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Research Article

Mask-Acne Prevalence and Risk Factors during the COVID-19 Pandemic: A Cross-Sectional Single Institution Study

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Mask usage in healthcare workers became a requirement in all hospitals after the COVID-19 pandemic. Dermatologists have increasingly been diagnosing facial skin reactions that were attributed to or exacerbated by increased mask usage. "Mask-acne," which is defined as a new onset or exacerbation of acne localized to the facial area under the mask, has been increasingly reported in the general population and healthcare workers during the COVID-19 pandemic. The purpose of this study is to assess the prevalence, severity, and risk factors contributing to mask-acne development among healthcare workers at a tertiary care center. The study was carried out via a web-based questionnaire. We evaluated healthcare workers' demographics, mask behaviors, confounding factors, and prevalence of mask-acne. The total number of responders was 201, most responders were physicians (62.7%), and the surgical mask was the most used type of mask (62.1%). Results showed that 40.2% of healthcare workers developed mask-acne with 62.9% of them having new onset mask-acne and 37.1% having an exacerbation of preexisting acne. Age <30 years, female gender, and prolonged mask usage >8 hours were significantly associated with mask-acne development. The study highlights the prevalence of mask-acne among HCWs and risk factors that contribute to its development in the hospital setting.

1. Introduction

An outbreak of a novel coronavirus SARS-CoV-2 was first identified in China as a cause of viral pneumonia and declared as a public health emergency of international concern in January 2020. By March 2020, COVID-19 had been declared a pandemic by the World Health Organization (WHO) [1]. Healthcare workers had to make several adjustments to their day to day lives, one of which was the strict abidance to face mask usage, which contributed to limiting the spread of the virus and preserving the health of frontline personnel [2].

The usage of face masks, which was previously limited to a subset of healthcare workers in particular settings, had now become generalized to include all personnel working on hospital premises. Face masks have been reported to cause new onset or flares of contact dermatitis, irritant dermatitis, rosacea, and acne [3–6].

Following the onset of the pandemic, a number of publications highlighted the occurrence of new onset acne or exacerbation of acne in individuals that have been using face masks [7–9]. The term mask-acne or "maskne" was coined as early as March 2020 to describe acne occurring on the areas of the face that were covered by the mask [10]. Healthcare

workers were particularly affected given the mandatory use of personal protective equipment in the hospital setting [2].

Facial dermatosis during the pandemic was hypothesized to be due to several factors including disruption of skin microbiome by the micro-occlusive environment of the mask, increased humidity and sweating under the mask, and friction with the skin [11, 12]. In addition, risk factors related to mask use duration, mask type, and individual demographics were reported to increase mask-acne risk [13].

Therefore, in this study, we aim to assess the prevalence, severity, risk factors, and mask behaviors related to mask-acne in healthcare workers at the Lebanese American University Medical Center-Rizk Hospital (LAUMC-RH) in Beirut, Lebanon.

2. Materials and Methods

2.1. Study Population and Process. A cross-sectional observational study was conducted through a web-based questionnaire that was filled anonymously. The questionnaire was developed to assess the demographics, mask use behaviors, prevalence of acne before and after the pandemic, and any confounding factors that may affect the prevalence. Moreover, a validated acne severity scale was used through a visual guide to assess the severity of mask-acne [14]. The questionnaire was sent to physicians, nurses, medical students, pharmacists, nutritionists, practical nurses, and staff of the hospital. The questionnaire was disseminated via email through the hospital directory. Reminder emails were sent to nonresponders after 15 days and monthly thereafter. Staff and healthcare workers aged 18 and above were eligible to participate in the study. Upon signing the informed consent, individuals answered the questionnaire through self-reporting via Google forms. The data were collected over a 6-month period between December 2021 and June 2022. During this period, hospital policies mandated that a mask (surgical or other) covering the nose and the mouth be always worn while on hospital premises and during interactions with patients or co-workers.

2.2. Minimal Sample Size Calculation. The total target population was estimated at 700 healthcare workers and staff. Our minimum target sample size was 187 individuals, which would give us a margin of error of 6.0% and a confidence level of 95.0% as calculated using the Epi info software, with an expected prevalence of mask-induced acne of 40.0%. We were able to collect 201 responses.

2.3. Definition of the Dependent Variable. An individual was labeled as having mask-induced acne if they experienced a new onset acne or an exacerbation of pre-existing acne over the area covered by the mask [7].

