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Comfort rules for face masks among healthcare workers during COVID-19 spread

A. Maniaci[1], S. Ferlito[1], L. Bubbico[7], C. Ledda[2], V. Rapisarda[2], G. Iannella[3,4], I. La Mantia[1], C. Grillo[1], C. Vicini[3], E. Privitera[1], S. Coco[1], G. Cammaroto[3], J.R. Lechien[5], G. Magliulo[4], A. Pace[4], G. Meccariello[3], S. Cocuzza[1]

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Abstract

Background. *The outbreak of Coronavirus disease 2019 (COVID-19) made imperative the use of protective devices as a source control tool. As there is no definite antiviral treatment and effective vaccine, the only efficient means of protecting and mitigating infectious contagion has been the use of personal protective equipment, especially by healthcare workers. However, masks affect the humidification process of inhaled air, possibly leading to a basal inflammatory state of the upper airways.*
Study design. *This is a single-center observational study conducted at the University Hospital of Catania from April 1, 2020, to June 31, 2020.*
Methods. *We analyzed the role of protective masks on the elimination of upper airways complaints in healthcare workers of the University Hospital of Catania. We evaluated 277 subjects through a self-administered 17 item questionnaire based on respiratory, work performance and health-related quality of life domains.*
Results. *A higher prevalence of nasal and ocular symptoms, perceived reduced work performance, difficulty in concentrating, and sleep disorders were found. After two weeks adhering to a list of good practices that we recommended, significant reversibility of the symptoms investigated and work performance enhancement were observed.*
Conclusions. *Despite clinical complaints related to personal protective equipment, effective amelioration*

[1] *Department of Medical and Surgical Sciences and Advanced Technologies "GF Ingrassia," ENT Section, University of Catania, Italy*
[2] *Department of Clinical and Experimental Medicine, Occupational Medicine Section, University of Catania, Italy*
[3] *Department of Head-Neck Surgery, Otolaryngology, Head-Neck and Oral Surgery Unit, Morgagni Pierantoni Hospital, Forlì, Italy*
[4] *Department of Sensory Organs, Sapienza University of Rome, Italy*
[4] *Department ENT and Audiology, University of Ferrara, Italy*
[5] *Department of Human Anatomy and Experimental Oncology, Faculty of Medicine, UMONS Research Institute for Health Sciences and Technology, University of Mons (UMons), Belgium*
[6] *Section of Otorhinolaryngology, Padua University, Treviso, Italy*
[7] *Department of Sensorineural Disability INAPP/Italian Institute of Social Medicine, Rome, Italy*

through usage rules is easily obtained. Given the essential use of protective masks, healthcare workers have to adhere to appropriate work and safety prevention rules.

Introduction

The pandemic caused by severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2) infection has become a global health emergency. The COVID-19 pandemic caused a significant impact on healthcare systems worldwide (1, 2).

To date, 21,260,760 people have been affected globally by COVID-19 and the WHO have reported that 761,018 have died from the disease (3).

The viral transmission through microdroplets leads to an easier COVID-19 transfer among people allowing the virus to spread. Therefore, in the absence of an adequate pharmacological therapy that contrasts the viral pathogen, the only effective tools available to avoid a possible mortal infection is the use of protective masks, personal distancing and disinfection (4, 5).

Moreover, as suggested by an interesting modelling study, some asymptomatic individuals are major contributors to the increase of the COVID-19 pandemic, due to the high infective viral loads possessed, transmitting COVID-19 with the same level of infectiousness as symptomatic subjects (4-8).

Personal Protective Equipment (PPE) use is extensively recommended for all individuals and especially healthcare workers (HCWs) because it is the only tool effective for preventing the spread of the virus and the COVID-19 infection (9). The rate of COVID-19 infection in HCWs is >10% in Italy, and within this dramatic scenario, the use of PPE has become mandatory (10).

The claim to use protective devices for HCWs is strengthened by the last COVID-19 overview of the Italian Ministry of Health, stating a growth of infections in HCWs that could put the entire healthcare system of individual hospitals at risk in case of its uncontrolled growth (11).

