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Prevalence of Face Mask-Induced Dry Eye and Ocular Irritation Amid COVID-19 Among Health Workers in Jazan

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Abstract **Background:** One of the most important defenses against the COVID-19 pandemic is the use of facemasks. Long-term facemask use can result in mask-associated dry eyes. This study explored the prevalence of face mask-associated dry eyes (MADE) and associated factors among health workers in Jazan. **Methods:** This prospective cross-sectional clinical study was carried out among healthcare workers (Physicians, Dentists, Pharmacists, Technicians, Nurses, and Administrative staff) who wore facemasks during duties at Prince Mohammed Bin Nair Hospital in Jazan, Sudi Arabia, from 2020 to 2022. Two hundred ninety-eight participants were randomly selected. The participants were given a questionnaire about their socio-demographic characteristics, occupational information, health information, and the duration they had used glasses, masks, and technological devices. The daily average quantity of time spent sleeping was also investigated. The severity of dry eye disease was determined using OSDI scores. The chi-square test and Fisher's exact test examined categorical variable connections. Mean differences were calculated using an independent t)-test. Logistic regression will discover COVID-19 severity predictors. A statistically significant P-value is < 0.050. **Result:** Among 298 health workers in this study fulfilling the inclusion criteria. The mean age of the respondents was 32.50 ± 7.46 years old, consisting of 61.3% male and 38.7% female out of 298 respondents whom the majority of them were Saudi (89.6%) and the rest non-Saudi (10.4%). Based on the Ocular Surface Disease Index (OSDI) score, almost half of the respondents (49.0%) obtained an average score in terms of dry eye disease. Only gender and marital status were significantly associated with OSDI score ($2 = 24.247, p < 0.001$ and $2 = 24.247, p < 0.05$ respectively. From the Health Information provided, most of the variables were significantly associated with the OSDI score. **Conclusion:** This study concluded that face mask-associated dry eye (MADE) prevalence among health practitioners stands at 51%, partly explaining the worsening dry eye disease symptoms among mask wearers.

Key Words COVID-19, Dry ye, Face mask, Healthcare workers

1. Introduction

Due to the advent of a new disease in December 2019 called Coronavirus disease 2019 (COVID-19), caused by SARS-CoV-2 and initially diagnosed in Wuhan, the month has been notable for everyone (Hubei Province, China) [1]. The global trend away from mask use is accelerating in hospitals, where staff and patients must wear them for extended periods of time [2], [3]. Different viewpoints on the pandemic and its effects have cast doubt on the efficacy of facemasks in stopping the spread of the COVID-19 virus, but the WHO nevertheless recommends their usage. Cloth, surgical, and respirator face masks all have advantages over doing without any form of protection [4]. In June of 2020, an American ophthalmologist named D.E. White identified a new ailment he called "mask-associated dry eye" (MADE) [5]. In a sample of 2,447 people who reported experiencing dry eye symptoms, 29% said that wearing a face mask made their condition worse [6]. Ocular surface inflammation and higher Ocular Surface disease index scores have been linked in other studies to prolonged and frequent face mask use [7], [8].

The MADE prevalence was high among healthcare providers in Jeddah, Saudi Arabia (70.9%) [9]. They dis-

covered a significant correlation between the use of face masks and an increase in instances of severe dry eye symptoms. There were correlations between MADE and variables, including chronological age, occupational status, mask use duration, and time spent in front of electronic screens. This study found that donning a face mask worsened the symptoms of those with ocular disorders. Employees without a history of vision problems participated as well. According to a study from the Tear Film and Ocular Surface Dry Eye Workshop II (TFOS DEWS II), Dry eye disease (DED) is a complex ocular surface condition that disrupts tear film homeostasis and develops ocular symptoms. The causes include neurosensory abnormalities, unstable tear film and hyperosmolarity, ocular surface injury, inflammation, etc [10]. Ocular pain, irritation, itching, and the sensation that something is stuck in the eye are all signs of dry eye disease [11]. The ocular surface disease index is the most often used patient-reported outcome questionnaire for assessing the subjective symptoms of Dry eye diseases (DED) [12].

To combat the present COVID-19 pandemic, governments across the globe have mandated the use of face masks. In contrast, those who don masks tend to breathe through the mask's top rather than their nose or mouth. It has been linked to increased tear film instability and accelerated hydration loss, both associated with eye irritation [13], [14]. As a result, during the COVID-19 pandemic, ocular irritation and dryness was observed in people who had never previously suffered from dry eyes [15], [16].

