

Correlation between extended surgical mask usage and adverse health effects during the COVID-19 pandemic among healthcare personnel in Jazan, Saudi Arabia

Suhaila A. Ali,¹ Ahmad Y. Alqassim,¹ Fatmah O. Alshekh,² Atheer M. Alshammakhi,² Rawan N. Omar²
Roaa A. Areeshi,² Roaa M. Alhazmi,² Lamees A. Zaalah,² Mohammed A. Muaddi,¹ Abdullah A. Alharbi¹

¹Family and Community Medicine Department, Faculty of Medicine, Jazan University; ²Faculty of Medicine, Jazan University, Jazan, Saudi Arabia

ABSTRACT

The global prevalence of COVID-19 has necessitated the use of personal protective equipment, particularly face masks, amongst healthcare workers (HCWs). However, extended face mask usage has led to adverse health effects. This cross-sectional study investigates the relationship between prolonged surgical mask-wearing and the development of adverse effects among 500 HCWs in Jazan, Saudi Arabia. The study utilized an anonymous questionnaire distributed across multiple departments in Jazan and Sabya Hospitals. The results indicated that most participants believed that wearing face masks for extended periods led to adverse skin and respiratory effects. The primary respiratory complaints were difficulty breathing and nasal itching, while skin-related issues included sweating, itching, and acne. Therefore, this study concludes that extended surgical mask usage during the COVID-19 pandemic could potentially lead to adverse health implications among HCWs in Jazan. Further research into this correlation is needed.

Correspondence: Fatmah O. Alshekh, Faculty of Medicine, Jazan University, Jazan, Saudi Arabia.
E-mail: fatimahalsheikh053040@gmail.com

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Introduction

The first recorded instance of the Coronavirus disease (COVID-19) was in Wuhan, China, in December 2019. The disease proliferated globally within a short span, prompting the World Health Organization (WHO) to declare it a pandemic respiratory disease by January 30, 2020.^{1,2} This global health crisis led the Saudi government, among others, to implement various precautionary measures to safeguard its citizens.³ Such measures largely consisted of partial or full-day lockdowns, and the mandatory use of personal protective equipment (PPE) – gloves, medical gowns, eye protection, and notably, surgical masks.^{4,5}

Historically, surgical masks were primarily worn by healthcare professionals (e.g., physicians, nurses, lab technicians), individuals with compromised immunity, and under specific circumstances.⁶ However, the pandemic has necessitated the universal use of face masks, extending beyond healthcare workers (HCWs).⁷ Face masks serve as a barrier against airborne particles, protecting the respiratory system. Moreover, in Saudi Arabia,

wearing face masks in public spaces like malls and hospitals is enforced to avoid financial penalties.⁸

Recently, attention has shifted towards potential adverse effects caused by prolonged mask usage, particularly regarding the respiratory system. Tight masks can restrict ventilation, leading to an increase in carbon dioxide (hypercapnia) levels. Hypercapnia, coupled with inadequate ventilation and hypoxia, can result in symptoms such as chest discomfort and rapid breathing (tachypnea). As carbon dioxide is a recognized respiratory stimulant, its accumulation can increase lung ventilation, impair cognition, and lead to confusion.⁵ However, earlier studies have suggested that wearing medical-grade masks does not significantly alter blood oxygen or carbon dioxide levels.^{9,10}

Alongside respiratory concerns, extended mask usage has been associated with several adverse effects, including acne, headaches, skin breakdown, impaired cognition, and chest discomfort. Consequently, masks are often perceived as uncomfortable, inconvenient, or bothersome. The safety of HCWs, particularly regarding PPE use and its potential side effects, is thus a significant concern.¹¹⁻¹³

Prolonged mask usage has demonstrated negative dermatological impacts, with HCWs experiencing acne, facial dermatitis, and pigmentation on the nose bridge, cheeks, and chin, with acne being the most common issue.¹⁴⁻¹⁶ Covering the face with a mask can create a humid environment conducive to hyperthermia, block facial ducts leading to acne, or trigger allergies to mask components.^{17,18}

Therefore, this study aims to explore the potential link between extended mask usage and skin and respiratory disorders.⁷ Despite its global relevance, there remains a scarcity of data on the true impact of masks on skin and respiratory health. Our objective is to fill this knowledge gap and provide insights into the risk factors, wearing duration, and adverse effects associated with mask usage. By shedding light on this pressing issue affecting not just healthcare workers, but the broader public, our findings may contribute towards a solution, especially as mask-wearing remains a crucial preventive measure in the ongoing pandemic.^{19,20}

Materials and Methods

Study design, settings, and population

The study employed an observational, cross-sectional methodological approach, collecting data through a self-administered online survey. The survey targeted a population sample in the Jazan region. Adults aged 18 and above in Jazan, Saudi Arabia, were included in the study, which was conducted in April 2022.