However, wearing protective equipment for many hours is not free of unwanted effects; prolonged use of PPE could expose HCWs to collateral problems of the upper airways. Indeed, it has been reported in the literature that PPE Filtering Face Pier (ffp2) could cause a deficit in the humidification process of the inhaled air; the possible consequent nasal obstruction and purely oral breathing are known to be predisposing factors for rhinitis and chronic inflammation of the nasal mucosa as well as problems of the upper respiratory tract (12).

This occurrence is even more relevant in subjects who suffer from chronic inflammation of upper airway mucosa and affected by allergic rhinitis or asthma, as well as immunosuppressed and those with recurrent upper airway infections (13, 14). It has recently been reported that the N95 filter face mask (FFR) may lead to worse respiratory function in subjects with high resistance and dead space such as those with chronic obstructive pulmonary disease (COPD) (15). Moreover, Ong et al. (16) showed a higher risk of headaches associated with PPE use in a cross-sectional study, with new headache episodes or exacerbation of pre-existing headache disorders (128/158 cases; 81.0%).

We designed this study to evaluate the real impact of the daily use of PPE on the

health issues and working performance status related to the prolonged use of masks on physicians, nurses and other HCWs. Furthermore, we investigated the effect of repeatable and straightforward rules for use in reducing protective devices-related symptoms, performing a second interview after applying our guidelines.

Methods

Study design

This was a single-center observational study conducted at the University Hospital of Catania from April 1 to June 30, HCWs who worked in COVID-19 and non-COVID-19 operative units of our tertiary university hospital were considered for possible enrollment in the study.

Inclusion criteria: all HCWs used a ffp1/ ffp2/ffp3 mask during work;

Exclusion criteria: subjects who did not report a constant use of PPE or who had incomplete self-assessments were excluded from the study.

In the first part of the survey, from each subject involved in the study, demographic data were acquired: gender, age, working role, working department, working in COVID-19 or not-COVID-19 unit.

Data concerning the type of protective device (Surgical, FFP1- FFP2 – FFP3 masks) was also collected.

Clinical aspects of all enrolled subjects were examined: smokers, presence of pathologies of upper respiratory airways, comorbidities such as rhinitis (allergic or vasomotor) or pulmonary disorders (asthma, COPD).

Finally, we developed a questionnaire to evaluate the impact of daily and continuous use of protective devices on health and work performance in HCWs (Figure 1). The questionnaire provided 8 specific items to investigate all possible side effects related to PPE use. The questionnaire defined the extent of the subject's discomfort, in the previous 2-weeks, of each item investigated, using a 5-point Likert-type scale (never, rarely, sometimes, frequently, always). Investigated symptoms had not to be present before operators started using PPE constantly.

The total sum of the responses obtained was then converted into a score from 0 to 40 points, where a high score corresponded to several discomforts related to PPE use.

The questionnaire was designed by an interdisciplinary academic team of otolaryngologists, hygiene specialists and psychologists. It was based on the validated Rinasthma questionnaire and investigated specific topics related to rhinitis symptoms and respiratory problems: nasal obstruction, rhinorrhea, sneezing or nasal itching and ocular disorders such as redness, tearing, itching of the eyes and other symptoms such as wheezing, coughing, feeling of chest obstruction and trouble breathing (17).

The last part of the questionnaire analyzed the presence of repercussions on the subject's quality of life such as sleep disorders (daytime sleepiness, snoring, daytime sleepiness, waking headache), the need to avoid certain environments or areas due to the symptomatology described above, consequent use of symptomatic drugs (nasal decongestants, saline solutions for the nose, headache medications, eye drops) and the overall reduction of job performance.

A group of subjects enrolled in the study also completed the same questionnaire again after a few days of work-rest (at least one week) in which they had limited the use of masks and had not used second-level PPE.

In the second part of our study, the same subjects were asked again to answer the subjective questionnaire only after they had followed for a minimum of two week the recommendations listed below:

- Abstaining from smoking
- Breathing in the open-air between visits

- Using daily isotonic nasal wash to prevent mucosal dryness
- Environmental humidification and temperature control
- Single-use of personal protective devices
- Treatment of comorbidities (especially asthma and other respiratory disorders).

