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Coronavirus Pandemic

Prevalence of face mask related complications among healthcare workers during the COVID-19 pandemic in Saudi Arabia

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Abstract

Introduction: During the coronavirus disease 2019 (COVID-19) pandemic, most healthcare workers (HCWs) were required to wear face masks for long periods of time. Since then, it has been shown that face masks have the potential to cause several physical adverse effects. This study aimed to estimate the prevalence of face mask-related complications among HCWs during the COVID-19 pandemic in Saudi Arabia. Furthermore, we compared the relationship between face mask usage with other variables, including the type of mask used and gender.

Methodology: A cross-sectional study was conducted using convenience sampling, with a targeted sample of 517 participants (35% nonresponse). Data was collected via an electronic survey, the link for which was distributed through social media sites, such as WhatsApp and Twitter, to reach HCWs across Saudi Arabia. Data was analyzed using the SPSS software.

Results: Overall, 438 HCWs who wore N95 or surgical masks for 4 hours or more per day on average were recruited. Skin-related complications in the nasal area had the highest prevalence (342, 78.1%), followed by behind the ear area (333, 76.0%), cheeks (307, 70.1%), and chin (248, 56.6%). Other complications included headaches (226, 51.6%), and eye-related complications (211, 48.2%). All face mask-related complications, except for behind the ear skin complications, were more associated with female gender.

Conclusions: Mask usage was significantly associated with the development of headaches, and eye, and skin-related complications. Female HCWs were more predisposed to these complications. Preventative measures and awareness activities should be considered to help reduce mask use related complications.

Key words: facemask; COVID-19; headache; complications; HCWs.

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Introduction

Coronavirus disease 2019 (COVID-19) is a respiratory infection caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). This disease was first discovered in China in December 2019 and was declared as a pandemic by the World Health Organization (WHO) in January 2020. COVID-19 is predominantly transmitted via respiratory droplets containing the virus, but could also be transmitted by the fecal-oral route, contact with blood and fomites, and mother-to-child transmission [1]. COVID-19 manifestations include fever, fatigue, shortness of breath, dry cough, and myalgia [2]. Saudi Arabia reported its first SARS-CoV-2 positive case on the 2nd of March 2020 [3]. Healthcare Workers (HCWs) are at high risk of contracting SARS-CoV-2 as they must attend to infected patients. In the early stages of the pandemic, the WHO initially recommended preventive measures, including wearing face masks [2]. While current guidelines on personal protective equipment (PPE) and infection prevention are continuously changing, the Saudi Public Health Authority and WHO continue to recommend PPE usage for HCWs when in contact with COVID-19 patients. PPE includes face masks, gowns, face shields, and goggles [4,5].

Despite their utility, several studies have shown that masks can cause a plethora of physical adverse effects on the user, including skin damage, headaches, and eye-related adverse effects. The duration of mask usage and the type of mask used (surgical, N95) are considered factors contributing to face mask-related complications [6,7]. The prolonged use of face masks has also been found to decrease the productivity of HCWs, as it may affect their physiological and psychological health [8].

In this study, we investigated the prevalence of face mask-related complications during the COVID-19

pandemic among healthcare workers in Saudi Arabia. Furthermore, we compared the relationship of face mask usage with other variables, including the type of mask used and gender.

Methodology

Study design and setting

This cross-sectional study was conducted from February to December 2021. Data was collected from HCWs in Saudi Arabia during the COVID-19 pandemic.

Population description

HCWs were recruited using convenience sampling. Enrolled participants included specialists, pharmacists, physicians, dentists, nurses, and interns. The inclusion criteria were: HCWs living in Saudi Arabia who wore face masks for 4 hours or more a day, were above the age of 18 years, and were able to provide informed consent. Individuals who wore face masks for less than four hours, primarily wore face masks other than N95 or surgical types, and those who did not correctly complete the survey were excluded.

Sample size

The sample size was determined using a single-proportion formula. A review of the literature revealed that the prevalence of acne, one of the most common adverse effects, was 53% [8]. We subsequently concluded that the minimum required sample size for this study was 383. In anticipation of non-responders, an additional 35% was added, bringing the total number of target participants to 517. A confidence interval of 95% and 5% margin of error were used.

