The Face Mask-Associated Dry Eye Symptoms in Workers Who Collecting Novel Coronavirus Nucleic Acid Sample During the Covid-19 Outbreak

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Research Article

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Abstract

Objectives

To evaluate the impact of face mask wearing on dry eye symptoms in health care professionals who collecting novel coronavirus nucleic acid sample during Omicron outbreak.

Methods

This cross-sectional online survey enrolled a total of 1135 health workers and social workers who were dispatched to the front line to participate in the fight against the epidemic. The ocular surface disease index (OSDI) questionnaire was also administered to quantify Mask-Associated Dry Eye (MADE) symptoms. The difference between wearing the face shield and safety-goggle was also investigated.

Results

In this study, the average score was 13.39 (3.39–23.39) and the prevalence of MADE symptoms including mild (23.62%), moderate (12.8%) and severe (4.09%) in Face Shield Group and mild (22.00%), moderate (11.67%) and severe (2.67%) in Safety-Goggles Group. The prevalence of MADE symptoms was higher in female (41.80%) and 50–65 age (64.65%).

Conclusions

A proportion of health and social workers suffer from dry eye symptoms related with wearing mask during the COVID-19 outbreak. MADE interventions should be implemented among health workers during the COVID-19 outbreak to reduce MADE symptoms effects and prevent long-term adverse outcomes.

1. Introduction

Dry eye disease(DED) ,one of the most prevalent ocular surface problem in daily ophthalmological practice[1], is a multifactorial disease of the ocular surface characterised by a loss of homoeostasis of the tear film, and accompanied by ocular symptoms, in which tear film instability and hyperosmolarity, ocular surface inflammation and damage, and neurosensory abnormalities have aetiological roles[2], which was a new definition from the second International Dry Eye workshop reported in the summer of 2017. The prevalence of DED was great differences worldwide range from 5–50%[3]. In China,the pooled prevalence of DED by symptoms and signs was 18.48% [4] .

The symptoms of DED, such as foreign body sensation, grittiness, itchiness, fatigue, and visual disturbances[5], can severely impact vision-related quality of life and that it carries a considerable economic burden of disease [3]. There were a plethora of risk factors that can contribute to the disease, such as normal aging, inflammatory conditions, systemic medications, environmental factors, and lifestyle such as prolonged electric devices using. Most recently ,a new factor that wearing face masks was considered to be related to DED during the Covid-19 outbreak. White DE purposed the term “mask associated dry eye (MADE)” to describe this condition [6] and increasingly concerned about mask-related dry eye research[7,8] Fan Q et al ‘s study show that risk factors of MADE included longer mask wearing time, nonstandard wearing of face masks, dry environment, older age, female sex, higher education and less outdoor time. Pre-existing dry eyes and use of glasses and contact lens could worsen dry eye symptoms[9].

The Coronavirus (COVID-19) pandemic had an outbreak in December 2019 in Wuhan[10] and has lasted over three years. The Chinese government had taken a number of steps to avoid infection and to quickly screen positive cases throughout China[11]. So many medical staff were pulled out of hospitals to participate in community-level nucleic acid detection, many social workers, as partner of health workers, were employed on a temporary basis for using a mobile phone app to scan a QR code to register the information data. Their prolonged use of masks may cause dry eye symptoms.

Health workers and social workers were at risk of MADE due to the prolonged use of face masks. The aim of this study was to assess the relationship between the wearing of face masks and the presence of MADE among health professional workers and social workers in Shenyang of China during the COVID-19 pandemic.

2. Methods And Materials

This cross-sectional, observational study included the health professionals, including doctors and nurses collecting novel coronavirus nucleic acid sample and social workers as partner of health workers collecting information data in the community during the Omicron outbreak in Shenyang, China. Participants were also divided into a Face-Shield group and a Safty-Goggle Group for comparison based on the different environment caused by the facial protection device they wore.

This study adhered to the tenets of the Declaration of Helsinki, and was approved by the Forth People’s Hospital of Shenyang Ethics Committee. Participants having a history of systemic or ocular disorders (including dry eye diagnosis) or who were using systemic or topical therapies (such as lubricants or artificial tears) were excluded from the research, as were contact lens wearers. The subjects were asked to make a note of the duration they kept their masks on during the work-day.

