

# Surgical Mask and N95 in Healthcare Workers of Covid-19 Departments: Clinical and Social Aspects

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**Summary.** *Introduction.* In order to prevent or slow down the transmission of COVID-19, various public health measures have been introduced, including social distancing, environmental disinfection and the use of personal protective equipment (PPE). In this perspective, the clinical practice of healthcare professionals has changed dramatically. As a matter of fact, the use of surgical masks and N95 has significantly worsened the job performance of workers who deal directly with COVID-19 disease. *Methods.* The study included 116 health workers employed in the pulmonology, intensive care and infectious diseases departments of Bari and Foggia Hospital, directly involved in the healthcare of patients affected by COVID-19. Between May 1, 2020 and May 31, 2020, each participant completed an online questionnaire aimed to investigate the impact of the COVID-19 pandemic on workers' lifestyle changes and job performances. We compared the results based on the type of mask used by each participant (surgical mask vs N95). *Results.* Although disturbances related to the use of the mask arose earlier in subjects who wore the N95 ( $p = 0.0094$ ), healthcare workers that wore surgical masks reported a statistically higher average score for a greater number of disorders. *Conclusions.* This is the first study that compares the effects of the two most used PPE on the quality of life of health workers and which highlights the greater discomfort caused by surgical masks. This result brings to light a serious social problem, being surgical masks widely used in everyday life by ordinary people and non-healthcare workers. ([www.actabiomedica.it](http://www.actabiomedica.it))

**KeyWords:** SARS-CoV-2; Surgical masks; N95; Life quality.

## Introduction

Since December 2019, there has been an outbreak of pneumonia of an unknown etiology that was first reported in Wuhan, Hubei Province, China. Severe Acute Respiratory Syndrome-Coronavirus-2 (SARS-CoV-2), a novel coronavirus, was identified as the causative virus for a new form of respiratory disease characterized by heterogeneous clinical

manifestations ranging from an asymptomatic course to Acute Distress Respiratory Syndrome (ARDS) (1,2). It has been demonstrated that SARS-CoV-2 is a highly contagious virus, which is mainly spread through close contact with infected people via respiratory droplets from cough or sneezing (3). In order to prevent or slow down the transmission of the COVID-19 several public health measures have been introduced, including social distancing, environmental

disinfection and use of personal protective equipment (PPE) (4). In this perspective, the health workers' clinical practice has changed radically. As a matter of fact, working with patients affected by COVID-19 put healthcare workers under both physical and psychological pressure (5).

We have investigated through the effects of wearing surgical face masks and N95 on quality life and job performances of workers dealing directly with Covid-19 disease.

## Materials and Methods

116 health workers among Medical Doctors (M.D.), residents, nurses and social health assistants employed in the pulmonology, intensive care and infectious diseases departments of Bari and Foggia Hospital, directly involved in the healthcare of patients affected by COVID-19, have been enrolled in this study between May 1, 2020 and May 31, 2020 (Tab.1).

We based our investigation calculating the average time of usage of face masks in 24 hours, considering both intra and extra hospital amount of time spent wearing a facial PPE (at least 8 hours/days).

Specific exclusion criteria were nasal septum deviation, acute allergic rhinitis, vasomotor rhinitis, rhinosinusitis with and without polyps, acute or chronic bronchopulmonary disorders, workers in good health

using both type of masks or using FFP2 masks with valve during their working hours. They provided an informed consent and completed an online questionnaire due to investigate the impact of the COVID-19 pandemic on workers' lifestyle changes and job performances.

Every participant was required to rate the amount of discomfort related to daily use of face masks.

So, we compared the results based on the type of mask used by each participant (N95 if healthcare workers were in direct contact with infected patients, surgical masks if they were not in direct contact with infected patients). Particularly we investigated specific subjective perceptions related to physiological alterations of different body districts and functions: nasal obstruction, dry nose, itching, sneezing, rinorrhea, feeling unfit, dyspnea, nausea, vomit, headache, vertigo, sight alteration, lachrymation, facial pain, tremor, irritability, lack of concentration, memory and appetite loss.