Data collection

A 25-item questionnaire (Supplementary File 1) was developed in accordance with the literature [9,10]. The questionnaire was reviewed by multiple experts including a dermatologist, and its validity was tested in a pilot study of 20 HCWs who were subsequently excluded from the final study. The questionnaire was composed of four sections: 1) Informed consent; 2) General data (gender, age, region, occupation, and work area); 3) Information related to the usage of masks (type of mask, daily wearing time of the mask, daily wearing time of goggles/face shield); and 4) Issues encountered by HCWs while using masks during the entire period of the COVID-19 pandemic, including the type of issue (eye, skin, headache), anatomical location, severity of symptoms, and previously diagnosed conditions. The final questionnaire was distributed over a period of one month, spanning from September 2021 to October 2021, through social media platforms such as WhatsApp, Twitter, and Telegram.

Ethical considerations

Before filling out the questionnaire, the participants were informed regarding the purpose of the study, that the data collection was anonymous, and that participation was voluntary. No reward was provided for participation. This study was approved by the Institutional Review Board of King Saud University on August 23, 2021 (IRB number: E-21-6130).

Statistical analysis

The data was analyzed using SPSS version 21.0 (IBM Inc., Chicago, USA) statistical software, and the alpha significance level was set at 0.05. The mean and standard deviation were used to describe continuous measured variables, and the median and interquartile ranges were used for continuous variables with skewness. Frequency and percentages were used to describe the categorically measured variables. Multiple response dichotomy analysis was applied to describe variables with more than one option (e.g., facial skin symptoms). The Kolmogorov–Smirnov test of statistical normality was applied to assess the statistical normality assumption for the metric variables. The bivariate Chi-square test of association was used to assess correlations between categorical variables. The total number of skin symptoms was computed for each face integumentary location by adding up the total number of individuals experiencing symptoms on each anatomical place, yielding a total number of skin complaints for the nose, cheeks, chin, ears, and eyes. Due to the zero-altered Poisson distribution (positive skewness) of the HCW's count of experienced skin conditions, a multivariate generalized linear (negative binomial) regression analysis was applied to assess the statistical significance of the predictors of the number of health care workers who experienced facial skin symptoms associated with excess face mask use during the pandemic. The association between the tested relevant predictor variables and the HCW's count of symptoms in the nose, chin, cheeks, ears, and eyes were expressed as the multivariate adjusted risk rate (RR) coefficients with the associated 95% confidence intervals (CI). In addition, multivariate binary logistic regression analysis was applied to assess the health workers' odds of experiencing headaches associated with excessive face mask use during the pandemic, while the association between predictor independent

variables was expressed as a multivariate adjusted odds ratio (OR) with the 95% CI.

Results

A total of 522 healthcare workers completed the questionnaire, of whom 84 were excluded from the final analysis because they met the exclusion criteria, leaving 438 valid participants. The majority of the participants were female (277, 63.2%). The mean age was 34.4 ± 9.8 years (age range: 20-67 years). Most respondents were located in the central region of Saudi Arabia (216, 49.3%), followed by the eastern region (94, 21.5%). Physicians were the most frequent responders (139, 31.7%), followed by nurses (106, 24.2%), and medical technologists (59, 13.5%). Regarding the type of mask, the majority (407, 92.9%) used surgical masks more frequently than N95 masks. After excluding those who wore face masks for less than 4 hours, the reported duration of usage was almost equally distributed among participants; 4-8 hours (221, 50.5%), more than 8 hours (217, 49.5%) (Table 1).