All participants were also asked to fill in the Ocular Surface Disease Index (OSDI) questionnaire[12] at the end of the three consecutive work-day. Both eyes of all the subjects were included in the statistical analyses.The online questionnaire was created using ”Wenjuan Xing,” a widely used, open, web-based questionnaire platform and the invitation to participate in the study was posted on “Wechat” for file sharing and messaging, one of the main ways people communicate in China. The 12-item OSDI score range from 0 to 100, with a score of 0 indicating no ocular symptoms and higher scores indicating greater symptom severity. The minimal clinically meaningful change in score for an individual is 10 points.

The OSDI score ≥ 13 was marked as clinically significant presence of DES (Classification of severity: mild (13 to 22), moderate (23 to 32), and severe (33 to 100)[13].

Descriptive statistics were used to summarise the results, and an Odds Ratio was calculated to quantify the magnitude of association using 95% Confidence Interval (CI) and P-value (< 0.05).Statistical Program for Social Sciences(IBM SPSS Corp, SPSS Statistics ver. 25, USA) was used for statistical analyses,paired samples t test and logistic regression was used to analyse factors associated with dry eye disease.

3. Results

3.1Geographic Characteristic

Of the 1135 participated in the survey, 68(5.99%) did not complete questionnaires in the three consecutive work-day, 32 (2.82%) did not pass the consistency checks. Finally, a total of 935(82.38%) participants were included in the analysis (shown in Table 1), with an effective response rate of 82.38%. Regarding the distribution of gender and age, 73.69% of health workers were female and26.31% were male, and 45.45% were aged 20–34, 65.23% were married, 29.84% were unmarried and 4.81% were divorced/widowed. 635(67.91%)were in Face-Shield Group, and 300(32.09%) were in Safety-Goggles Group. The mean age of all participants was (34.89 ± 6.8) years. All of them spent more than average 10 hours of wearing face mask per day in the last two months.

Table 1
Geographic Characteristic

	Total (%)	Face-Shield Group(%)	safety-Goggles Group(%)
Gender	935(100%)	635(67.91%)	300(32.09%)
Male	246(26.31%)	182(73.98%)	64(26.02%)
Female	689(73.69%)	453(65.75%)	236(34.25%)
Age,years			
20–34	425(45.45%)	300(70.59%)	125(29.41%)
35–49	312(33.37%)	207(66.35%)	105(33.65%)
50–65	198(21.18%)	128(64.65%)	70(35.35%)
Marital Status			
Married	611(65.35%)	430(70.38%)	181(29.62%)
Unmarried	279(29.84%)	190(68.10%)	89(31.90%)
Divorced/Widowed	45(4.81%)	35(77.78%)	10(22.22%)
Education			
College degree and below	236(25.24%)	148(62.71%)	88(37.29%)
Bachelor’s degree	458(48.98%)	334(72.93%)	124(27.07%)
Master’s degree	217(23.21%)	129(59.45%)	88(40.55%)
Doctor’s degree	44(4.71%)	44(100%)	0(0.00%)
Post of duty			
Information Collection	448(47.91%)	306(68.30%)	142(31.70%)
Nucleic Acid Collection	487(52.09%)	329(67.56%)	158(32.44%)
Occupation			
Doctor	187(20.0%)	129(68.98%)	58(31.02%)
Nurse	300(35.09%)	200(66.67%)	100(33.33%)
Social worker	448(47.91%)	306(68.30%)	142(31.70%)

3.2 Prevalence of Dry Eye Symptoms

In this study, a total of 363 (38.82%) of the respondents reported OSDI score greater than or equal to 13 points. Table 2 presents the prevalence of MADE symptoms including mild (23.62%), moderate (12.8%) and severe (4.09%) in Face Shield Group and mild (22.00%), moderate (11.67%) and severe (2.67%) in safety-Goggles Group. The prevalence of MADE symptoms was higher in female (41.80%)and 50–65 age (64.65).