In this group of subjects, the results of the first and second questionnaires were compared to assess whether the symptoms initially reported by enrolled subjects decreased after they stopped using PPE continuously.

Ethical approval statement and statistical analysis

Informed consent was obtained from each HCW. This study was conducted in accordance with the Declaration of Helsinki. All the interviews were conducted anonymously. All data were collected and analyzed by the same two operators (A.M. and C.L.) who followed the procedure until the end of the study. Data analysis was performed using IBM SPSS Statistics Version 25. Descriptive statistics were reported. The T-test for paired samples was used to determine the difference between observations. The chi-square test was performed to analyze group differences; a p-value of <0.05 was considered statistically significant. The present study was approved by the Ethics Committee of the University Hospital of Catania (n. 54/2020).

Results

A total of 277 HCWs were enrolled in the study. Among them, 17 subjects were excluded due to incomplete evaluation of self-assessment procedures. The study group's average age was 42.5 years; 56.3% and 43.7% of evaluated subjects were male and female, respectively. All sociodemographic and clinical characteristics are summarized in **Table 1**. We found that 68.9% of subjects reported an almost continuous use of protective devices (**Figure 2**). Regarding PPE use, the most interesting aspect that emerged was that 40% of all the subjects enrolled used a simple surgical mask. All these subjects belonged to the non-COVID-19 units. In the COVID-19 units, 27.0% reported the use of FFP2 masks, 28.3% FFP3 masks, 12.1 % FFP1 masks and 32.4% an alternation of the three. **Figure 3** show the use of the different PPE in COVID -19 and non-COVID-19 units.

HCWs' health problems

Previous pathologies of upper respiratory airways were reported in 53.4% of subjects. Distribution of different comorbidities is shown in **Figure 4**.

Among the comorbidities detected before PPE use, rhinitis was identified in 34.28% of HCWs. Allergic rhinitis in 27.79% and vasomotor rhinitis in 6.49%; the other upper airway symptoms are shown in **Table 2**.

Nasal disorders

After continuous PPE use, specific nasal symptoms were reported by 83.4% of subjects, of whom 32.9% defined as "Sometimes" the symptoms, whereas 19.4% reported "Often". Analyzing data in detail, there was a higher association between the type of device (FFP2 or FFP3 mask) used and nasal symptoms ($p=0.001$).

Eyes disorders

Eye symptoms such as itching, tearing or redness of the eyes were detected in up to 75% of HCWs. In particular, the disorder was classified as "Often" in 18.2% of HCWs, while it was reported as never in 5.7% of cases. No differences emerged for the type of mask used regarding the prevalence of eye symptoms ($p>0.05$).

Among the subjects analyzed, 74.7% presented variable concentration difficulties, of which "Sometimes" in 32.2% and

"Never" in 2.8% of HCWs.

Pulmonary Disorders

Lower respiratory tract symptoms were reported in up to 59.2 % of subjects from "Rarely" to "Always". In particular, wheezing, coughing, tightness in the chest or difficulty breathing were described ''Sometimes" in 18.7%, up to ''Often'' and ''Always'' in 10.46% and 2.16%, respectively (**Table 2**). HCWs using FFP2 and FFP3 reported higher percentages of this complication (p=0.002).

Quality of life and performance evaluation

Common sleep disorders such as nocturnal awakenings were detected in 78.6% of HCWs.

Due to respiratory symptoms, 51.45% of HCWs reported the need to avoid certain areas and environments (30.4% sometimes and 25.6% always).

Finally, due to the previously reported symptoms, 42.7% of subjects perceived impairment of work performance consequent to PPE use. It should be noted that this work performance reduction was reported as "Sometimes" in 28.9% of cases, "frequently" in 13.1% and "never" only in 0.7% of HCWs.

Stopping PPE use and clinical symptoms

We re-interviewed all HCWs enrolled to evaluate whether symptoms previously evaluated decreased after stopping continuous use of PPE (**Figure 5**).