Table 1. Descriptive analysis of sociodemographic characteristics of healthcare workers (n = 438).

	n (%)
Gender	
Male	161 (36.8)
Female	277 (63.2)
Age (years), mean (SD)	34.37 (9.81)
Age group	
20-30 years	202 (46.1)
31-40 years	118 (26.9)
41-50 years	88 (20.1)
≥ 51 years	30 (6.8)
Clinical role	
Medical technologists	59 (13.5)
Medical students/Interns	51 (11.6)
Physicians	139 (31.7)
Nurses and assistant nurses	106 (24.2)
Dentists	47 (10.7)
Other (RT, PT, Dietitians and Pharmacists)	36 (8.2)
Working areas	
General Medical Floor	124 (30.7)
Critical Care Unit	87 (21.5)
General surgical floor	103 (25.5)
Laboratory Department	56 (13.9)
Radiology department	40 (9.9)
Pharmacy	16 (4.0)
Outpatient clinical areas	158 (39.1)
Operation Room	62 (15.3)
Emergency Room	111 (27.5)
Residence	
Central region	216 (49.3)
Eastern region	94 (21.5)
Western region	71 (16.2)
Northern region	22 (5.0)
Southern region	35 (8.0)
Types of masks used at work	
N-95 Masks	31 (7.1)
Surgical Masks	407 (92.9)

The nasal bridge area had the highest overall prevalence of skin complications (342, 78.1%), followed by behind the ear area (333, 76.0%), cheeks (307, 70.1%), and chin (248, 56.6%). Headaches (226, 51.6%) and eye-related complications (221, 48.2%) had a lower prevalence than skin-related complications (Table 2).

Nasal bridge

The majority of HCWs (342, 78.1%) reported experiencing at least one of the nasal bridge problems associated with prolonged face mask use (Table 2). The most reported nasal skin problem was redness (165,

Table 1 (continued). Descriptive analysis of sociodemographic characteristics of healthcare workers (n = 438).

	n (%)
Hours per day wearing masks	
4-8 hours per working day	221 (50.5)
> 8 hours per working day	217 (49.5)
Adjunctive PPE used	
Goggles	66 (34.0)
Face shield	159 (82.0)
Daily hours using adjunctive PPE's	
<4 hours per working day	55 (12.6)
4-8 hours per working day	77 (17.6)
> 8 hours per working day	63 (14.4)
None	243 (55.5)
Previous diagnosis with a skin condition in any of the following areas: behind the ear, cheek, chin, nasal bridge.	
Yes	46 (10.5)
No	392 (89.5)
Type of previously diagnosed skin disorder, n=43*	
Acne	24 (55.8)
Rosacea	5 (11.6)
Dermatitis	11 (25.6)
Others	9 (20.9)
Worsening of skin condition following face mask use	
Yes	32 (69.6)
No	14 (30.4)
Previous diagnosis with chronic headache type	
Yes	43 (9.8)
No	395 (90.2)
Type of previously diagnosed headaches, n = 42**	
Tension headache	9 (21.4)
Migraine	30 (71.4)
Other type of headache	6 (14.3)
Worsening of headache upon face mask use	
Yes	17 (39.5)
No	26 (60.5)
Previous diagnosis with an eye condition	
Yes	48 (11.0)
No	390 (89.0)
Type of previously diagnosed eye condition, n = 47**	
Dryness	26 (55.3)
Myopia	9 (19.1)
Astigmatism	5 (10.6)
Conjunctivitis	9 (19.1)
Eyelid cysts	2 (4.3)
Other eye disorders	3 (6.4)
Worsening of eye condition upon wearing face mask	
Yes	24 (50.0)
No	24 (50.0)

SD: standard deviation; RT: respiratory therapists; PT: physiotherapists; PPE: personal protective equipment; * Three missing responses; ** One missing response.

Table 2. Descriptive and bivariate analysis of overall integumentary complaints and face mask use at work (n = 438).

	Total n (%)	Face Mask Used		*p* value
		N95 N = 31	Surgical N = 407	
Nasal complaints				
No	96 (21.9)	2 (6.5)	94 (23.1)	0.031
Yes	342 (78.1)	29 (93.5)	313 (76.9)	
Cheek complaints				
No	131 (29.9)	4 (12.9)	127 (31.2)	0.003
Yes	307 (70.1)	27 (87.1)	280 (68.8)	
Chin complaints				
No	190 (43.4)	8 (25.8)	182 (44.7)	0.041
Yes	248 (56.6)	23 (74.2)	225 (55.3)	
Ear complaints				
No	105 (24.0)	4 (12.9)	101 (24.8)	0.134
Yes	333 (76.0)	27 (87.1)	306 (75.2)	
Eye complaints				
No	227 (51.8)	8 (25.8)	219 (53.8)	0.003
Yes	211 (48.2)	23 (74.2)	188 (46.2)	