Table 2
Prevalence of Dry eye Symptoms

		Face Shield Group					safety-Goggles Group				
	Total		Non(%)	Mild(%)	Moderate(%)	Severe(%)		Non(%)	Mild(%)	Moderate(%)	Sev
	935	635	381(60.60%)	150(23.62%)	78(12.28%)	26(4.09%)	300	191(63.67%)	66(22.00%)	35(11.67%)	8(2
Gender											
Male	246	182	122(67.03%)	36(19.78%)	22(12.09%)	2(1.10%)	64	49(76.56%)	10(15.63%)	5(7.81%)	0(0
Female	689	453	259(57.17%)	114(25.17%)	56(12.36%)	24(5.30%)	236	142(60.17%)	56(23.73%)	30(12.71%)	8(3
Age,years											
20–34	425	300	207(69.00%)	62(20.67%)	31(10.33%)	0(0.00%)	125	97(77.60%)	26(20.80%)	2(1.60%)	0(0
35–49	312	207	129(62.32%)	48(23.19%)	24(11.59%)	6(2.90%)	105	69(65.71%)	20(19.05%)	13(12.38%)	3(2
50–65	198	128	45(35.16%)	40(31.25%)	23(17.97%)	20(15.63%)	70	25(35.71%)	20(28.57%)	20(28.57%)	5(7
Marital Status											
Married	611	420	256(60.59%)	98(23.33%)	52(12.38%)	14(3.33%)	191	122(63.87%)	41(21.47%)	22(11.52%)	6(3
Unmarried	279	180	104(57.78%)	44(24.44%)	22(12.22%)	10(5.56%)	99	62(62.63%)	23(23.23%)	12(12.12%)	2(2
Divorced/Widowed	45	35	21(60.00)	8(22.86%)	4(11.43%)	2(5.71%)	10	7(70.00%)	2(20.00%)	1(10.00%)	0(0
Education											
College degree and below	236	150	92(61.33%)	34(22.67%)	18(12.00%)	6(4.00%)	88	58(65.91%)	18(20.45%)	10(11.36%)	2(2
Bachelor's degree	458	311	182(58.52%)	76(24.44%)	40(12.86%)	13(4.18%)	124	78(62.90%)	29(23.39%)	14(11.29%)	3(2
Master's degree	217	130	80(61.54%)	30(23.08%)	15(11.54%)	5(3.85%)	88	55(62.50%)	19(21.59%)	11(12.50%)	3(3
Doctor's degree	44	44	27(61.36%)	10(22.73%)	5(11.36%)	2(4.55%)	0	0(0.00%)	0(0.00%)	0(0.00%)	0(0
Post of duty											
Information Collection	448	306	190(62.09%)	70(22.88%)	36(11.76%)	10(3.27%)	142	91(64.08%)	34(23.94%)	15(10.56%)	2(1
Nucleic Acid Collection	487	329	191(58.05%)	80(24.32%)	42(12.77%)	16(4.86%)	158	100(63.29%)	32(20.25%)	20(12.66%)	6(3
Occupation											
Doctor	187	129	76(58.91%)	33(25.58%)	14(10.85%)	6(4.65%)	58	38(65.52%)	12(20.69%)	6(10.34%)	2(3
Nurse	300	200	115(57.50%)	47(23.50%)	28(14.00%)	10(5.00%)	100	60(60.00%)	22(22.00%)	14(14.00%)	4(4
Social Worker	448	306	190(62.09%)	70(22.88%)	36(11.76%)	10(3.27%)	142	93(65.49%)	32(22.54%)	15(10.56%)	2(1

3.3 Severity of Dry Eye Symptoms

As shown in Table 3, the average score on the OSDI for MADE symptoms for all respondents were 13.39(3.39–23.39) and 13.75 (4.89–22.61), 12.64 (4.44–20.84), respectively in Face Shield group and safety-Goggles group. Score in female 14.75(4.11–25.39) was significantly higher than male (9.59(3.42–15.76), $p < 0.05$). There were significant differences of MADE scores between 50–65 ages 20.39(5.65–14.74) and the other two groups 10.82(3.21–18.43) and 12.47(4.21–20.73). The nucleic acid collection group 14.14(4.17–24.11) including doctor(14.53(4.07–10.46) and nurse 13.59(4.11–23.07) was higher than information collection group 12.55(4.08–21.02)made up of social workers 12.52(4.06–20.98, $p < 0.05$)). There were significant differences of MADE scores

between Face Shield group and safety Goggles group only related with gender 7.83 (4.12–10.64) vs 13.94 (4.89–22.99, $p < 0.05$) and age (9.13 (4.25–14.01) vs 11.75 (4.44–19.06) vs 20.22 (6.25–34.19), $p < 0.05$).