In this group of 240 HCWs, overall nose-related symptoms decreased from 83.4% to 56.7% ($p<0.001$) as did ocular symptoms decreasing by approximately 25% (75% vs 56.2 %; $p<0.001$). Concentration disorders were reported in less than 21% (74.4 vs 58.7%; $p<0.001$) of HCWs. It is interesting to note that work performance improvement was recorded (42.8% vs 30.8%; $p =0.003$).

Moreover, sleep disorders, that were 60.5%, were reduced to 23% ($p= 0.001$) of cases and the need to avoid specific environments and take symptomatic medications decreased from 30.6 to 25.7% ($p=0.18$) and 44% to 39.6% ($p=0.22$) of HCWs, respectively.

Discussion and Conclusions

Since the outbreak of COVID-19, the WHO and the local health authorities have recommended rigid measures to limit the spread of the virus. HCWs were a relevant target, because of their high exposure. The health authorities recommended using protective masks for the protection of HCWs, which proved to be the only useful protective device (1-3, 9).

The continuous use of masks brought about a consistent change in daily habits, eventually affecting the upper airways with a deficit in the humidification process. This situation could involve a tendency to a basal inflammatory state, a common condition for several nasal disorders having a high prevalence in the general population and a burden on the quality of life, such as asthma, allergic and vasomotor rhinitis (18).

Several disease-specific questionnaires have been developed and validated for use in allergic rhinitis and asthma research, providing evidence of both the burden of disease and the effectiveness of treatments (19).

We focused our study on the use of masks and its consequences on HCWs' performance and quality of life, paying attention to respiratory symptoms and comorbidities such as rhinitis, asthma and COPD. HCWs have had to use protective devices for a longer time, which have proved to be the only protection against viral infection.

Sun et al., in a prospective study at a tertiary hospital, enrolled 97 subjects with COPD, monitoring the HCWs for symptoms and physiologic variables when wearing a N95 (15).

The authors, who generally recommend the use of N95 masks for COPD subjects, in the presence of Forced Expiratory Volume in the first second (FEV1 scores) <30%, dyspnea, headache or dizziness, recommended removing the N95 mask immediately. Consistent with previous hypotheses, our results reported recurrence of nasal obstruction, runny nose, sneezing or nasal itching in our HCWs, particularly pronounced in smokers and allergic subjects. Other symptoms that may be related were eye disturbances, attention disturbances and sleep disturbances, all of which converge to a reduced work performance. In particular, the statistical comparison between the total mean score of the different mask's groups revealed a significant difference of Surgical mask vs FPP1 Mask ($p=0.0006$), Surgical mask vs FPP2 Mask ($p= 0.0028$), Surgical mask vs FPP3 Mask $p<0.0001$ and Surgical mask vs Combined Usage $p<0.0001$.

However, it is essential to specify that the real validity of the estimate of sleep disorders with a simple subjective questionnaire is limited by confounding factors such as mood disorders related to pandemic psychic stress and, last but not least, previous unrecognized or underestimated respiratory disorders such as snoring or hypopneas/apnea.

As allergic diseases impact Quality of Life (QoL) as described in the literature, we compared this to our data, which included only HCWs using masks. We found a higher weight of allergic diseases on QoL (20-23).

Notably, our data on work performance reduction were worse than the Work Productivity and Activity Impairment Allergic Specific Questionnaire (WPAI-AS) employed in the (24) MASK study.

Moreover, we asked our HCWs to adhere to several good practices, proposed by information sheets, and we established the way to evaluate any variation. After a minimum of two weeks following these practices, we re-evaluated the same symptoms, and we found a significant reduction in their expression (Figure 6). Nasal obstruction, rhinorrhea and nasal itching diminished by 32.3%, reduced performance by 18.3% and ocular symptoms by 24.8% (**Figure 5**).

These ameliorations proved both the burden of mask usage on HCWs and how it can be counterbalanced by several good practices that are easy to adhere to, effectively counteracting this symptomatology associated with easily applicable countermeasures. After all, HCWs must wear PPE to preserve their health and prevent and limit contagious diseases. However, they also need to be looked after, especially in a working environment and when they already present comorbidities, to obtain proper compliance with PPE and to ensure a satisfying work performance and quality of life.