2.4. Questionnaire. The questionnaire prompted for data pertaining to the following points:

(1) Demographics of participants including age, gender, skin type, chronic illness, and occupation within the hospital.

(2) Mask behaviors such as the type of mask worn (Surgical, KN95, and N95), duration of mask usage per day, breaks from mask wearing, double masking, and reuse of same mask. Participants were asked about mask behaviors pre- and post-COVID-19 pandemic.

(3) Current and previous history of acne, aggravation of pre-existing acne, or new onset acne following the pandemic, as well as mapping of the areas of the face that were affected. The participants were invited to rate the severity of mask-acne through the visual acne severity scale [14].

(4) Confounding factors that were accounted for: application of cosmetics or creams over the face prior to mask-wearing, medications use, vitamins or supplements use, and hormonal abnormalities.

2.5. Statistical Analyses. All statistical analyses were conducted using the SPSS version 28.0 software (IBM Corp. Released 2021. IBM SPSS Statistics for Windows, version 28.0. Armonk, NY: IBM Corp). Categorical variables were explored and summarized using frequency and percentage. The summary of the continuous variables was reported using the mean, standard deviation, and confidence intervals. Chi-square or Fisher's exact test was used to associate acne-related factors with mask-acne. Simple and multiple logistic regression models were used. Variables with a p value less than 0.05 on bivariate analysis were used for the logistic regression models.

2.6. Statements of Ethics. This study was approved by the LAU Institutional Review Board (reference #: LAU.-SOM.JK1.13/Jan/2022) and conducted according to their standards, applicable government regulations, and institutional research policies and procedures. All participants signed an informed consent, and confidentiality was maintained by filling the questionnaire anonymously.

3. Results

3.1. Demographic Data. Demographic data pertaining to our sample are summarized in Table 1. A total of 201 participants were included in the study. The majority were females (125; 62.1%). Most of the participants were aged less than 30 years (135; 67.1%). Most of the responders were physicians (126; 62.7%), followed by nursing staff (48; 23.9%), administrative staff (20; 9.9%), and pharmacists (7; 3.5%).

3.2. Mask Wearing Behavior. Table 2 summarizes the masking behavior of our sample. Notably, the most reported type of mask used was a surgical mask (125; 62.1%), followed by KN95 mask (60; 29.9%). Most participants (166; 82.5%) rarely or never practiced double masking (wearing two masks on top of each other), whereas 6 participants (2.9%) reported the contrary. Most participants wore a mask daily for 5–7 days per week (176; 87.6%) for a duration of >4 hours per day (190; 94.5%). Most participants replaced their mask

Table 1: Demographic data pertaining to the sample of participants ($n = 201$).

Gender	N (percentage)
Male	76 (37.9%)
Female	125 (62.1%)
Age	
<30 years	135 (67.1%)
>30 years	66 (32.9%)
Occupation	
Physician	126 (62.7%)
Nurse	48 (23.9%)
Pharmacist	7 (3.5%)
Administrative staff	20 (9.9%)
Prior history of chronic illness	
Yes	170 (84.6%)
No	31 (15.4%)
Skin type	
Oily or mixed skin	122 (60.7%)
Non-oily skin	79 (39.3%)

Table 2: Summary of mask wearing behavior among 201 healthcare workers and staff at a tertiary care center.

Mask type	Frequency (%)
Surgical mask	125 (62.1%)
KN95	60 (29.9%)
N95	14 (7.0%)
Cotton mask	2 (1.0%)
Number of hours of mask wearing per day	
<8 hours	103 (51.2%)
>8 hours	98 (48.8%)
Number of days of mask wearing per week	
1-2 days	4 (2.0%)
3-4 days	21 (10.4%)
5–7 days	176 (87.6%)
Same mask usage for longer than 1 day	
Yes	78 (38.8%)
No	123 (61.2%)
Taking regular breaks from mask wearing at work	
Yes	161 (80.0%)
No	40 (20.0%)
Makeup use underneath the mask	
Yes	57 (28.4%)
No	144 (71.6%)

daily (123; 61.2%), and 161 (80.0%) participants took regular breaks from mask-wearing during their day.

Prior to the COVID-19 pandemic, 86 participants (42.7%) reported mask usage at work. Of these, 56.9% used the mask 1 to 2 times per week, while 15.1% reported mask usage 3 to 5 times per week, and 27.9% used it daily while at the hospital. The most used mask was the surgical mask (95.3%). Adverse effects such as erythema, itching, or rash behind the ear were reported in only 3.4% of the participants.