Jazan, one of the 13 provinces within Saudi Arabia, is situated on the south-western border of the country and is home to over 1.6 million residents, as per the 2019 census conducted by the Saudi General Authority of Statistics.¹⁹

Sampling method and sample size

The approach to sampling involved recruiting a convenience random sample of 817 participants. The selected sample size was determined based on a 95% confidence interval, a maximum error of 5%, a non-response rate of 20%, and was calculated using the following sample size formula.

Data collection instrument

The data was collected using a self-administered structured questionnaire in Arabic. This questionnaire was adapted from an English version previously used in a similar study conducted in the United States in 2007.²⁰ Two bilingual professionals translated the instrument to ensure the accuracy and appropriateness of the wording. A panel of experts then reviewed and vetted the translated instrument for its validity and suitability for adult respondents. A few questions were revised to reflect the local culture of Saudi Arabia. The translated version was pilot-tested among 25 students for reliability, yielding a Cronbach's alpha of >0.80 . The questionnaire comprised 42 questions, with the first section targeting demographic and socioeconomic data. The remaining six sections focused on five broad areas of environmental health issues: indoor air hazards, outdoor air hazards, public health nuisances, household hazardous waste, water hazards, and flood protection.

Data analysis

The data were coded and entered into Microsoft Excel before being imported into the Statistical Package for Social Sciences software program, version 25.0, for further analysis. Qualitative variables were compared using the Chi-square test, while quantitative variables were assessed using Student's T-test, ANOVA, and regression analyses. Statistical significance was determined using a value of $\alpha=0.05$ or less.

Ethical considerations

All participants were informed about the study's objectives and assured that their participation posed no expected harm. They were also assured of the full anonymity and confidentiality of their data. Consent to participate was requested from each participant. The study received ethical approval from the Standing Committee for Scientific Research at Jazan University (Reference# REC-43/06/138).

Results

Socio demographic characteristics of participants

The study encompassed a total of 500 respondents. Two-thirds of the respondents were aged between 20-34 years, with females comprising 62.4% of the participants. Notably, more than half (52%) were employed at the Sabya General Hospital, while the remainder (48%) worked at the Jazan General Hospital. Concerning mask-wearing duration, 48% of respondents reported wearing masks for 5-8 hours, followed by 30% for 9-12 hours, 19.6% for 0-4 hours, and 2.4% for over 12 hours (Table 1).

In terms of occupation, nurses formed the largest group (28.6%), followed by medical doctors (25.4%) (Figure 1).

Participant opinions on prolonged surgical mask wearing

Our findings revealed that the majority of the respondents (73.4%) believed that prolonged mask usage could lead to side effects on the skin and respiratory system, while 26.6% disagreed. More than

half of the respondents (56%) reported discomfort while using face masks, whereas 44% reported feeling comfortable.

Impact of prolonged mask use on respiratory system

Of the respondents, 48.8% reported experiencing difficulty in breathing while using face masks at least once, with 13.2% experiencing this issue every time they wore a mask. A total of 31.4% of respondents never experienced nasal dryness, and 8.8% always had this issue. In addition, 30% never suffered from mouth dryness while using masks, while 12.4% did. Nasal itching was always experienced by 20.4% of respondents when using masks for extended periods. Further, most respondents (71.6%) believed that prolonged mask use could impair normal nasal airflow (Table 2).

Impact of prolonged mask use on skin

When discussing skin effects, 13.2% of participants reported constant irritation/redness in the mask area, while approximately 33.3% (an estimated third) reported never experiencing this issue. Additionally,

Table 1. Demographic information (n=500).