48.2%) followed by itchiness (137, 40.1%), oiliness (118, 34.5%), acne, and pain (both 112, 32.7%) (Table 3). According to the Chi-square test of independence, female HCWs experienced significantly more nasal skin-related acne, itchiness, enlarged pores, oily skin, skin peels, and redness of the nose ($p < 0.05$), while the remainder of the nasal skin complaints showed no significant difference in incidence between male and female HCWs. Overall, these findings suggest that HCWs who used surgical face masks for their work on average reported 36.2% fewer nasal skin complaints than those who used N95 face masks ($p = 0.037$). Moreover, HCWs who used adjunctive PPE for more than 4 hours per day reported 14.2% higher nasal skin complaints ($p = 0.016$). HCWs' occupation, age, daily hours of face mask use, and other predictor variables were not significantly associated with the reported rate of nasal skin complaints associated with face mask use (Table 4).

Ear

The second most reported complaint overall involved the skin behind the ear (333, 76.0%, Table 2). The most reported ear problems were pain (262, 78.7%), redness (123, 36.9%), itchiness (101, 30.3%), and burning (47, 14.1%) (Table 3). The gender of HCWs showed no significant association with the rate of behind the ear skin complications. However, HCWs who used surgical face masks primarily reported 46.2% fewer complications than those who used N95 face masks ($p = 0.005$). Moreover, those who used face masks for more than 8 hours reported 1.37 times more behind the ear skin problems than those who used them for 8 hours or less per shift ($p = 0.012$) (Table 4).

Table 3. Descriptive analysis of healthcare workers who experienced skin complaints on their nasal bridge, cheeks, chin, or ears during the pandemic.

	Nasal bridge n (%)	Cheeks n (%)	Chin n (%)	Behind the ear n (%)
Acne	112 (32.7)	158 (51.5)	28 (56.9)	0
Skin eschar	42 (12.3)	27 (8.8)	19 (7.7)	21 (6.3)
Dryness of skin	82 (24.0)	84 (27.4)	59 (23.8)	39 (11.7)
Burning sensation	43 (12.6)	33 (10.7)	14 (5.6)	47 (14.1)
Superficial skin Blistering and burns	12 (3.5)	9 (2.9)	0	19 (5.7)
Itchiness of the skin (pruritus)	137 (40.1)	101 (32.9)	85 (34.3)	101 (30.3)
Skin wrinkles	15 (4.4)	15 (4.9)	8 (3.2)	0
Enlarged skin pores	42 (12.3)	33 (10.7)	17 (6.9)	0
Face skin indentation	28 (8.2)	21 (6.8)	9 (3.6)	0
Skin Flaking	20 (5.8)	17 (5.4)	11 (4.4)	9 (2.7)
Deep full thickness ulcer (bone and muscle may be exposed)	4 (1.2)	1 (0.3)	0	0
Thickening of skin (Lichenification)	9 (2.6)	6 (2.0)	3 (1.2)	10 (3.0)
Oily skin	118 (34.5)	1 (0.3)	2 (0.8)	0
Swelling of the skin	26 (7.6)	17 (5.5)	10 (4.0)	43 (12.9)
Skin maceration	8 (2.3)	1 (0.3)	0	6 (1.8)
Skin peeling	25 (7.3)	26 (8.5)	19 (7.7)	31 (9.3)
Pain	112 (32.7)	48 (15.6)	24 (9.7)	262 (78.7)
Skin hyperpigmentation	21 (6.1)	17 (5.5)	15 (6.0)	3 (0.9)
Redness of skin	165 (48.2)	115 (37.5)	49 (19.8)	123 (36.9)
Tingling sensation	8 (2.3)	16 (5.2)	18 (7.3)	26 (7.8)
Total number of affected persons	**342 (78.1)**	**307 (70.1)**	**248 (56.6)**	**333 (76)**

Cheeks

Out of all participants, 307 (70.1%) reported experiencing one or more cheek problems (Table 2). The most common cheek complaints reported by female HCWs were acne (139, 50.2%), followed by redness (83, 30.0%) and itchiness (74, 26.7%), whereas among male HCWs, redness was the most common complaint (32, 19.9%), followed by itchiness (27, 16.8%) and acne (19, 11.8%). The findings showed that female gender, prolonged face mask usage, and PPE usage for more than 4 hours were significantly associated with cheek complaints. However, the HCWs' age and type of face masks used showed no statistical significance (Table 4).