3.3. Mask-Induced Acne after the COVID-19 Pandemic. After the COVID-19 pandemic, mask-induced acne (or mask-acne) was reported in 81 participants (40.2%). Of these, 51 participants (62.9%) had new onset mask-acne and 30 (37.1%) had a history of acne that was exacerbated following the pandemic. Most cases (90.1%) with new onset mask-acne were reported to be mild according to the acne severity scale, and none of the participants reported severe acne. Most patients with mask-acne used the mask for 5–7 days (85.1%) and for more than 8 hours per day (61.7%). Responders with mask-acne reported using mainly a surgical mask or a KN95 (54.3% and 34.5%, respectively). Other adverse effects were also reported by participants, with redness and itching being the most reported adverse events (18.6% and 14.5%) after mask usage (Figure 1). To note, redness, itching, burning, and dryness were more significantly reported in patients with mask-acne ($P < 0.05$). This may in part be due to the disruption of skin microenvironment, textile-skin interaction, and pressure-induced dermatosis by the mask [12].

Risk factors associated with acne were also assessed. Makeup use under the mask was reported in 57 participants (28.3%), and hormonal abnormalities were reported by 21 participants (10.4%). 8 participants (3.9%) reported vitamin B12 consumption, 8 participants (3.9%) reported non-specified hair and nail supplements consumption, 6 participants (2.9%) reported whey protein consumption, and 8 participants (3.9%) reported oral contraceptives use.

3.4. Bivariate and Multivariable Analysis Results. A summary of the bivariate analysis correlating the presence of mask-induced acne with other variables is summarized in Table 3. Mask-acne was associated with female gender (82.7% vs. 48.3%; $P < 0.001$) and younger age (77.7% vs. 60.0%; $P = 0.009$). About 29.7% of patients with mask-acne reported having nonoily skin compared to 70.3% of patients with oily or mixed skin, while 45.8% of participants with no mask-acne had nonoily skin ($P = 0.027$). Using the mask for more than 8 hours was noted in 61.7% of responders with mask-acne, compared with 40.0% among co-workers with no mask-acne ($P = 0.003$). Moreover, wearing makeup under the mask was reported in 39.5% of participants with mask-acne as compared to 20.8% of participants without mask-acne ($P = 0.004$). However, using a particular type of mask, the duration of mask use per week, wearing the same mask for more than 1 day or taking breaks from the mask did not significantly differ between participants with and without mask-acne.

Multivariate regression revealed that female gender {OR = 5.40 CI (2.4–12.1), $P < 0.001$}, and using a mask >8 hours/day {OR = 2.15 CI (1.13–4.10), $P < 0.02$}, and age <30 years {OR = 2.82, CI (1.36–5.84); $P = 0.005$} are associated with increased risk of mask-acne (Table 4).

4. Discussion

Adverse effects of mask wearing were reported in multiple studies since the start of the pandemic, and mask-acne was among the most reported side effects [6, 9, 15]. Mask-acne is a subtype of acne mechanica that dermatologists started diagnosing after the pandemic, and it was defined as either a new onset acne located under the mask covered area or

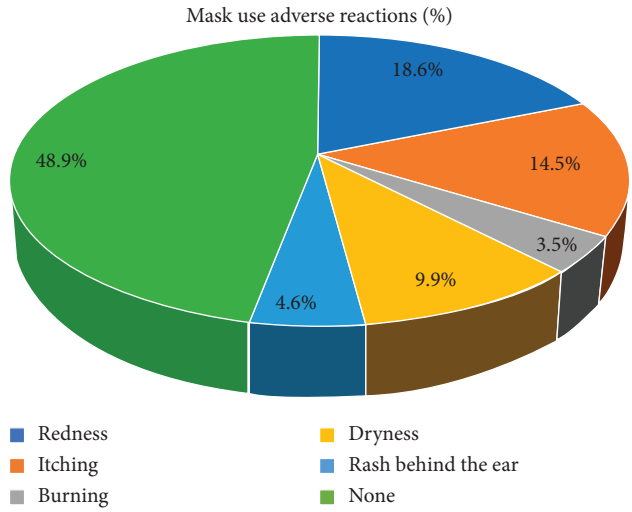

Figure 1: Pie chart of mask use adverse reactions following the COVID-19 pandemic.

Table 3: Summary of the results of the bivariate analysis cross-tabulating presence of mask-induced acne with multiple variables.

