

Original Article

Mycological Study in Different Types of Face Masks

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ABSTRACT

Objectives: The objective of the study is to investigate fungal contamination of reused face masks among patients and healthcare workers in a tertiary care hospital.

Material and Methods: A cross-sectional study was conducted in 96 subjects by the Department of ENT in Justice K S Hegde hospital, a unit of the K S Hegde Medical Academy, affiliated to NITTE (Deemed to be University), Mangalore, India, for 2 months (August 2021- September 2021). This study included healthcare workers and patients visiting the outpatient department (OPD) and wards, using the same mask for three consecutive days.

Results: A total of 96 people participated in the study, divided into three different groups. The first group comprised 32 individuals using surgical masks, the second group included 32 people using N95 masks, and the third group consisted of 32 individuals using cloth masks. In the first week of incubation, fungal growth was detected in one individual wearing an N95 mask, and in the second week, fungal growth was observed in individuals using a surgical mask, an N95 mask, and a cloth mask. The growing fungus was *Candida albicans*. The results indicate no statistically significant association between the type of mask used and the occurrence of fungal growth ($p > 0.05$).

Conclusion: Our study highlighted the need for future research to determine the prevalence and diversity of different fungal species on face masks.

Keywords: COVID-19, Healthcare, Mucormycosis, N95 mask, Surgical mask

INTRODUCTION

Amidst the COVID-19 pandemic, the use of face masks has been paramount in curbing the spread of the virus.^[1] Various types of face masks, like N95 masks, cloth masks, and surgical masks, became an essential tool in safeguarding public health, highlighting the importance of adhering to proper safety measures during their use.^[2]

The cleanliness and hygiene of reusable masks became necessary to reduce the risk of microbial contamination and subsequent infections.^[3] In India, health care providers faced significant difficulties during the second wave of COVID-19 due to a surge in cases of mucormycosis among patients.^[4] Uncontrolled diabetes, prolonged ICU stays, and the administration of corticosteroids were identified as contributing factors.^[4]

In addition to that, there have been speculations regarding the potential role of contaminated face masks, along with other medical equipment such as oxygen masks and nasal prongs, in worsening the outbreak.^[4]

Studies on fungal contamination of reused face masks and whether it could act as a potential source of infection are limited. Our study aims to investigate fungal contamination of reused face masks among patients and healthcare workers of our tertiary care hospital.

MATERIAL AND METHODS

This hospital-based cross-sectional study was done in patients and healthcare workers in the OPD and wards of the Department of ENT for a period of two months from August 2021 to September 2021, after getting clearance from the Institutional Ethics Committee. Written consent was obtained from all individuals who participated in the study.

The study population included healthcare workers and patients visiting the OPD and admitted ward patients who had been using the same mask for three consecutive days. Patients who were infected with COVID-19 and pre-diagnosed with fungal infection were excluded. All the patients included in the study were asked to submit their used masks, which

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were then sent to the microbiology laboratory for culture and fungal growth assessment. The masks were subjected to 4 weeks of incubation.

Assessment of microbial growth was done at the end of each week, and results were noted.

Statistical analysis

Data was presented in tabular form in Microsoft Excel version 2016, which included the type of mask used, the culture result in 4 weeks of incubation, and the microscopy result in each week, and analysed using SPSS software version 25.

RESULTS

A total of 96 people participated in the study, divided into three different groups. The first group comprised 32 individuals using surgical masks, the second group included 32 people using N95 masks, and the third group consisted of 32 individuals using cloth masks.

During the first week, fungal growth was observed in one individual wearing an N95 mask. The specific type of fungal growth detected was *Candida albicans*. Out of 32 individuals using N95 masks, one (3.1%) had fungal growth in the first week, while 96.9% did not. Among those using surgical and cloth masks, none exhibited fungal growth during the first week. The results indicate no statistically significant association between the type of mask used and the occurrence of fungal growth ($p > 0.05$) [Table 1].

Fungal growth was observed in one individual using a surgical mask, one individual using an N95 mask, and one individual using a cloth mask during the second week. *Candida albicans* constituted the growth present in all masks [Table 2].