Chin

Chin complications due to prolonged use of face masks were reported by 248 HCWs (56.6%) (Table 2). The most common complication was acne (28, 56.9%), followed by itchiness (85, 34.3%), dryness (59, 23.8%) and redness (49, 19.8%) (Table 3). According to the Chi-squared test of independence, female HCWs experienced more significant chin complications such as acne, scars, dryness, peeling, hyperpigmentation, and redness ($p < 0.05$), while the remainder of the chin complaints did not differ significantly between male and female HCWs. Further analysis revealed that HCWs who used PPE along with a face mask for more than 4 hours per day were 1.15 times more likely to have chin complaints than those who used PPE for less than 4 hours or those who did not use it at all. The type of mask and daily hours of face mask use were not significantly associated with HCWs' reported rate of face mask-related chin complaints (Table 4).

Headaches

Overall, 226 (51.6%) HCWs reported experiencing headaches. Female HCWs were 2.33 times more likely to experience headaches with prolonged face mask usage compared to male HCWs ($p < 0.001$). The findings showed that HCWs' age was negatively associated with their likelihood of having headaches while wearing face masks for extended hours. The logistic regression analysis predicted that for each additional year of a HCWs' age, the odds of experiencing headaches decreased by 2.7% ($p = 0.021$).

Table 4. Multivariable negative binomial regression analysis of the number of healthcare workers with measured association of skin and eye complaints with face mask use during the pandemic.

	Multivariate adjusted Risk Ratio (RR)	95% CI for RR		*p* value
		Lower	Upper	
Eye complications				
Female gender	1.597	1.184	2.153	0.002
Age	1.008	0.994	1.023	0.280
Surgical mask	0.578	0.358	0.931	0.024
Daily hours of facemask use	1.019	0.770	1.349	0.893
Daily hours of adjunctive PPE with facemask use	1.038	0.919	1.172	0.548
Behind the ears complications				
Female gender	0.967	0.748	1.251	0.800
Age	0.992	0.978	1.005	0.215
Surgical mask	0.538	0.349	0.830	0.005
Daily hours of using face masks > 8 hours per shifts	1.368	1.072	1.746	0.012
Outpatients care areas/clinics	1.289	0.998	1.665	0.052
Nasal bridge complications				
Female gender	1.478	1.157	1.888	0.002
Age	0.996	0.984	1.008	0.515
Surgical mask	0.638	0.418	0.972	0.037
Daily hours of using adjunct PPE with face masks > 4 hours	1.142	1.025	1.273	0.016
Daily hours of using face masks	1.106	0.873	1.402	0.404
Chin complications				
Female gender	1.744	1.276	2.384	< 0.001
Age	0.986	0.970	1.001	0.070
Surgical mask	0.699	0.433	1.128	0.143
Daily hours of using face masks	1.238	0.933	1.644	0.140
Daily hours of using adjunct PPE with face masks	1.158	1.026	1.307	0.017
Western region	0.618	.406	0.941	0.025
General surgical floors	0.699	.495	0.988	0.042
Cheek complications				
Female gender	1.940	1.477	2.550	< 0.001
Age	0.991	0.978	1.005	0.201
Surgical mask	0.785	0.500	1.233	0.293
Daily hours of using adjunct PPE with face masks >4 hours	1.160	1.040	1.294	0.008
Daily hours of using face masks	1.302	1.009	1.680	0.042

PPE: personal protective equipment; CI: confidence interval.

However, a history of chronic headaches was not associated with face mask-related headaches (p = 0.144). Moreover, face mask type, hours of usage, and wearing PPE were not significantly associated with the odds of experiencing face mask-related headaches (Table 5).