		Mask-acne present	No mask-acne	*P* value
Gender	Male	14 (17.3%)	62 (51.6%)	<0.001
	Female	67 (82.7%)	58 (48.4%)	
Age	<30 years	63 (77.7%)	72 (60.0%)	0.009
	>30 years	18 (22.3%)	48 (40.0%)	
Skin type	Oily or mixed	57 (70.3%)	65 (54.2%)	0.027
	Non-oily	24 (29.7%)	55 (45.8%)	
Mask type	N95	7 (8.6%)	7 (5.8%)	0.187
	KN95	28 (34.6%)	32 (26.7%)	
	Surgical mask	44 (54.3%)	81 (67.5%)	
	Cotton mask	2 (2.5%)	0	
Days mask used per week	1-2 days	1 (1.2%)	3 (2.5%)	0.344
	3-4 days	11 (13.6%)	10 (8.3%)	
	5–7 days	69 (85.2%)	107 (89.2%)	
Duration of mask	<8 hours	31 (38.3%)	72 (60.0%)	0.003
	>8 hours	50 (61.7%)	48 (40.0%)	
Makeup under mask	Yes	32 (39.5%)	25 (20.8%)	0.004
	No	49 (60.5%)	95 (79.2%)	

Table 4: Multivariate regressions model with adjusted OR for mask-induced acne.

Factors	Adjusted OR (95% CI)	*P* value
Female gender	5.40 (2.39–12.17)	<0.001
Age <30	2.82 (1.36–5.84)	0.005
Mask >8 hours/day	2.15 (1.13–4.10)	0.019
Using makeup under the mask	1.15 (0.54–2.45)	0.704
Having oily skin	1.44 (0.73–2.85)	0.285

OR, odds ratio.

exacerbation of pre-existing acne due to mask wearing [7]. In this study, mask-acne was found in 40.2% of the participants, with 62.9% of these participants having new onset mask-acne and 37.1% experiencing exacerbation of pre-existing acne. The main risk factors that contributed to mask-acne were young age (<30 years), female gender, and the duration of mask usage (>8 hours/day).

The reported prevalence of mask-acne in the general population ranges from 17.0% to 56.0% [6, 8, 9, 15, 16]. In a study on the prevalence of mask-acne in physicians who had acne during their lifetime, Özkesici Kurt found that 45.3% of responders reported an exacerbation of acne, and one third had relapse [8]. Similarly, Cretu et al. reported mask-acne in 56.0% of healthcare workers [17]. Moreover,

Techasatian et al. studied 833 individuals, 42.9% of which were healthcare workers and found that acne was the most commonly reported mask-related facial adverse event in 39.9% of participants [6]. Notably, the prevalence of mask-acne in the healthcare workers was higher when compared to nonhealthcare workers (59.0% vs 51.0%) [6]. The findings of our study mirror the findings of previous studies. Interestingly, 25.2% of the participants in our study reported new onset acne following the COVID-19 pandemic, which is a higher percentage than previous reports. Özkesici Kurt reported that only 7.5% had new onset acne in their cohort of physicians [8], while Choi et al. found that 16.9% of participants in their study had new onset acne related to the mask [9]. Therefore, since our study was conducted later in the pandemic (2022), new onset mask-acne may have been underreported in the literature and has since increased with the elapsed time in the pandemic.

Our study reflects the change in masking behavior that resulted from the policies related to PPI usage following the pandemic. In fact, prior to March 2020, mask usage was reported by 42.7% of our participants during working hours. The duration of mask wearing was limited to 1-2 days per week in most of our responders (56.9%). A small number of participants (3.4%) reported adverse events related to mask wearing such as erythema and pruritus. None of them had reported mask-acne prior to the pandemic. Following the start of the pandemic, all of the HCWs who had participated in our study (100%) reported wearing masks while on hospital premises for five to seven days per week (87.6% of the responders). Adverse events were reported in around 18.0% of participants and 40.2% reported mask-acne. The participants who wore the mask for more than 8 hours were 2.15 times more likely to have mask-acne compared to those who used it for less than 8 hours {OR: 2.15 CI (1.13–4.09), P value = 0.019}. Previous studies have also shown that side effects related to mask wearing including acne irritation, rashes, and itching are more likely to occur with longer duration of mask wearing [6, 11, 13, 15].