Variable	Category	Frequency	Percent
Age (years)	20-34	319	63.8
	35-45	144	28.8
	46-55	31	6.2
	56-65	4	.8
	>65	2	.4
Gender	Male	188	37.6
	Female	312	62.4
Hospital	Jazan general hospital	240	48
	Sabya general hospital	260	52
How long do you use face mask?	0-4 hours	98	19.6
	5-8 hours	240	48
	9-12 hours	150	30
	>12 hours	12	2.4

Table 2. Association between prolonged use of a surgical mask and adverse respiratory effects.

Item	Always (%)	Sometimes (%)	Rarely (%)	Never (%)	P-value
Do you have difficulty in breathing while using face-masks?	66 (13.2)	244 (48.8)	92 (18.4)	98 (19.6)	<0.001
Do you have dryness of nose while using face-masks?	44 (8.8)	152 (30.4)	147 (29.4)	157 (31.4)	0.023
Do you have dryness of mouth while using face-masks?	62 (12.4)	144 (28.8)	144 (28.8)	150 (30)	0.045
Do you have nasal itching while using mask for prolonged time?	102 (20.4)	148 (29.6)	105 (21)	145 (29)	<0.001
Do you have nasal skin irritation/discoloration/scar while using for prolonged time?	72 (14.4)	126 (25.2)	124 (24.8)	178 (35.6)	0.035
Do you think prolonged use of face mask does impair your normal nasal air flow?	358 (71.6% - Yes)	142 (28.4% - No)			<0.001

The P-values were calculated using a chi-square test. P<0.05 is considered statistically significant.

16.6% always experienced itching, and 11.4% and 22.8% always experienced hyperthermia and sweating, respectively, in the mask area. More than half of the respondents reported noticing acne in the mask area (Table 3).

Our findings revealed that 45% of respondents sometimes discarded masks after coughing or sneezing while using them. Around a third removed their masks for a while if they felt uncomfortable. About 37.8% sometimes lowered their masks in the

Table 3. Association between prolonged use of a surgical mask and adverse skin effects.

Item	Always (%)	Sometimes (%)	Rarely (%)	Never (%)	P-value
Do you notice irritation/ redness over the mask covered area while on mask?	66 (13.2)	156 (31.2)	116 (23.2)	162 (32.4)	<0.001
Do you notice itching over the mask covered area while on mask?	83 (16.6)	167 (33.4)	125 (25)	125 (25)	0.012
Do you notice hyperthermia over the mask covered area while on mask?	57 (11.4)	133 (26.6)	124 (24.8)	186 (37.2)	<0.001
Do you notice sweating over the mask covered area while on mask?	114 (22.8)	165 (33)	132 (26.4)	89 (17.8)	0.029
Did you notice acne over the mask covered area?	289 (57.8% - Yes)	211 (42.2% - No)			<0.001

The P-values were calculated using a chi-square test. P<0.05 is considered statistically significant.