Eyes

At least one eye related complaint was reported by 211 (48.2%) of the study participants (Table 2). The analysis further showed that the most prevalent complaint was dryness (105, 49.8%), followed by eye discomfort (98, 46.4%), itchiness (63, 29.9%), redness (55, 26.1%), tearing (53, 25.1%), blurred vision (50, 23.7%), burning (43, 20.4%), and foreign body sensation (21, 10.0%).

When asked about a prior diagnosis of an eye condition, 48 (11.0%) HCWs answered yes, with eye dryness being the most common condition (26, 55.3%). Other conditions included myopia (9, 19.1%), and conjunctivitis (9, 19.1%). With regard to the worsening of their eye condition, 24 (50.0%) HCWs stated that eye complications progressed with the prolonged use of face masks (Table 1). Female HCWs were 1.6 times more likely to experience these eye-related complications than their male colleagues (p = 0.002). Other factors such as the HCWs' age showed no significant difference with the mean rate of reported eye symptoms (p = 0.28). The findings further suggested that HCWs who used surgical face masks were 42.2% less likely to develop eye symptoms than those who wore N95 face masks (p = 0.02). The daily hours of face mask use, as well as the use of adjunctive PPE did not significantly affect the rate of eye symptoms (Table 4).

Discussion

In this study, the area that was reported to be most frequently affected by skin complications related to face mask use was the nasal bridge (78.1%). This is supported by prior studies in the literature, including those of Daye *et al.* (40.7 %) [9], Alizadeh *et al.* (82.7 %) [11] and Gürlek and Özyürek (69.9%) [12]. The area with the second highest prevalence was the skin behind the ear (76.0%), which was also reported by Daye *et al.* (28.4%) [9] and Gürlek and Özyürek (69.8%) [12].

A previous descriptive cross-sectional study conducted to assess headache associated with PPE during the COVID-19 pandemic found that 57.5% of participants experienced headaches [13], which is consistent with our finding of 51.6%. Furthermore, a different cross-sectional study conducted in Mexico found that 67.5% of respondents reported PPE related headaches [14]. The higher prevalence compared to the present study could be explained by the fact that 93.0% of the participants in the aforementioned study predominantly wore N95 masks, and they also included participants who wore face masks for less than 4 hours.

Multiple studies reported an increase in eye complaints with the use of face masks during the COVID-19 pandemic. This has been observed by White and he coined the term MADE for "mask associated dry eye" [15]. Boccardo then suggested a definition for MADE and produced a questionnaire to assess it called MADE-Q [16]. Later, a study on 6,925 individuals of the Chinese general population found a 7.9% incidence rate of MADE using a modified version of MADE-Q [17]. In contrast, the current study reports that 48.2% of HCWs complained of eye symptoms. This could be due to the fact that about one third of the participants in Fan *et al*.'s study wore face masks for less than 4 hours, while the current study excluded that group. Environmental factors, such as low humidity, which has been linked in the literature to dry eyes, may also have contributed to this difference, as the central region of Saudi Arabia has a dry desert climate [17,18].

In the current study, females were found to have a statistically significant higher prevalence of headaches, skin and eye-related adverse events associated with wearing protective face masks. In agreement with this, a cross-sectional study found that the severity of skin reactions was significantly associated with the female gender. [19]. This could be due to the fact that in this

Table 5. Multivariate binary logistic regression analysis of healthcare workers' odds of experiencing headaches associated with face mask use during the pandemic.

	Multivariate adjusted Odds Ratio (OR)	95% C.I for OR		*p* value
		Lower	Upper	
Female gender	2.325	1.461	3.700	< 0.001
Age	0.973	0.950	0.996	0.021
History of chronic headaches	1.816	0.816	4.044	0.144
Occupation = RT, PT, dietitians & pharmacists	3.278	1.281	8.391	0.013
Surgical mask	0.858	0.338	2.174	0.746
Hours using the face mask per work shift	1.200	0.763	1.886	0.431
Hours using the adjunctive PPE per work shift	1.044	0.852	1.281	0.676

RT: respiratory therapists; PT: physiotherapists; PPE: personal protective equipment; CI: confidence interval.

and the previously mentioned studies, females made up most of the study participants. In contrast, a cross-sectional study conducted in China to estimate the prevalence of skin injuries caused by PPE usage among HCWs showed that males had a higher prevalence of skin injuries than females, even though females made up 88% of the study participants. This was described by the authors to be due to easier perspiration and comparative disregard for daily skin care in males than in females [20]. However, other cross-sectional studies found no statistically significant increased risk associated with gender for skin side effects [21] or headaches [14] triggered by mask usage.