DED is one of the most common ocular surface conditions worldwide. A global epidemiological survey found that DED prevalence ranges from 5 to 64% [17]–[19]. In Al-Ahsa, Saudi Arabia, DED prevalence was 32.1% [20].

Due to the constant use of facial masks in the healthcare industry, dry eye syndrome is a significant concern for many individuals in this field. Objectives Determine the prevalence of face mask-induced dry eye and ocular irritation and its association with other risk factors that influenced this condition during the COVID-19 pandemic among health workers in the Prince Mohammed Bin Nasser Hospital, Jazan, Saudi Arabia.

2. Materials and Methods

This prospective cross-sectional clinical study was carried out among healthcare workers (Physicians, Dentists, Pharmacists, Technicians, Nurses, and Administrative staff) who wore face masks during duties at Prince Mohammed Bin Nair Hospital in Jazan, Sudi Arabia, from 2020 to 2022.

Exclusion criteria include a history of contact lens use, topical eye medication use, or ocular surgery (refractive surgery, cataract surgery), in addition to any significant ocular or systemic disease that can induce dry eye disease (such as Diabetes Mellitus, Sjogren syndrome, or diuretic drug user).

The sample size was determined by using Epi Info software. Statistical analysis and statistical Package for the social sciences software entered and analyzed data. Continuous variables were expressed as means $\pm$ SD, and categorical variables as percentages and frequencies. The Chi-square test and Fisher's exact test examined categorical variable connections. Mean differences were calculated using an independent t-test. Logistic regression will discover COVID-19 severity predictors. A P-value of < 0.050 is statistically significant.

All procedures used in this investigation were legal and ethical by the Helsinki Declaration. Each individual who was asked to complete the Proforma consented to do so. Both Arabic and English versions of these options were accessible. Eye fatigue, photo phobia, and blurred vision were noted alongside non-visual complaints such as dryness, pain, discomfort, and lacrimation. The questionnaire was based on the Dry Eye-Related, Quality-of-Life Score questionnaire. It primarily comprised Yes or No questions and many alternatives to reflect subjective measurement and the OSDI score for objectively evaluating dry eyes. The participants were given a questionnaire about their socio-demographic characteristics, occupational information, health information, and the time they had used glasses, masks, and technological devices. The daily average quantity of time spent sleeping was also investigated. The severity of dry eye disease was determined using OSDI scores. The OSDI values were categorized as follows: 0-12 indicated normal, 13-22 indicated mild, 23-32 indicated moderate, and 33-100 indicated severe dry eye symptoms [21]. The data was inputted into SPSS 20. Using the correlation test, several factors about the OSDI score were examined. If the probability value was less than 0.01, significance was determined.

3. Result

Among the 298 health workers included in this study, they fulfilled the inclusion criteria. The mean age of the respondents was 32.50 $\pm$ 7.46 years old, consisting of 61.3% male and 38.7% female out of 298 respondents whom the majority of them were Saudi (89.6%) and the rest non-Saudi (10.4%). A total of 30.1% respondents had the minimum diploma qualification, about half (51.5%) had undergraduate degrees, and the rest (18.5%) had postgraduate qualifications. Almost half of the respondents were equally single (41.4%) and married (58.6%). Among the married females, a total of 5.5% (n = 4) of them were pregnant, while the rest were not.

Based on the Ocular Surface Disease Index (OSDI) score, almost half of the respondents (49.0%) obtained normal score in terms of dry eyes disease. A total of 23.2% of the rest had mild eye dryness, 10.1% in the moderate and 17.8% were in the severe category of dry eye disease. Almost one third of the respondents are paramedics (30.4%), a quarter were doctors (25.9%) and nurses (22.9%) followed by administrative personnel (11.3%) and pharmacist (9.5%).

Based on the analysis, Table 1 showed that only gender and marital status were significantly associated with OSDI score $2 = 24.247, p < 0.001$ and $(2 = 24.247, p < 0.05)$ respectively).

In terms of occupational information provided by the respondents, Table 2 indicated that only working experiences is significantly associated with OSDI score $(2 = 26.140, p < 0.05)$.