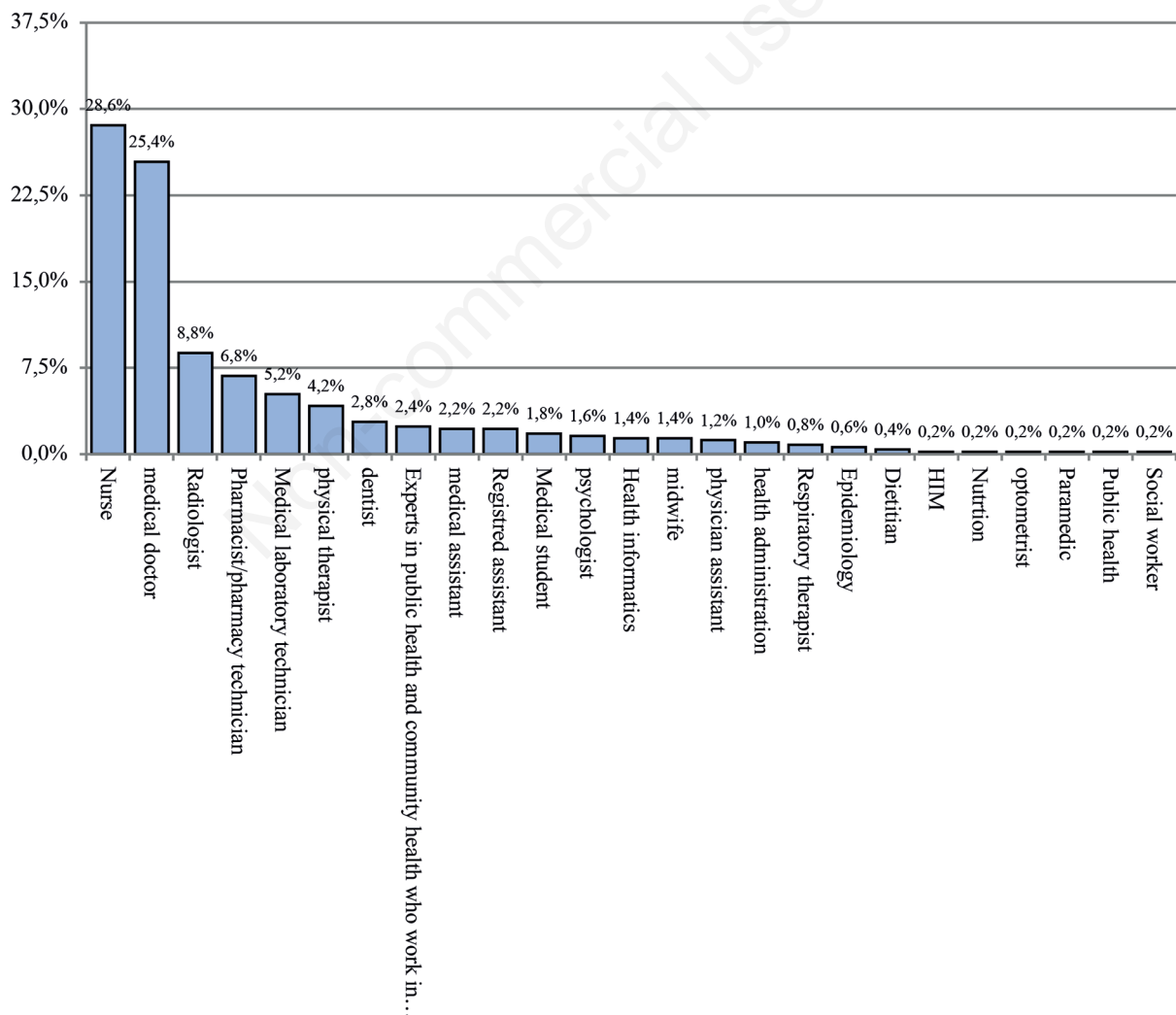


Figure 1. Occupation of the participants.

hospital for reasons other than eating or drinking. Over one-third (36.6%) admitted to sometimes touching the outer aspect of the mask while wearing it (Table 4).

Regarding mask disposal, more than half of the respondents placed used masks directly into the trash, while 28.4% disposed of them in biomedical waste units (Figure 2).

Table 4. Attitudes during face mask wearing.

Item	Always (%)	Sometimes (%)	Rarely (%)	Never (%)	P-value
Do you discard the mask if you cough/sneeze while using?	122 (24.4)	225 (45)	101 (20.2)	52 (10.4)	<0.001
While using mask if you feel uncomfortable do you remove the mask for some time?	174 (34.8)	173 (34.6)	77 (15.4)	76 (15.2)	0.043
Have you ever lowered down your mask in the hospital for any other purpose besides eating or drinking?	92 (18.4)	189 (37.8)	109 (21.8)	110 (22)	0.007
Have you touched the outer aspect of the mask while wearing the mask?	130 (26)	183 (36.6)	80 (16)	107 (21.4)	<0.001

