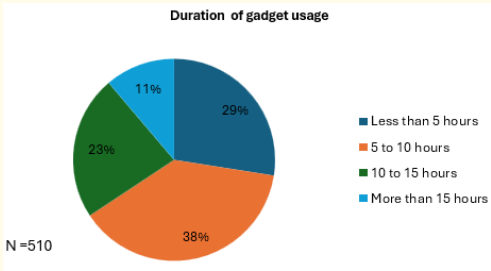

Figure 9: Duration of gadget usage.

We found a significant association between artificial tears and DED ($\chi2(3) = 16.412$, $p = 0.001$). We could also find a significant association between the contact lens and non-contact lens wearers ($\chi2(3) = 16.375$; $p = 0.001$) and there is a significant association between DED and face mask wear($\chi2(3) = 21.547$; $p = 0.010$).

The patients who had undergone LASIK, SMILE and cataract surgery also reported DED figure 10. More than 50% of the population reported eyes becoming sensitive to air conditioning (Figure 11).

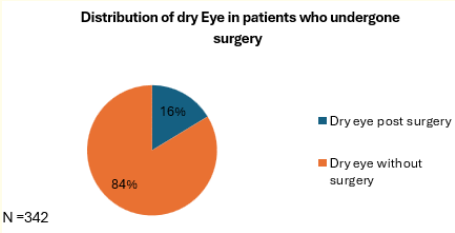

Figure 10: Distribution of dry eye in patients who have undergone surgery.

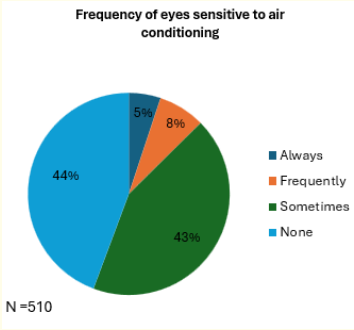

Figure 11: Frequency of eyes sensitive to air conditioning.

Discussion

Dry Eye Disease (DED) is a significant and growing concern, particularly during pandemics, because it has a negative effect on an individual's quality of life. The prevalence of DED, assessed using the Ocular Surface Disease Index (OSDI) questionnaire, varies globally, ranging from 5% to 50% in the adult population, and its occurrence increases steadily with age [36]. We observed a decline in OSDI scores with age, up to 30 years, followed by a steep increase. This could be due to the increased usage of gadgets among individuals under 20 years old compared to those over 20 years. Additionally, aging may contribute to a substantial increase in OSDI scores after 40 years of age. Titiyal., *et al*. conducted a hospital-based study in northern India using the OSDI questionnaire and reported a prevalence of 32% of DED based on OSDI score. It is important to note that this study was conducted in 2018, representing a pre-pandemic prevalence [37]. Furthermore, our study revealed that 24% of the general population experiences severe DED, whereas Titiyal., *et al.* reported a prevalence of 9%.MR Sánchez-Valerio., *et al*. conducted a study among office workers and reported the prevalence of DED was 79.6% in the year 2020. Mallik., *et al*. conducted a cross-sectional study in India among employees working in a university with an average usage of a computer for a minimum of 2 hours daily; a history of computer usage above 5 years found a DED prevalence of 75% in the year 2017 [38].

DED can significantly impact productivity and may lead to the development of other corneal diseases. Untreated DED can result in ocular infections, corneal ulcers, and even blindness.

Donthineni., *et al*. found the incidence was notably higher in males during the 3rd, 4th, 9th, and 10th decades ($p < 0.03$), while in the 5th and 6th decades of life, it was more prevalent in females ($p < 0.0001$) [39].

In contrast, our study reported a DED prevalence of 67% attributed to the pandemic lifestyle, with females having a 1.19 times higher risk than males. A study from Jordan found that DED is more common in females and contact lens wearers [40].

A study conducted in Chinese elementary school showed an increased incidence of DED among children due to smartphone usage, further noting a reduction in the blink rate associated with prolonged smartphone use [41]. Consistent with these findings, our study also revealed a significant association between gadget usage and the DED severity.

A study involving Polish university students revealed a 57.1% prevalence of dry eye symptoms [37].

Factors such as electronic device usage, medical history (including psychotropic and gluco corticosteroid usage, depression, diabetes, and allergies), refractive errors, metropolitan living, stress, and even a history of SARS-CoV-2 infection were correlated with dry eye symptoms [38].

A study of Chinese high school students during the COVID-19 outbreak found a high prevalence (70.5%) of symptomatic dry eye disease (DED). Significant risk factors included higher perceived stress scores, prolonged screen time, poor sleep quality, and being female [39].

The above studies show that a high prevalence of dry eye has been noted in different parts of the world. The associating factors were increased screen time [38].

But also studies show that dry eye disease is significantly association with depression and poor sleep quality [37].

These observations suggest that dry eye cannot be solely attributed to inadequate blinking while using visual display terminals (VDTs).

A review by Ketil., *et al*. explored the pathophysiological mechanisms linking visual display terminal (VDT) use to dry eye disease (DED), emphasizing impaired blinking patterns as a key factor. While hypotheses include changes in parasympathetic signaling and blue light exposure, evidence for their role remains limited. Understanding these mechanisms is crucial for advancing treatment and prevention strategies for VDT-associated DED [40].

Igor., *et al*. reported a positive correlation between DED and dry skin, although their study used the Schein questionnaire and clinical assessment methods to evaluate DED [41]. Nevertheless, our study yielded similar results, indicating a significant association between DED and dry skin. Additionally, Meibomian Gland Dysfunction (MGD), a leading cause of DED, is highly prevalent worldwide, with Asian countries exhibiting a prevalence exceeding 60%. Vitamin D deficiency [42], extended digital screen exposure [43], LASIK (laser-assisted in situ keratomileusis problems [44], and contact lens use are additional risk factors for DED. One notable limitation of our study is the lack of clinical assessment of dry eye due to the COVID-19 outbreak, which necessitated digital survey collection methods.

Our study revealed a concerning prevalence rate of 67% for Dry Eye Disease (DED). We identified a significant association between DED and dry skin. It is important to note that our study relied on survey-based data. Nonetheless, recognizing the connection between DED and dry skin can assist clinicians in identifying DED symptoms in patients with dry skin during medical history assessments, and vice versa. Although the eye and skin are distinct body parts, both play a role in surface lubrication. Therefore, there may be a common underlying factor that regulates both conditions. Considering the association between DED and dry skin, clinicians can diagnose DED at an early stage through comprehensive patient history assessments. This proactive approach will alleviate DED severity and enhance the overall quality of life for affected individuals. Further studies are required to find the association between psychological factors dry eye and dry skin.

Conflict of Interest

The authors declare no financial or non-financial conflicts of interest that could have influenced the outcome or interpretation of this research.

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