Moreover, participants were asked to rate psychological and job performances impact of COVID-19 pandemic. Each item has been evaluated using a scale ranging from 0-10 where 0 meaning absence of any kind of alteration and 10 meaning complete alteration of the item compared to pre- COVID-19 period (Tab. 2).

To assess the association between sex and the other investigated variables, an univariate analysis was performed, by using double-entry contingency tables and computing chi square (Chi2) and Odds Ratios (OR) with 95% Confidence Intervals (95% CIs), considering as significant p values <0.05.

The assessment of significant differences across the means of continuous variables relied on the t-test for independent samples considering as significant values with p values <0.05. To assess distribution of the variables, we used the Bartlett test. P values <0.05 were considered significant.

Variables that were significant in univariate analyses were evaluated in a logistic regression model to study the relationship between face mask related disorders and the explanatory variables, while adjusting for confounding factors and effect modification if needed. Data analyses were performed with STATA-MP software, version 15.

**Table 1.** Sample characteristics

	<b>N (116)</b>
<b>Sex</b>	
<i>F</i>	69
<i>M</i>	47
<b>Age, years</b>	41.6 (11.6)
<b>Weight (kg)</b>	68.9 (12.4)
<b>Height (cm)</b>	168.5 (8.2)
<b>Smoke habit, N</b>	31
<b>Job</b>	
<i>Nurse</i>	52
<i>Resident</i>	14
<i>Structured Doctor</i>	32
<i>Social health worker</i>	18

**Table 2.** This table shows the average score given by our sample when investigated on the usage of face mask. Each item is described as a score from 0 (any disturb) to 10 (complete alteration)

	<i>Surgical mask - Average (DS)</i>	<i>N95- Average (DS)</i>	<i>Univariate analysis p value</i>	<i>Multivariate analysis p value</i>
<b>Did you have face mask linked disturbs? How many days after?</b>	7.1 (10.4)	3.6 (4.8)	0.0094	
<b>Nasal Obstruction</b>	2.5 (3.2)	1.9 (2.7)	0.1425	
<b>Dry Nose</b>	2.4 (2.7)	2.8 (3.1)	0.2388	
<b>Itch</b>	3.7 (3.6)	2.8 (2.9)	0.0792	
<b>Sneezing</b>	2.0 (3.1)	1.5 (2.5)	0.1792	
<b>Rhinorrhea</b>	1.5 (2.7)	1.0 (2)	0.1279	
<b>Intolerance</b>	3.2 (3.4)	2.2 (2.8)	0.0556	
<b>Air loss sensation</b>	3.7 (3.4)	2.9 (3.2)	0.1166	
<b>Nausea</b>	0.8 (2.1)	0.1 (1.0)	0.0135	
<b>Vomit</b>	0.3 (1.0)	0.1 (0.9)	0.1969	
<b>Headache</b>	2 (3.5)	2.4 (0.3)	0.2797	
<b>Dizziness</b>	0.7 (2.1)	0.1 (0.06)	0.0173	
<b>Blurred vision</b>	1.05 (2.3)	0.4 (1.5)	0.0328	
<b>Lachrymation</b>	0.9 (1.8)	0.4 (0.1)	0.0697	
<b>Facial pain</b>	1.6 (2.8)	2.9 (2.8)	0.0125	0.007
<b>Tremors</b>	0.05 (0.2)	0.01 (0.1)	0.1041	
<b>Irritability</b>	1.39 (2.2)	0.5 (1.6)	0.0091	
<b>Reduced concentration</b>	0.9 (2.1)	0.8 (2.0)	0.3343	
<b>Memory loss</b>	0.6 (2.0)	0.1 (0.6)	0.0234	
<b>Appetite Loss</b>	0.2 (0.8)	0.2 (0.9)	0.3949	
<b>Are you having trouble falling asleep?</b>	1.7 (3.1)	0.8 (1.8)	0.0290	
<b>Do you have nighttime awakenings?</b>	2.3 (3.6)	0.8 (2.1)	0.0024	
<b>Do you wake up tired?</b>	2.5 (3.7)	0.9 (2.2)	0.0025	
<b>Do you feel less productive?</b>	2 (2.9)	0.3 (1.4)	0.0000	0.039
<b>Do you feel frustrated?</b>	1.5 (3.0)	0.3 (1.0)	0.0007	
<b>Do you feel sad?</b>	1.4 (2.8)	0.2 (0.7)	0.0002	
<b>Do you feel embaraced?</b>	0.2 (1.2)	0 (0)	0.0764	
<b>From 0 to 10, how much your job activity has got worse?</b>	3.4 (2.9)	5.1 (3.4)	0.0036	

## Results

A statistically significant difference emerged in the average of the days of onset of the disorders related to the use of the mask between those who wore the surgical mask (7.1 days) and those who wore N95 mask (3.6 days;  $p = 0.0094$ ).