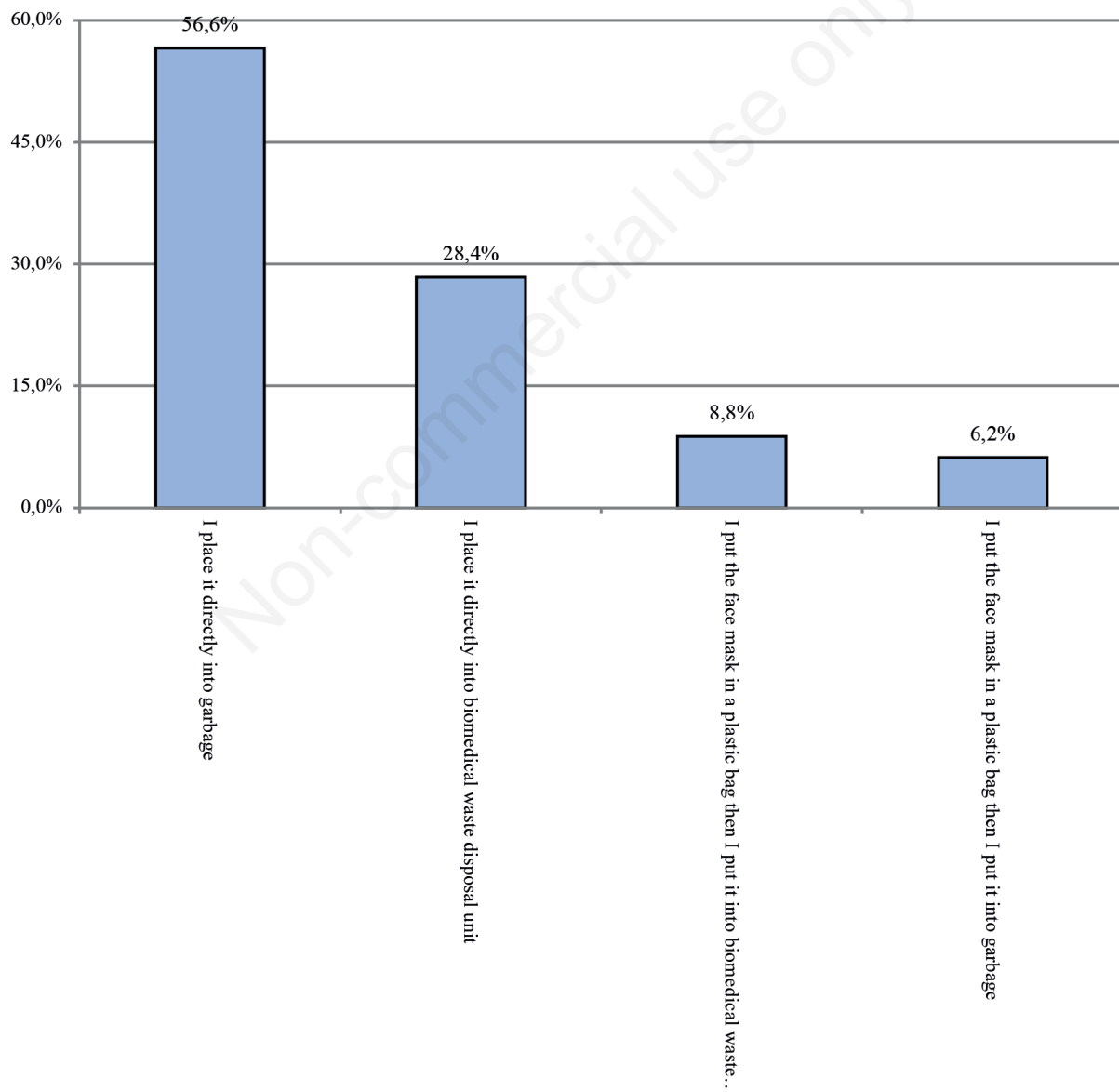


Figure 2. Disposal of face mask approaches.

Most respondents (82.4%) claimed never to reuse masks. Conversely, 14.2% admitted to reusing masks until they became dirty. A small proportion reused masks until they were damaged (2.6%) or made breathing difficult (0.8%) (Figure 3).

In terms of mask sterilization, most participants (88.8%) reported not needing to sterilize masks, opting instead to discard them. Only 6.8% sterilized their masks with alcohol, and 2.6% used a washing machine for sterilization (Figure 4).