Female gender was associated with more than 5 times increase in the likelihood of mask-acne compared to male gender {OR = 5.40 CI (2.4–12.1), $P < 0.001$}. This is consistent with the findings of the study conducted on healthcare workers in Turkey by Altun and Topaloglu Demir which showed a significant increase in mask-acne among females (76.8% vs. 23.2%) [11]. In contrast, two other studies done on the general population found no significant difference between males and females on the development of mask-acne [13, 18]. A recent systematic review by Heng and Chew failed to demonstrate any significant difference between males and females in the prevalence of any type of acne [19].

Age was also another significant factor that increased mask-acne risk. Multivariate analysis showed that being less than 30 years of age is a significant risk factor for mask-acne {OR = 2.82, CI (1.36–5.84); $P = 0.005$}. Similar results were seen by Anon Paichitrojjana where those under the age of 30 were 1.96 times more likely to develop mask-acne than those over the age of 30 [13].

Mask-acne is considered a subset of "acne mechanica" with textile-skin friction by the face mask leading to disruption of the skin microenvironment and microbiome dysbiosis [12]. *Cutibacterium acnes* selection and increased virulence due to skin microbiota dysbiosis is hypothesized to be the main factor for inflammation in mask-acne [12]. Additionally, wearing the mask for increased periods of time leads to physical hair follicle occlusion, increased sebum production, and increased sweating which can contribute to mask-acne [13]. Moreover, having oily skin is associated with acne, and sebaceous gland hyperplasia is a pathophysiological factor in the development of acne [20]. Therefore, we looked at the skin type as reported by the patient and found that 70.3% of patients with mask-acne reported having oily or mixed skin compared to 29.7% of patients reporting nonoily skin ($P = 0.027$). This is the first study in literature that reports skin type in relation to mask-acne and having oily skin was associated with a significant increase in mask-acne development.

The use of makeup under the mask and its risk on mask-acne is controversial. This study shows that reported makeup application prior to wearing the mask was significantly associated with increased risk of mask-acne on bivariate analysis (39.5% vs. 20.8%; $P = 0.004$). However, on multivariate analysis makeup application was not significantly associated with mask-acne (OR = 1.15 CI (0.54–2.45); $P = 0.704$). Bakhsh et al. found a positive correlation between the use of makeup and acne ($P = 0.005$). This is in contrast to other studies that found no increase in the prevalence of acne among people who applied makeup/cosmetic products under the mask [11, 13].

In our study, we did not find any significant associations between the presence of mask-acne and mask type. Other studies have demonstrated that N95 mask use was correlated with an increased risk of developing mask-acne [11, 18]. This difference may be attributed to the low number of N95 mask used in our cohort (7.0%). There were no significant associations between mask reusage and interruptions in mask wearing (breaks) and the presence of mask-acne in our sample.

Interestingly, most of our responders reported that the severity of mask-acne was mild. Severe acne was reported by 6 patients (7.8%) with pre-existing acne who experienced a flare in their disease with mask wearing. None of the patients who reported new onset mask-acne had severe disease (51 patients). This is in concordance with data from different studies where most cases of mask-acne were reported to be mild [11, 13].

The main limitation of the study is that it was carried out via a web-based and self-designed questionnaire, which meant that mask-acne severity data and diagnosis was made by the participants, and this was not verified by a dermatologist. We attempted to correct this by providing a validated visual guide in the questionnaire. Moreover, since our sample consisted of healthcare workers only, our results cannot be extrapolated to conclusions regarding mask-acne in the general population.

5. Conclusion

This study revealed an elevated prevalence of mask-induced acne among HCWs post-COVID-19 pandemic in comparison to prepandemic era at our institution in Lebanon

(40.2% vs. 3.0%). Also, the study particularly highlighted the high occurrence of new onset mask-acne, reaching 62.9%. Most cases of mask-acne were mild in severity. Additionally, we identified multiple risk factors for the development of mask acne in our population, the most important being younger age (<30 years), female gender, and prolonged mask usage (>8 hours). As COVID-19 restrictions are gradually being lifted worldwide, a decrease in the number of mask-induced acne cases is expected. However, further studies considering our limitations are necessary to validate our results and provide a more comprehensive understanding of this dermatological issue among HCWs.

Data Availability

The data is secured on Google forms anonymously, and is available and can be accessed as needed. Analytical data is secured on SPSS software sheets and available upon request from the corresponding author.

Ethical Approval

This study was approved by the LAU Institutional Review Board (IRB reference #: LAU.SOM.JK1.13/Jan/2022).

Conflicts of Interest

The authors declare that there are no conflicts of interest.

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