In order to mitigate complications mentioned previously, preventive measures were advised in various literature. For instance, it was advised to use a protective ear strap [22], use protective barrier film (cream) on affected areas and to avoid over-tightening the face mask [23]. Furthermore, to avoid eye complications blinking exercises and use of lubricant eye drops were suggested [24].

Several studies recommend breaks from PPE contact every few hours to alleviate both skin and eye irritation [23-25]. As such, we recommend that institutions where HCWs are mandated to wear PPE for prolonged periods schedule regular breaks in well-ventilated areas. Additionally, organizing webinars and campaigns to increase the knowledge of HCWs in regards to prevention, early detection and self-management of skin and eye conditions caused by face masks can also be helpful.

This study has several strengths. Firstly, as respondents were still routinely wearing face masks at the time of data collection, the recall bias in this study was limited. Moreover, we evaluated the experiences of HCWs of various specialties in several regions of Saudi Arabia, which added to the generalizability of the results. However, there are some limitations. The sample size was small relative to the Saudi Arabian population. In addition, generalizations regarding the adverse effects of surgical masks did not consider different manufacturers using different materials to make the masks. The convenience sampling used by researchers is a limitation, but it nevertheless allowed a larger reach for a study with limited resources. Other factors, such as pre-existing systemic conditions and stress levels that could also influence the adverse effects observed in the participants were not assessed, but could be the focus of future studies. Finally, complications were reported subjectively and were not evaluated objectively by a specialist. Thus, we suggest further research to be carried out with control groups using objective assessment methods.

Conclusions

The highest self-reported complications within our study group of HCWs wearing face masks for more than 4 hours per day during the COVID-19 pandemic were skin complications, followed by headaches and eye related complications. Female HCWs were more predisposed to headaches, skin and eye complaints. N95 masks were more likely to cause nasal bridge and behind the ear symptoms, as well as eye related complaints. With HCWs continuing to wear face masks and to be better prepared for future pandemics, preventative measures and educational activities should be considered to help reduce the occurrence of potential mask use related complications.

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Annex – Supplementary Items

Supplementary File 1. Questionnaire.

The prevalence of face mask related complications during the COVID-19 pandemic among healthcare workers in the Kingdom of Saudi Arabia

Dear Participant,
Thank you for agreeing to take part in this online questionnaire survey with a study title of: **The prevalence of face mask related complications during the covid-19 pandemic among healthcare workers in the Kingdom of Saudi Arabia.** This research is under the supervision of Dr. Khalifa BinKhamis. The purpose of this online survey is to estimate the prevalence of different complications that arise in healthcare workers (HCW) due to the usage of face masks. Understanding their prevalence will enhance the awareness of these mask-related issues and help in creating solutions to control them. It will take approximately 5 minutes to complete the survey. Be assured that all answers you provide will be kept in strict confidentiality. Please feel free to email the team at facemaskresearch71@gmail.com to answer your questions. If you are willing to participate in this online survey, please click "Next" to begin.

* Required

General Data

1. Gender *
   - o Male
   - o Female

2. Age (please answer in English numbers) *

_____

3. Region *
   - o Northern
   - o Central
   - o Eastern
   - o Southern
   - o Western

4. Occupation *
   - o Physician
   - o Nurse
   - o Dentist
   - o Pharmacists
   - o Physiotherapist
   - o Specialist (Technologist)
   - o Intern
   - o Other: _____

5. If you chose intern in the previous question, please specify the field
   - o Medical Intern
   - o Pharmacological Intern
   - o Dentistry Intern
   - o Specialist Intern
   - o Nursing intern
   - o Other: _____