In particular, the sample wearing surgical masks reported a statistically higher average score for the following disorders: nausea ( $p = 0.0135$ ), dizziness ( $p = 0.0173$ ), blurred vision ( $p = 0.0328$ ), irritability ( $p = 0.0091$ ) and memory loss ( $p = 0.0234$ ). Who wore the N95 mask reported a higher level of facial pain ( $p = 0.0125$ ).

Those who wore surgical masks compared to those who wore N95 masks had greater difficulty falling asleep ( $p = 0.0290$ ), more nocturnal awakenings ( $p = 0.0024$ ), woke up more tired ( $p = 0.0025$ ), felt less productive ( $p = 0.0000$ ), felt more frustrated ( $p = 0.0007$ ) and sadder ( $p = 0.0002$ ). Who wore an N95 mask, on the other hand, found their job activity to be worse ( $p = 0.0036$ ).

The multivariate analysis confirmed the statistical significance for facial pain ( $p = 0.007$ ) and feeling less productive ( $p = 0.039$ ).

No statistically significant associations emerged between the discomfort associated with the use of the mask and sex, anamnesis for allergic diseases, habit of smoking cigarettes, type of department, age, weight, duration of work shift, average number of working hours and duration of breaks.

## Discussion

Scientific evidence showed that the use of adequate PPE is essential to reduce the spread risk of viral respiratory diseases both in hospital and extra hospital settings. Although the transmission of COVID-19 is not entirely clear, it is believed to be mainly through respiratory droplets from cough or sneezing (3). For healthcare workers providing direct inpatient care for patients with COVID-19, a face mask should be used (6). We investigated and compared how the use of surgical face masks and N95 changed workers' quality life and job performances. The type of mask that should be used for the management of COVID-19 patients varies according to the setting, type of personnel/person and activity (7). There is consensus that N95 masks offer better protection than surgical masks for aerosol-generating procedures, such as intubation, tracheotomy, endotracheal aspiration, face mask ventilation, non-invasive mechanical ventilation, high-flow oxygen therapy or bronchoscopy. Surgical masks instead are suitable for non-aerosol-generating procedures (6). The N95 respirators prevent inhalation of small airborne particles. As a matter of fact, they are designed to minimize facial seal leakage and have a tighter seal than that of surgical masks. In contrast, medical masks

provide barrier protection against large droplets and are loose fitting (6).

The number of layers is another feature that may contribute to the ability of the mask to prevent viral transmission. Surgical masks usually have one to two layers of protection and, compared with N95 masks four-layers, they provide a lower protection but a higher level of comfort (8). In light of the greater number of layers and the greater adhesion to the face of the N95 respirator compared to the surgical mask, we expected different results from those obtained. In fact, although disturbances related to the use of the mask arose earlier in subjects who wore the N95, healthcare workers that wore surgical masks reported a statistically higher average score for a greater number of disorders. In particular, caregivers wearing surgical masks reported a statistically higher average score for nausea, dizziness, blurred vision, irritability and memory loss. Moreover, they complained of greater sleep disturbances and felt less productive, more frustrated and sadder. On the contrary, who wore the N95 mask found their job activity worse and reported a higher level of facial pain than surgical masks users. The higher facial pain caused by the N95 respirator is easily justified by the greater adherence of the mask to the face compared to the surgical mask. On the other hand, it is not clear why healthcare workers who wore surgical mask complained of a greater number of disturbances. Furthermore, it has been demonstrated that the subjective perception of discomfort increases significantly with increasing thermal stress (9). In particular, the use of facemasks could hinder the normal breathing process since the mouth and nose are in direct contact with a hot and wet air cushion that is generated under the mask (10). The heat exposure leads to an increase in respiratory rate and causes general thermal discomfort, which affects to the entire human body. The negative impact of the use of masks on human thermoregulation mechanisms can also lead to adverse skin reactions such as contact dermatitis (10). In fact, both groups complained of itching, although no statistically significant difference was found between the two groups.