Table 3
Severity of Dry eye symptoms

	Total	*p*	Face Shield Group	safety-Goggles Group	*p*
	OSDI Score(95%CI)		OSDI Score(95%CI)	OSDI Score(95%CI)	
	13.39(3.39–23.39)		13.75 (4.89–22.61)	12.64 (4.44–20.84)	0.065
Gender					
Male	9.59(3.42–15.76)	0.015*	10.20(4.56–15.84)	7.83 (4.12–10.64)	0.0125*
Female	14.75(4.11–25.39)		15.18 (5.12–25.24)	13.94 (4.89–22.99)	
Age,years					
20–34	10.82(3.21–18.43)	0.0342*	11.52(4.25–18.79)	9.13 (4.25–14.01)	0.0487*
35–49	12.47(4.21–20.73)		12.83(4.38–21.28)	11.75 (4.44–19.06)	
50–65	20.39(5.65–14.74)		20.48(6.64–34.32)	20.22 (6.25–34.19)	
Marital Status					
Married	13.2(4.23–22.17)	0.698	13.42 (4.56–22.28)	12.71 (4.32–21.1)	0.523
Unmarried	13.79(4.11–23.47)		14.46(4.78–24.14)	12.59 (4.35–20.83)	
Divorced/Widowed	13.56(4.16–22.96)		14.13(4.35–23.91)	11.56 (4.11–19.01)	
Education					
College degree and below	13.12(4.05–22.19)	1.254	13.59(4.25–22.93)	12.34 (4.09–20.59)	1.123
Bachelor's degree	13.55(4.11–22.99)		13.93(4.44–23.42)	12.59(4.44–20.74)	
Master's degree	13.3(4.12–22.48)		13.51 (4.65–22.37)	12.99 (4.52–21.46)	
Doctor's degree	13.82(4.23–23.41)		13.82 (4.89–22.75)	0.00(0.00–0.00)	
Post of duty					
Information Collection	12.55(4.08–21.02)	0.022*	12.94(4.27–21.61)	11.72 (4.21–19.23)	0.548
Nucleic Acid Collection	14.14(4.17–24.11)		14.52 (4.77–24.27)	13.34 (4.35–22.33)	
Occupation					
Doctor	13.59(4.11–23.07)	0.035*	13.98 (4.68–23.10)	12.71(4.44–20.98)	0.621
Nurse	14.53(4.07–10.46)		14.86 (4.79–24.93)	13.86 (4.61–23.11)	
Social Worker	12.52(4.06–20.98)		12.94 (4.22–21.66)	11.61 (4.08–19.14)	

4. Discussion

- To our knowledge, this is the first study evaluating the relationship of MADE prevalence in the health workers and social workers supported fighting Covid-19 in China. The results show that all participants had high prevalence of dry eye symptoms, which could have been related with long-time wearing mask.
- Before, a survey identified significant relationships between face mask wearing and increased mask wearing time and MADE incidence. The increased incidence of MADE due to the use of masks. This novel finding suggests that frequent wearing of face masks and longer daily mask wearing time are risk factors for MADE in China general population by MADE-Q[9].
- In a survey of Face Mask-Related Ocular Surface Modifications, the Ocular Surface Disease Index (OSDI) score was abnormal in more than half of the cases[14].
- When compared with non-mask related epidemiological studies, such as Caffery B et al. 's, which study occurred before the COVID-19 outbreak ,resulting in an unadjusted prevalence of 22.0% (95% CI, 20.8–23.1%), the highest was aged 55–64 years (24.7%; 95% CI, 22.1–27.3%), and women was statistically higher(24.7%; 95% CI, 23.2–26.2%) than men (18.0%; 95% CI, 16.4–19.7%)[15].
- Another meta-analysis indicated the prevalence of DED by symptoms and signs was 13.55% (95% CI = 10.00-18.05) and that of DED by symptoms was 31.40% (95% CI = 23.02–41.13) in Chinese people aged 5–89 years. Even considering the region, our study occurred in Northeast China, while in Song's study, the prevalence of DED by symptoms and signs in Northeast China was 26.42% [4]. So there has been an increase in mask-related dry eye symptoms since the Covid-19 outbreak.

Our results demonstrate that female has a statistically higher OSDI score than male, which concurs with previously reported papers on DED epidemiology [16]. For female, the prevalence of DED symptoms starts increasing from 14% at 50 years of age to 22% for those 80 + years of age [17]. Some previous studies have also reported age-specific sex differences, which may be the result of a combination of different hormones acting on the eye surface, lacrimal glands and so on[18,19].

The highest average OSDI score was found in the group over 50–65 years of age,which result was similar to that aged 40–64 years had the highest mean ± SD DEQ-5 score[16]. Since we haven't included participants above the age of 65, and there were very few participants over the age of 60, affecting the overall prevalence and making it unrepresentative of all age groups.