6. Areas (please select all that apply) *
- Intensive care unit
- Medical ward
- Surgical ward
- Operating room
- Laboratory
- Clinic
- ER
- Outpatient department
- Pharmacy
- Radiology
- Other: _____

Information related to the daily usage of masks

7. What type of mask do you primarily use? *
- Surgical
- N95
- None of the above

8. During the period of COVID-19, on average, how many hours a day did you use the mask? *
- Less than 4 hours
- 4 - 8 hours
- more than 8 hours

9. Which of the following do you primarily wear with your face mask? *
- Goggles
- Face shield
- Goggles and face shield
- None of the above

10. During the period of COVID-19, on average, how many hours a day did you use the items selected above (goggles/face shield)? (Skip this question if you selected none of the above in question 9)
- Less than 4 hours
- 4 - 8 hours
- More than 8 hours

Issues encountered by HCW while using face masks since the beginning of COVID-19

Skin related adverse effects

11. Have you experienced any of the following complication on your nasal bridge? (Please select all that apply) *
- Dryness
- Oily skin
- Itching/ pruritis
- Flaking
- Tingling
- Burning sensation
- Pain
- Peeling
- Thickening of skin (Lichenification)

- Acne
- Swelling
- Maceration
- Redness
- Wrinkles
- Scar
- Hyperpigmentation
- Facial indentation
- Enlarged pores
- Superficial ulcer (blister)
- Deep full thickness ulcer (bone, muscle and tendon may be exposed)
- None of the above
- Other: _____

12. Have you experienced any of the following complications on your cheek? (Please select all that apply) *

- Dryness
- Itching/ pruritis
- Flaking
- Tingling
- Burning sensation
- Pain
- Peeling
- Thickening of skin (Lichenification)
- Acne
- Swelling
- Maceration
- Redness
- Wrinkles
- Scar
- Hyperpigmentation
- Facial indentation
- Superficial ulcer (blister)
- Deep full thickness ulcer (bone, muscle and tendon may be exposed)
- Enlarged pores.
- None of the above
- Other: _____

13. Have you experienced any of the following complications on your chin? (Please select all that apply) *

- Dryness
- Itching/ pruritis
- Flaking
- Tingling
- Burning sensation
- Pain
- Peeling
- Thickening of skin (Lichenification)
- Acne
- Swelling
- Maceration
- Redness

- Wrinkles
- Scar
- Hyperpigmentation
- Facial indentation
- Enlarged pores
- None of the above
- Other: _____

14. Have you experienced any of the following complications behind your ear? (please select all that apply) *

- Dryness
- Itching/ pruritis
- Flaking
- Tingling
- Burning sensation
- Pain
- Peeling
- Thickening of skin (Lichenification)
- Swelling
- Maceration
- Redness
- Scar
- Hyperpigmentation
- Superficial ulcer
- None of the above
- Other: _____

15. Have you been previously diagnosed with a skin condition on any of the following areas (behind the ear, cheek, chin, nose bridge)? *

- Yes Move to question 16
- No Skip to question 18

Diagnosed skin condition

16. What skin condition were you diagnosed with?

_____

17. Have you noticed it worsening upon wearing the face mask?

- Yes
- No

Headache-related adverse effects

18. During the period of COVID-19 have you experienced headaches while wearing face masks? *

- Yes
- No

19. Have you been previously diagnosed with a type of headache? *

- Yes Move to question 20
- No Skip to question 22

Diagnosis of a type of headache

20. What type of headache were you diagnosed with?

_____

21. Have you noticed it worsening upon wearing the face mask?
- o Yes
- o No

Eye-related adverse effects

22. Have you experienced any of the following eye-related complications? (Please select all that apply) *
- o Dry eye feeling
- o Discomfort
- o Redness
- o Tearing
- o Burning
- o Foreign body sensation
- o Itching
- o Blurred vision
- o None of the above
- o Other: _____

23. Have you been previously diagnosed with an eye condition? *
- o Yes Move to question 24
- o No End questionnaire

Diagnosed eye condition

24. What eye condition were you diagnosed with?

_____

25. Have you noticed it worsening upon wearing the face mask?
- o Yes
- o No