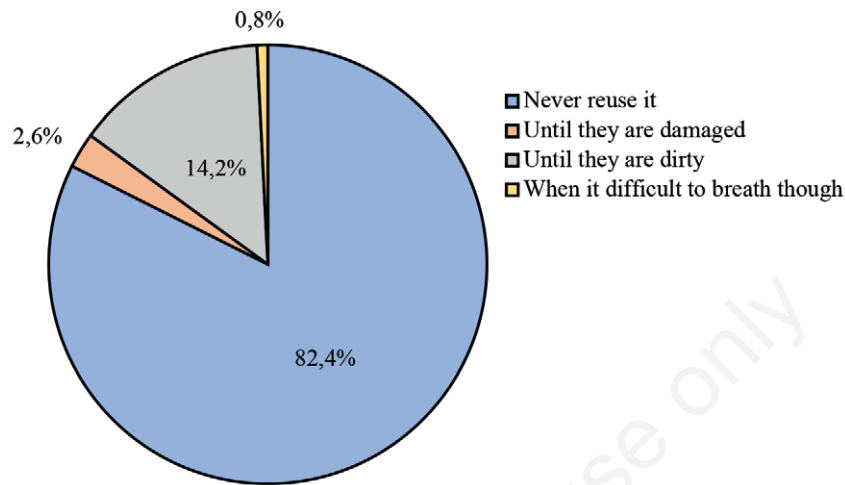


Figure 3. Patterns of reusing the face mask.

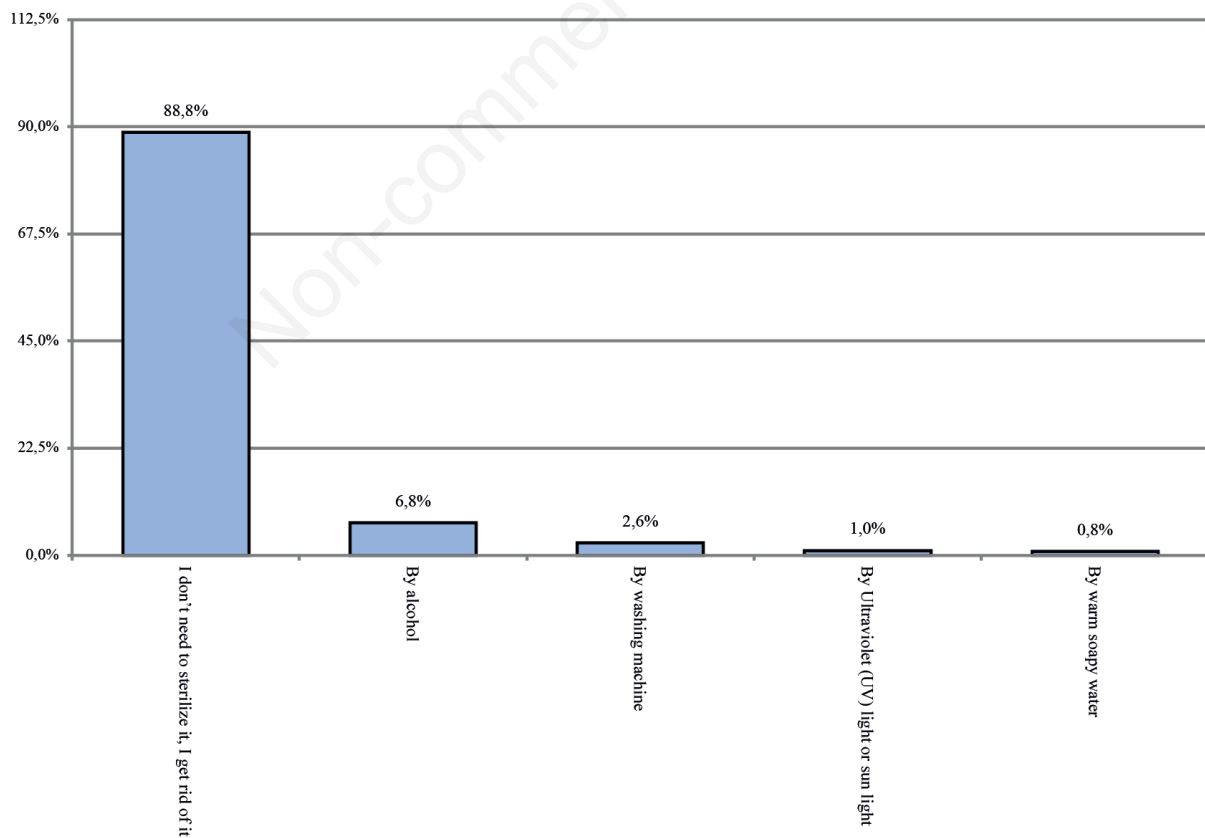


Figure 4. How will you sterilize your mask?