Due to the concomitant pandemic spread of the SARS-CoV-2 infection, the authors were not allowed to perform a clinical-diagnostic examination.

Although the questionnaire represents a modified version of a previous one, the current one we administered had not been validated for statistical purposes.

However, it provided incisive and valid measurements of health changes in HCWs.

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Riassunto

Regole di comfort per le maschere facciali tra gli operatori sanitari durante la diffusione del COVID-19

Obiettivo. L'epidemia della malattia da Coronavirus 2019 (COVID-19) ha reso obbligatorio l'utilizzo di dispositivi di protezione come strumento di controllo della fonte dell infezione. In considerazione dell attuale assenza di un trattamento antivirale definitivo e di un vaccino efficace, l'unico mezzo efficace di protezione e riduzione del contagio infettivo è rappresentato dall'uso di dispositivi di protezione individuale, soprattutto tra operatori sanitari. Tuttavia, l'uso di maschere facciali influisce sul processo di umidificazione dell'aria inspirata, potendo comportare uno stato infiammatorio basale delle vie aeree superiori.

Tipologia di studio clinico. Abbiamo eseguito uno studio monocentrico osservazionale retrospettivo condotto nell ospedale universitario di Catania dal 1° aprile al 31 Giugno 2020.

Metodi. Abbiamo analizzato il ruolo delle maschere protettive sui disturbi delle vie aeree superiori lamentati dagli operatori sanitari presso l'Azienda Ospedaliera Universitaria di Catania. Abbiamo valutato 277 soggetti attraverso un questionario autosomministrato composto da 17 item basato sulla qualità respiratoria, sulle prestazioni lavorative e sulla qualità della vita correlata.

Risultati. Sono stati riscontrati una maggiore prevalenza di sintomi nasali e oculari, una ridotta performance lavorativa percepita, difficoltà di concentrazione e disturbi del sonno. Tuttavia, attenendosi a un elenco di buone pratiche da noi raccomandate per un periodo di due settimane, si è verificata una riduzione significativa dei sintomi precedentemente rilevati ed un miglioramento delle prestazioni lavorative.

Conclusioni. Nonostante la possibile presenza di disturbi clinici correlati, attraverso il rispetto di semplici regole di utilizzo è possibile ottenere un efficace miglioramento della sintomatologia riferita. Dato l'uso indispensabile delle maschere protettive, gli operatori sanitari devono eseguire adeguate norme di prevenzione della sicurezza sul lavoro.

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Corresponding author: Dr. Salvatore Ferlito, Department of Medical and Surgical Sciences and Advanced Technologies "GF Ingrassia", ENT Section, University of Catania, Via Santa Sofia 78, 95123 Catania, Italy
e-mail: ferlito@unict.it

Figure 1 - Protective Device Mask-related Airway Complaint Questionnaire. The first part of the questionnaire included questions on the population features examined. The second part investigated the related possible symptoms during device use, with a score range between 0-32. HCWs were subjected to the Italian version after translation.

Gender	Male	Female					
Age	Less than 30 years	Between 30 and 40 years	Between 40 and 50 years	Over 50 years old			
What is your job title?	Physician	Nurse	OSS/OSA	Other			
Department of origin	COVID	Not COVID (Specify)					
What type of protective device do you use?	Surgical mask	FFP1 mask	FFP2 mask	FFP3 mask		A combination of the above	
What is your average working use of the mask?	Occasional (less than 1 hour per shift)	Often (between 1 and 3 hours)	Always (entire duration)				
Working seniority	1-5 years	5-10 years	10-15 years	> 20 years			
Smoking habit	Never smoked	Former Smoker	<5 Cigarettes a day	between 5 and 10 Cigarette a day		Cigarettes> 10 a day	eCigarette / IQOS
Do you suffer from the following airway diseases?	No pathology	Allergic rhinitis	Non-allergic rhinitis	Asthma		COPD	Other (specify)
	Never	Rarely	Sometimes	Often	Always		
Nasal disorders (nasal obstruction, rhinorrhea, sneezing or nasal itching	0	1	2	3	4		
Ocular disorders (redness, tearing, itching of the eyes)	0	1	2	3	4		
Attention disorder	0	1	2	3	4		
Breathing disorders (wheezing, coughing, feeling of chest obstruction and trouble breathing)	0	1	2	3	4		
Sleep disorder (daytime sleepiness, snoring, daytime sleepiness, waking headache)	0	1	2	3	4		
Need to avoid specific environment	0	1	2	3	4		
Need to use drugs (nasal decongestants, saline solutions for the nose, headache medications, eye drops)	0	1	2	3	4		
Reduced overall working performance	0	1	2	3	4		
Total score							