	OSDI Score, n(%)				c2 (p-value)
	Normal	Mild	Moderate	Severe	
Age					2.540 (0.057)^
Gender					
Male	102 (59.6)	37 (21.6)	15 (8.8)	17 (9.9)	24.247 (<0.001)
Female	44 (34.6)	32 (25.2)	15 (11.8)	36 (28.3)	
Marital Status					
Single	53 (42.7)	28 (22.6)	19 (15.3)	24 (19.4)	7.845 (0.049)
Married	93 (53.4)	41 (23.6)	11 (6.3)	29 (16.7)	
Nationality					
Saudi	124 (47.1)	63 (24.0)	29 (11.0)	47 (17.9)	4.232 (0.237)
Non-Saudi	22 (62.9)	6 (17.1)	1 (2.9)	6 (17.1)	
Education level					
Diploma	41 (48.2)	23 (27.1)	6 (7.1)	15 (17.6)	6.312 (0.389)
Undergraduate	81 (51.9)	30 (19.2)	15 (9.6)	30 (19.2)	
Postgraduate	24 (42.1)	16 (28.1)	9 (15.8)	8 (14.0)	
For Married Woman, Are you pregnant (n=72)					
Yes	1 (25.0)	0 (0)	1 (25.0)	2 (50.0)	4.035 (0.214)*
No	26 (38.2)	21 (30.9)	5 (7.4)	16 (23.5)	

Table 1: Association between Sociodemographic and OSDI Score (n=298)

	OSDI Score, n(%)				c2 (p-value)
	Normal	Mild	Moderate	Severe	
Occupation/Profession					
Doctor	40 (48.2)	20 (24.1)	12 (14.5)	11 (13.3)	17.378 (0.136)
Nurse	34 (45.3)	13 (17.3)	8 (10.7))	20 (26.7)	
Pharmacist	11 (40.7)	11 (40.7)	0 (0)	5 (18.5)	
Paramedical	48 (57.8)	16 (19.3)	7 (8.4)	12 (14.5)	
Administrative	13 (43.3)	9 (30.0)	3 (10.0)	5 (16.7)	
Working Experience					
Less than 5 years	29 (42.0)	9 (13.0)	11 (15.9)	20 (29.0)	26.140 (0.010)
5 Years	38 (46.9)	26 (32.1)	7 (8.6)	10 (12.3)	
10 years	40 (48.2)	26 (31.3)	5 (6.0)	12 (14.5)	
15 years	24 (63.2)	4 (10.5)	5 (13.2)	5 (13.2)	
20 years	15 (55.6)	4 (14.8)	2 (7.4)	6 (22.2)	
Working Duty					
= 8 Hours	126 (49.8)	57 (22.5)	24 (9.5)	46 (18.2)	1.216 (0.749)
>8 hours	20 (44.4)	12 (26.7)	6 (13.3)	7 (15.6)	
Use Face Mask					
Yes	135 (50.0)	64 (23.7)	27 (10.0)	44 (16.3)	4.250 (0.227)*
No	11 (39.3)	5 (17.9)	3 (10.7)	9 (32.1)	
Type of Face Mask (n=241)					
Not available	11 (39.3)	5 (17.9)	3 (10.7)	9 (32.1)	
Surgical Mask	114 (55.6)	34 (16.6)	18 (8.8)	39 (19.0)	8.289 (0.162)*
Cloth mask	2 (25.0)	2 (25.0)	0 (0)	4 (50.0)	
If Yes, How Long (n=241)					1.249 (0.293)*
Woman, use makeup around eyes and eyebrows (n=107)					
Yes	10 (29.4)	10 (29.4)	2 (5.9)	12 (35.3)	2.867 (0.413)
No	34 (36.6)	22 (23.7)	13 (14.0)	24 (25.8)	

Table 2: Association between Occupational Information and OSDI Score (n=298)

From the Health Information provided, most of the variables were significantly associated with the OSDI score (Table 3). Specifically, being diagnosed with chronic diseases |((2 = 13.288, p<0.05)), ocular diseases |((2 = 28.753, p<0.001)), dry eyes $(2 = 34.589, p < 0.001)$, blepharitis $(2 = 8.282p < 0.05)$, atopic or allergies $(2 = 30.466, p < 0.001)$ and the usage of contact lens $(2 = 10.091, p < 0.05)$ were among variables found to be significantly associated.

Bold: p-value < 0.25 (include in Multiple Logistic Regression)

Using simple logistic regression with significance level at $p < 0.05$, analysis revealed that the odd of abnormal OSDI score (mild, moderate and severe) is higher only for several variables, specifically: female compared to male $(OR = 1.886, 95\%CI = 1.309 - 2.719, p = 0.001)$, women who uses makeup around eyes and eyebrows $(OR = 2.400, 95\%CI = 0.917 - 4.924, p = 0.020)$, being diagnosed with ocular diseases $(OR = 4.000, 95\%CI = 1.501 - 10.658, p = 0.006)$, diagnosed with dry eyes $(OR = 3.818, 95\%CI = 1.966 - 7.416, p < 0.001)$, diagnosed with blepharitis $(OR = 9.000, 95\%CI = 1.140 - 71.038, p = 0.037)$ and the usage of contact lenses $(OR = 2.154, 95\%CI = 1.116 - 4.158, p = 0.022)$ as shown in Table 4.