Out of 32 individuals using surgical masks, one (3.1%) had fungal growth in the second week, while 96.9% did not. Among those using N95 masks, one individual had fungal growth, and among those using cloth masks, one individual also had fungal growth during the second week. The results

Table 1: Comparison of the type of masks used and fungal growth (week 1)

Type of mask	Fungal growth		Total	p-value
	Yes	No		
	Number (%)			
Surgical (32)	0 (0)	32 (100)	32 (100)	>0.05
N95 (32)	1 (3.1)	31 (96.9)	32 (100)	
Cloth (32)	0 (0)	32 (100)	32 (100)	
Total	1 (1.0)	95 (99.0)	96 (100)	

The p-value shows no significance in the association between masks used and fungal growth.

Table 2: Comparison of the type of masks used and fungal growth (week 2)

Type of mask	Fungal growth		Total	p-value
	Yes	No		
	Number (%)			
Surgical (32)	1 (3.1)	31 (96.9)	32 (100)	>0.05
N95 (32)	1 (3.1)	31 (96.9)	32 (100)	
Cloth (32)	1 (3.1)	31 (96.9)	32 (100)	
Total	3 (3.0)	94 (97.0)	96 (100)	

The p-value shows no significance in the association between masks used and fungal growth.

showed there is no statistically significant association between the types of masks used and the occurrence of fungal growth ($p > 0.05$).

One individual using an N95 mask had fungal growth during the first week, and in the second week, one individual from each group exhibited fungal growth. No fungal growth was observed during the 3rd and 4th week period in any of the groups.

DISCUSSION

The mycological investigation conducted on 96 various types of face masks provided valuable insights into the microbial communities thriving on these essential protective items. Among the masks examined, four masks showed the presence of *Candida albicans* growth during the initial and subsequent weeks of incubation. *Candida albicans*, an opportunistic fungal pathogen that typically exists as a harmless component of the mucocutaneous tissue in most individuals. However, under conditions of decreased host defences, it can transform from a benign inhabitant to a highly pathogenic organism.^[5]

Mucormycosis, a rare yet lethal fungal infection that manifests with blood vessel invasion, leading to thrombosis, necrosis, tissue infarction, and even mortality. Literature states three primary factors associated with a significant rise in mucormycosis cases. These include corticosteroid usage, uncontrolled diabetes mellitus, and infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).^[6,7]

Our study findings showcase the dynamic nature of microbial colonisation on different face masks and emphasise the importance of regular monitoring and maintenance. During the initial months of the pandemic, guidelines for wearing masks were primarily recommended for individuals exhibiting COVID-19 symptoms, healthcare professionals, and those living near infected individuals. Hence, the general population faced many difficulties in accessing face masks due to a shortage in production, subsequently leading to mask

reuse. Several studies suggest that surgical masks and N95 respirators provide better protection and are preferable for regular use in healthcare settings compared to cloth masks.^[8]

Research by Chin *et al.* suggested that SARS-CoV-2 can survive on masks for up to 7 days, thus highlighting the lack of detailed studies addressing factors associated with mask reuse during the pandemic.^[9] Furthermore, a study conducted by Biswal *et al.* revealed fungal contamination in a significant portion of face masks used by healthcare workers, with surgical masks, K95, and N95 masks being among the contaminated protective gear. Commonly isolated fungal species on the inner surfaces of these masks included *Alternaria* sp., *Penicillium* sp., and *Aspergillus* sp., with humidity and duration of mask use identified as crucial factors influencing fungal growth.^[10] The findings of our study showed the growth of only one type of organism, namely *Candida albicans*, in different weeks of incubation, thus indicating the presence of different types of fungal species on face masks used during the pandemic.

Strategies aimed at reducing microbial growth through regular cleaning and mask replacement are crucial for identifying potential health hazards associated with fungal contamination. While the identification of *Candida albicans* growth on masks in our study does not imply widespread fungal contamination across all masks, it highlights the need for further investigations to ascertain the prevalence and diversity of fungal species on face masks.

CONCLUSION

The growth of *Candida albicans* on face masks in our study highlights the need for proper mycological surveillance and mask hygiene. Timely replacement of masks by infected individuals and health workers is crucial in controlling the spread of the infection to healthy individuals. By thoroughly understanding the microbial dynamics on face masks, we can enhance infection prevention strategies and ensure the safe and effective use of these essential protective measures.

Ethical approval: The study approved by the Institutional Ethics Committee at K S Hegde Medical Academy, number INST.EC/EC/135/2021-22 REG.NO.EC/NEW/INST/2020/834, dated 30th November 2021.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent.

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