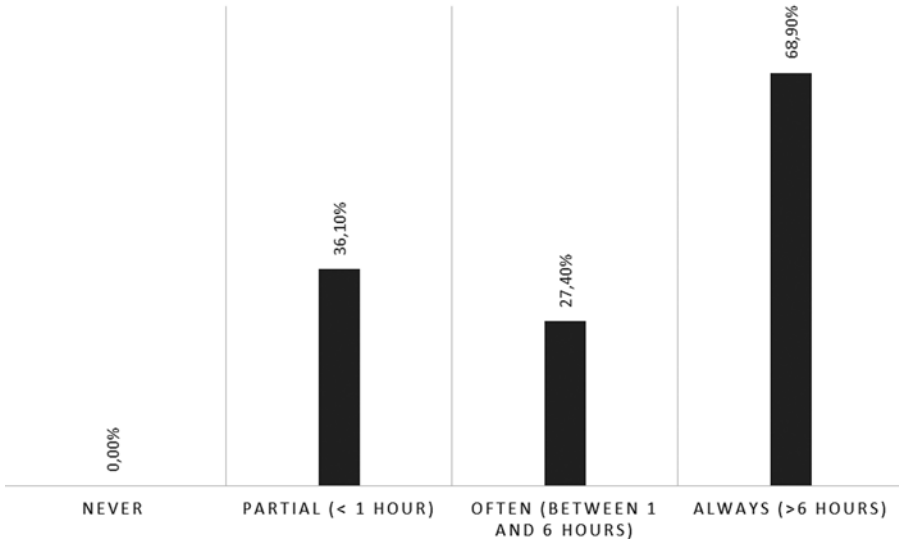

Figure 2 - Device Time Usage percentage

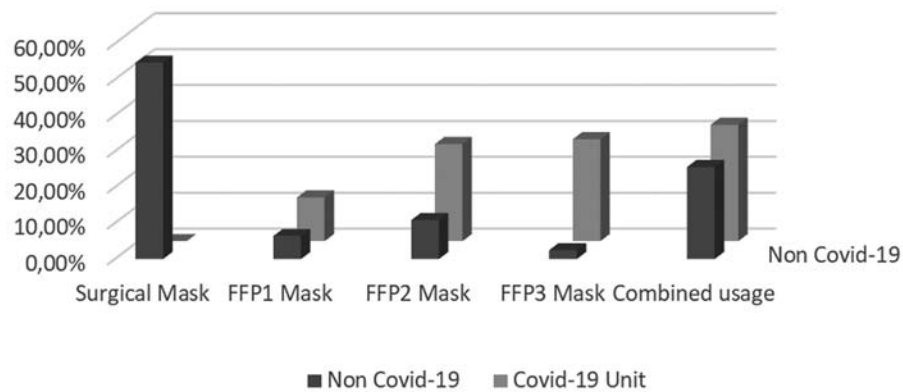

Figure 3- Differences in protective device type use between COVID-19 and non-COVID-19 Units