4. Discussion

Similar to previous studies, we found that 51% of hospital staff encountered mask-associated dry eye (MADE). In one

	OSDI Score, n(%)				c2 (p-value)
	Normal	Mild	Moderate	Severe	
Diagnosed with chronic diseases					
Yes	8 (32.0)	2 (8.0)	5 (20.0)	10 (40.0)	13.288 (0.003)*
No	138 (50.5)	67 (24.5)	25 (9.2)	43 (15.8)	
Diagnosed with ocular disease					
Yes	5 (20.0)	3 (12.0)	1 (4.0)	16 (64.0)	28.753 (<0001)*
No	141 (51.6)	66 (24.2)	29 (10.6)	37 (13.6)	
Have undergone refractive surgery					
Yes	2 (25.0)	3 (37.5)	0 (0)	3 (37.5)	3.893 (0.212)*
No	144 (49.7)	66 (22.8)	30 (10.3)	50 (17.2)	
Diagnosed as dry eyes					
Yes	11 (20.8)	14 (26.4)	5 (9.4)	23 (43.4)	34.589 (<0.001)
No	135 (55.1)	55 (22.4)	25 (10.2)	30 (12.2)	
Diagnosed as Blepharitis					
Yes	1 (10.0)	3 (30.0)	2 (20.0)	4 (40.0)	8.282 (0.021)*
No	145 (50.3)	66 (22.9)	28 (9.7)	49 (17.0)	
Diagnosed with atopic or allergic					
Yes	9 (22.5)	7 (17.5)	5 (12.5)	19 (47.5)	30.466 (<0.001)
No	137 (53.1)	62 (24.0)	25 (9.7)	34 (13.2)	
Do you wear contact lenses					
Yes	13 (31.7)	10 (24.4)	4 (9.8)	14 (34.1)	10.091 (0.018)
No	133 (51.8)	59 (23.0)	26 (10.1)	39 (15.2)	

Table 3: Association between Health Information and OSDI Score (n=298)

study, 70% of healthcare employees reported developing MADE as a novel side effect of prolonged face mask use during the COVID-19 pandemic [22]. Another was done in Jeddah, Saudi Arabia, among Healthcare Workers in Primary Healthcare Centers during the COVID-19 Pandemic, showing a MADE percentage of 70.9%. 8 Another study found that 71.7% of Jordanian medical students exhibited dry eye symptoms. Additionally, the study found that being female and spending more time in front of electronic devices were significantly associated with dry eye symptoms while donning a face mask was not [23].

In an effort to combat the COVID-19 pandemic, the Saudi Arabian government has mandated the use of face masks in all public and private structures. However, despite the decline in COVID-19 occurrences, hospital staff are still required to wear face masks, placing them at risk for complications such as ocular diseases such as dry eyes. Recent research indicates that even among individuals who have never been diagnosed with dry eyes, regular face mask use is associated with an increase in dry eye symptoms [14].

The findings revealed that aberrant OSDI scores were 3.69 times more prevalent in females than males, indicating that gender may be a significant predictor of OSDI. Low levels of serum testosterone in women, which possesses anti-inflammatory properties, may exacerbate dry eye symptoms in women, consistent with previous research demonstrating a link between dry eyes and inflammatory processes and the impact of sex hormones on the immune system [24]. Another Chinese study found a correlation between the use of eyeglasses or contact lenses, age, female gender, and continuous facemask use and MADE in otherwise healthy individuals [25]. Despite numerous previous studies that found a correlation between females and MADE, this study did not discover a statistically significant link [23], [25]. Nev-