In this context, since the microclimate temperature in the N95 facemask is significantly higher than in the surgical masks, we expected greater discomfort. We believe that the greater sensation of blurred vision

could be attributed to the reduced facial seal of the surgical mask, which involves the escape of exhalations with consequent eye irritation or dryness and fogging of the eyeglasses or visors, if worn. Moreover, we found that surgical masks, being made up of fewer layers, tend to humidify more easily with sweat and exhaled air, leading to a bad smell which could cause a higher sense of nausea. As regards sleep disturbances, during the COVID-19 pandemic more studies confirmed an increased risk of insomnia for caregivers directly involved in the healthcare of patients affected by COVID-19 (11,12). We consider that the lesser protection against the SARS-CoV-2 made the operators less tolerant to the discomfort caused by the surgical mask compared to the N95. Similarly, the lower safety offered by the surgical mask could cause greater anxiety and fear of becoming infected, favouring the difficulty of falling asleep, nocturnal awakenings and insomnia. So even from a psychological point of view more attention was paid to the problems due to the use of the surgical mask rather than to those resulting from the N95. In this perspective, the sample wearing surgical masks may have reported a statistically higher average score for memory loss precisely because it was more concentrated on disinfection and prevention procedures rather than work activity. Furthermore, what came out of our study is that those who worked closely with infected patients and who therefore wore the N95 mask reported fewer complaints than those who were not in direct contact with infected patients and wore the surgical mask. This can be explained by the fact that those who wore the surgical mask, even if far from direct contact with infected patients, felt less protected during working hours and more afraid of the infectious risk, thus increasing the discomfort created by the mask. However, we could observe that those who wore the N95 mask, being in direct contact with infected patients, had a statistically significant deterioration in working quality, probably because they were subjected to greater physical and psychological stress due to the absence of work breaks.

These results lead us to an important observation: if the surgical mask causes greater discomfort than the N95 mask, this represents an important social problem because the surgical mask is the most used type, even outside working hours, not only by doctors, nurses and

socio-health workers, but by the whole community in general. This has repercussions especially during the summer months when the whole population face extreme hot days. Therefore, according to Morabito and his colleagues, we believe that the use of a specific heat health warning systems with personalized information, based on individual, behavioral and environmental characteristics, would represent a good strategy to help a fast adaptation of the population at a time where the priority is to avoid SARS-CoV-2 infection (10). Also individual (e.g. weight, height, age) and behavioural (type of activity carried out and clothing worn) characteristics, environment and occupational situation (if the worker is exposed to the sun outside or in shaded areas or indoors) are important information which should be considered to alleviate heat-stress situations (in terms of recommended breaks, rests in shaded areas, hydration, management of shifts and working hours, distribution of the various tasks breaks, etc).

## Conclusion

The COVID-19 pandemic has radically changed health workers' clinical practice, forcing them to wear uncomfortable PPE and to work under both physical and psychological pressure. Unlike what we expected, those who wore the surgical mask complained of more ailments than those who wore the N95 mask. We believe that this result highlights a serious social problem, not only for health workers, but also for the whole population that must wear surgical masks to reduce the risk of SARS-CoV-2 spreading. In this perspective, it would be important to implement a series of measures (including heat health warning systems and management of work activities according to personal characteristics) to reduce the discomfort induced by masks in the general population.

Our study is the first to investigate the effects of the two most used PPE on the health and quality of life of healthcare professionals.

Being these devices widely used in everyday life by ordinary people and non-healthcare workers (office workers, shopkeepers, restaurateurs, etc), more studies involving larger samples are required to confirm our results.

**Conflict of Interest:** The author declares that he has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

**Ethical approval:** This study was approved by Institutional Review Board OF University of Foggia, Foggia, Italy, Via Luigi Pinto 1- 71122 Foggia (FG).

**Informed consent:** All participants included in the study signed informed consent.

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