A small sample study measured respirator related OSDI scores for health workers that were higher than our average ,the mean OSDI score in the morning was 20.1 ± 8.3 (0–68.75), which significantly increased to 27.4 ± 10.4 at the end of the work-day (0–81.25)[20]. Scalinci SZ's Research has shown that health workers and people who need to wear masks for at least 6 hours a day (At least 5 days a week during the 60 days prior) the highest absolute increase was: +12.50.) and thought it was related to wearing masks for a long time [21]. Moshirfar et al.(2020) and Giannaccare G et al(2020)reported that mask wear can accelerate the evaporation of tears and exacerbate the symptoms of dry eye and harm the ocular surface[22,23] .

Despite studies showing that wearing sealed goggles in healthcare workers will result in dehydration on ocular surface[24]. The safety-goggles group showed a partial statistically significant decrease in OSDI score relative to those for the face shield group, suggesting wearing safety-goggles maybe a little bit better than wearing face shield.

The study found that the exposure of the ocular surface to high speed air flow (1.5 m/s) reduces the lower tear meniscus height and area and increases the blink frequency[25].One possible explanation for the worsening of DED symptoms might be related to loose fitting of masks around the nose. Without a proper seal, respiratory gas might be diverted upwards towards the eyes[21]. This is similar to our Face Shield group, but the safety-Goggles protect the air flow of the mask, so the score of this group is generally lower than that of the Face Shield group, but we do not see a significant difference. This could also be due to safety Goggles providing an alternative environment, or it could be related to dry eyes.

For example, the surrounding temperature and humidity ofwearing safety goggles was different with wearing face shield. Previous research has revealed that the temperature and humidity of gases inside a face mask that travels through the upper edge of the mask towards the ocular surface can be higher. This hot air current produces instability, increased evaporation, hyperosmolarity, and a decrease in tear film renewal, all of which contribute to the development of dry eye symptoms. In turn, the severity of the symptoms is linked to the tear lipid layer's thickness[26].Alternatively, as a result of exhaled air, oxygen levels decline, and the air contains more carbon dioxide, causing degeneration of the lacrimal and ocular surfaces, which lowers pH and lowers stromal pH, resulting in corneal issues [27,28]. Silkiss RZ proposed that the use of adhesive tape over one's mask on the bridge of the nose to minimize the upward direction of air towards the eyes may improve surroundings of the eye.[29].

We also saw higher rates and scores in the nucleic acid sampling group, which included medical staff, than in the information collection group, which included social workers, despite the fact that information collection is typically done by scanning a code using a mobile phone App, which may lead to confusion about whether time spent on a mobile phone is a factor affecting dry eye [30]. However, there was no evidence that this group was more numerous than those who did not use cell phones. However, even if health-care employees do not use mobile phones for work, they may spend a significant amount of time on terminal electronic devices in their other jobs or personal lives, thus this does not eliminate the dry eye disease induced by this factor.

It is recommended that we do not remove the mask, and certainly not remove Face Shield and safety Goggles, and we do not know if wetting the sampled environment increases the possibility of viral aerosol formation. However, using necessary interventions such as sodium glass cellulose eye drops when convenient may reduce and prevent dry eye.

Limitations

These participants didn't undergo a complete ophthalmological examination including a best corrected visual acuity (BCVA), intraocular pressure (IOP) measurement, biomicroscopic anterior segment examination and fundus examination with 90 D lens. We used a personal commitment to the above instead.The OSDI score only represents symptoms, but cann't represent diagnosis of DE, therefore, a variety of other objective methods should be employed to evaluate DES.

Conclusion

A proportion of health workers suffer from dry eye symptoms related with wearing mask during the COVID-19 outbreak. High-risk health workers and social workers for DE symptoms were those female, older, and with face shield. DE interventions should be implemented among health workers during the COVID-19 outbreak to reduce DE symptoms effects and prevent long-term adverse outcomes.

Declarations

Ethical approval

The study was approved by The Fourth People's Hospital of Shenyang Ethics Committee and in line with the principles of the Declaration of Helsinki.

Competing Interests

All of our authors participated in the study and agreed to the publication of the results. The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Contributions:

Jintao Ren contributed to the conception of the study; Jie Yu and Jintao Ren performed the experiment; Jie Yu Liang Zhang Chunguang Lu contributed significantly to analysis and manuscript preparation, Jie Yu and Dongning Liu performed the data analyses and wrote the manuscript; Jintao Ren and Dongning Liu helped perform the analysis with constructive discussions.

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Availability of data and materials

Not applicable

Informed consent

We gave an informed consent form at the top of the questionnaire, and only with consent can we continue to answer the OSDI content, so all participants in our study knew and agreed to participate in this study.

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