Variables	Crude OR	Crude β	SE	Wald	95% CI (Lower, Upper)	p-value
Age	1.000	-3.43x10-4	0.003	0.010	0.993, 1.006	0.921
Gender						
Male	1.000	0.635	0.186	11.582	1.309, 2.719	0.001
Female	1.886					
Marital Status						
Married	1.000	0.2992	0.182	2.594	0.939, 1.912	0.107
Single	1.340					
For Married Woman, Are you pregnant (n=73)						
Yes	1.000	0.480	0.25	3.693	0.991, 2.634	0.055
No	1.615					
Nationality						
Saudi	1.000	-0.526	0.350	2.262	0.298, 1.173	0.133
Non-Saudi	0.591					
Education level						
Diploma	1.000	-0.077	0.160	0.231	0.676, 1.268	0.631
Undergraduate	0.926	0.318	0.268	1.409	0.813, 2.326	0.235
Postgraduate	1.375					
Occupation/Profesion						
Doctor	1.000	0.187	0.232	0.651	0.765, 1.900	0.420
Nurse	1.206	0.375	0.392	0.915	0.675, 3.134	0.339
Pharmacist	1.455	-0.316	0.222	2.019	0.472, 1.127	0.155
Paramedical	0.729	0.268	0.368	0.530	0.635, 2.692	0.467
Administrative	1.308					
Working Experience						
Less than 5 years	1.000	0.322	0.244	1.739	0.855, 2.225	0.187
5 Years	1.379	0.124	0.223	0.308	0.731, 1.751	0.579
10 years	1.132	0.072	0.220	0.108	0.699, 1.653	0.742
15 years	1.075	-0.539	0.336	2.569	0.302, 1.128	0.109
20 years	0.583					
Working Duty						
= 8 Hours	1.000	0.223	0.300	0.553	0.694, 2.250	0.457
>8 hours	1.250					
Use Face Mask						
No	1.000	-0.435	0.406	1.152	0.292, 1.433	0.283
Yes	0.647					
Type of Face Mask (n=241)						
Not available	1.000	-0.661	0.412	2.575	0.230, 1.157	0.109
Surgical Mask	0.517	0.663	0.904	0.539	0.330, 11.407	0.463
Cloth mask	1.941					
If Yes, How Long (n=241)	0.926	-0.077	0.041	3.551	0.854, 1.003	0.060
Woman, use makeup around eyes and eyebrows (n=127)						
No	1.000	0.875	0.376	5.410	1.148, 5.019	0.020
Yes	2.400					
Diagnosed with chronic diseases						
No	1.000	0.754	0.429	3.091	0.917, 4.924	0.079
Yes	2.125					
Diagnosed with ocular disease						
No	1.000	1.386	0.500	7.687	1.501, 10.658	0.006
Yes	4.000					
Have undergone refractive surgery						
No	1.000	1.099	0.816	1.810	0.606, 14.864	0.178
Yes	3.000					
Diagnosed as dry eyes						
No	1.000	1.340	0.339	15.647	1.966, 7.416	<0.001
Yes	3.818					
Diagnosed as Blepharitis						
No	1.000	2.197	1.054	4.345	1.140, 71.038	0.037
Yes	9.000					
Diagnosed with atopic or allergic						
No	1.000	-0.019	0.061	0.093	0.871, 1.106	0.760
Yes	0.982					
Do you wear contact lenses						
No	1.000	0.767	0.336	5.226	1.116, 4.158	0.022
Yes	2.154					

Table 4: Simple Logistic Regression Analysis (n=298)

ertheless, the most recent study confirmed previous research by demonstrating that the prevalence of dry illness increased with age. This trend was most pronounced among Covid-19 patients and health professionals, similar to the increase in the prevalence of dry eye complaints among those who wore face coverings for extended periods of time [26], [27].

This study examined the relationship between the length of time individuals wear face masks and the frequency with which they experience dry eyes. The researchers intended to determine the relationship between MADE and variables such as age, gender, marital status, occupation, and duration of mask use.

One study found that the use of corrective lenses was associated with MADE and could worsen MADE outcomes due to disruption of tear film stability, which is associated with dry eyes. This finding was consistent with previous research indicating that people with pre-existing eye diseases or who wore corrective lenses had more severe symptoms [25]. Another study discovered that contact lens wearers with more severe eye symptoms also tended to wear face masks for extended duration of the day. If mask use continues, this may increase the prevalence of dry eye in the future [28].

5. Conclusion

This study found that 51% of medical practitioners have mask associated dry eye (MADE), which may help to explain why mask users are more likely to have symptoms of dry eye diseases (DED). Predictors of mask associated dry eye (MADE) prevalence include age, gender, married status, nationality, occupation, years of work experience, and duration of mask use. Eye care professionals should inform their patients about the dangers of using face coverings improperly. The findings also demonstrate the necessity of adjusting work hours to reduce the amount of time employees spend gazing at screens and wearing masks. Education about preventive measures including face masks, exhaust blowers, and eye medicines for dry eyes will also help minimise the occurrence of mask associated dry eye (MADE).

Conflict of Interest

The authors declare no conflict of interests. All authors read and approved final version of the paper.

Authors Contribution

All authors contributed equally in this paper.

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