Discussion

This investigation sought to establish a correlation between prolonged surgical mask usage and the onset of adverse effects during the COVID-19 pandemic, specifically focusing on the impact on the skin and respiratory system of healthcare workers in Jazan city. The worldwide acknowledgment of the severity of COVID-19's clinical manifestations and the challenges posed by its early diagnosis have necessitated the extended use of Respiratory Protective Devices (RPD) to curb the further spread of the virus.^{21,22} These preventive measures are not only advocated for healthcare workers but also for the general public, particularly in public settings where maintaining social distancing is difficult.⁷

In the absence of a definitive treatment for COVID-19, preventive strategies, including mask usage, have become quintessential in the effort to mitigate virus transmission between infected and uninfected individuals.²³ However, extended contact with masks can potentially increase the prevalence of allergic contact dermatitis and other skin complications.²⁴

The most reported respiratory side effects in our study were breathing difficulties and nasal itching, with a significant 71.6% of respondents affirming that prolonged mask usage impairs their normal nasal airflow. This finding echoes a similar study conducted in India which reported 58.2% of respondents experiencing breathing difficulties upon exertion and 52.0% reporting an itchy nose. Another earlier study stated that 63.71% found breathing while wearing a face mask challenging, 37.10% experienced a dry nose, and 46.77% had a dry mouth.²⁵ These variations in findings can likely be attributed to differences in the sampled populations, their specific occupations, and exposure durations to mask-wearing. In our study, the majority of respondents were nurses, potentially exposed to longer durations of mask usage, thereby triggering more adverse effects. In contrast, the aforementioned study primarily involved ear, nose, and throat professionals, thereby possibly limiting its results.

In terms of skin complications, our research revealed that the most prevalent adverse effects were sweating and itching over the mask-covered area, with prevalence rates of 22.8% and 16.6% respectively. Additionally, we found that over half of the respondents reported acne development over the mask-covered area. These findings align with another Indian study, reporting excessive mouth-area sweating in 67.6% of respondents and acne in 56.0%.²⁶ Furthermore, a separate Saudi Arabian study concluded that dermatologic complications, such as eczematous eruptions, acne, erythematous rashes, dry hand skin, and pressure injuries like nasal bridge scarring, were more common due to prolonged usage of PPE or face masks during the COVID-19 pandemic.²⁷ An earlier study in the

United States also reported skin breakdown in 175 respondents, acne in 182 respondents, and impaired cognition in 81 respondents.⁵

These adverse skin reactions to PPE and face masks may compromise adherence to their use, thereby increasing the risk of unprotected virus exposure. To mitigate these skin reactions and improve compliance, it is advisable to use appropriate protective measures, limit the duration of exposure, regularly replace used masks, and implement strategies such as nasal breathing encouragement and pre-use respirator refrigeration to reduce the heat burden caused by prolonged mask usage.

However, our study was not without limitations. As an observational study, it is not designed to establish a causal relationship. We did not assess preexisting conditions like high body mass index, asthma, and other potential confounding factors, which could potentially influence or amplify the adverse effects reported. Additionally, factors like stress level and sleep quality, which could contribute to these adverse effects, were not included in our survey. Recall bias is another potential limitation.

To mitigate these adverse effects and improve mask-wearing compliance, educational programs tailored toward HCWs' surgical mask usage are essential. Techniques such as encouraging nasal breathing, taking brief mask breaks in safe environments, and staying hydrated can help alleviate the discomfort associated with prolonged mask usage. Such strategies are crucial as face masks remain an indispensable protection against COVID-19.

Conclusions

This study underscores the potential adverse health effects of prolonged surgical mask usage among healthcare workers in the context of the COVID-19 pandemic. Our findings from Jazan, Saudi Arabia, suggest a significant prevalence of respiratory and skin-related issues associated with extended mask usage. Major respiratory complaints included breathing difficulties and nasal itching, while skin-related issues primarily consisted of sweating, itching, and acne.

Despite the limitations of this observational study, including potential recall bias, these findings provide valuable insights into the impacts of prolonged mask usage. This data highlights the urgent need for further research to understand and mitigate these adverse effects better. It also emphasizes the necessity for comprehensive guidelines and educational programs to ensure the effective and comfortable use of masks. As the pandemic continues, these findings are crucial in improving the safety and comfort of healthcare workers serving on the front lines.

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