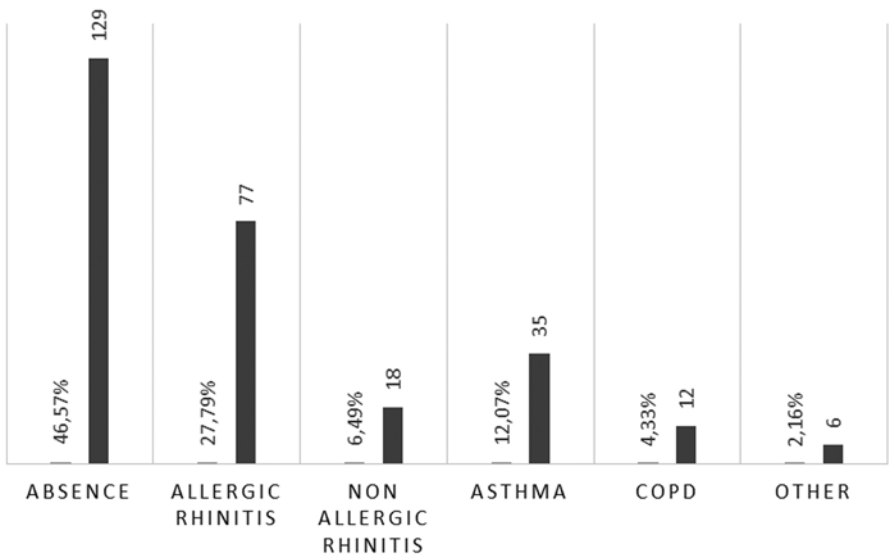

Figure 4 - Distribution of the major comorbidities in the study population

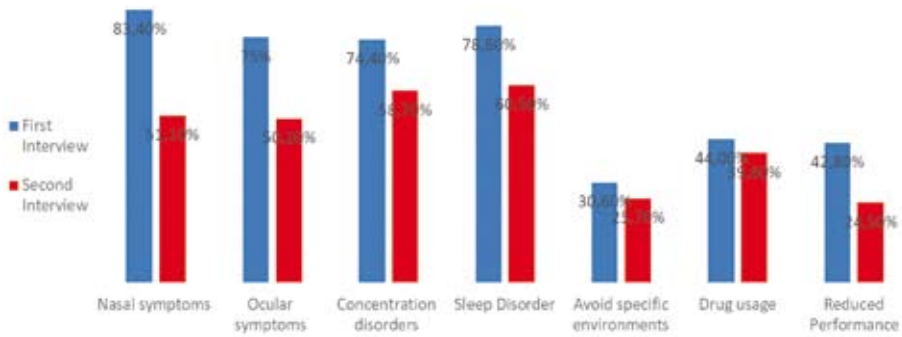

Figure 5 - Comparison of the results obtained after the second interview after good health practices

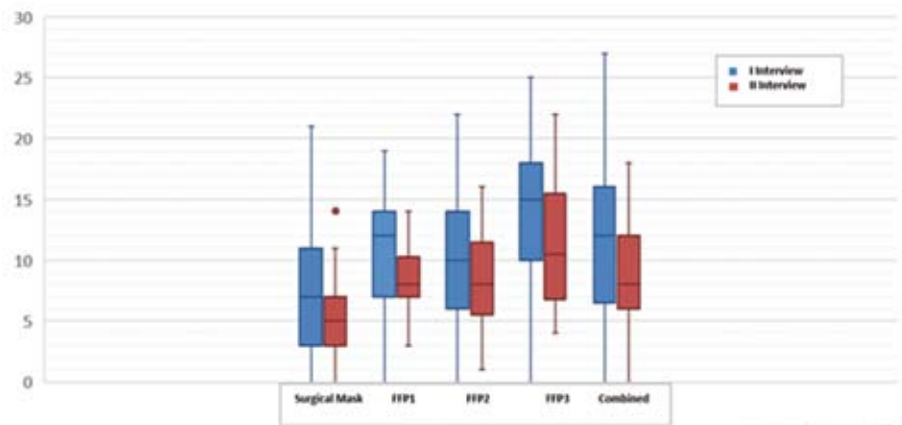

Figure 6 - Box and Whiskers Chart. Multiple boxplot scores of different protective devices are represented

Table 1 - Demographic and clinical features

	No.	Percentage
Total number	277	
Sex		
Male	156	56.3%
Female	121	43.7%
Age (average years old)	42.5	
Range < 30 y	53	(19.1%)
30-40 y	78	(28.1%)
40-50 y	70	(25.2%)
> 50 y	76	(27.4%)
Mean device usage		
Partial (< 1 hour)	10	(36.1%)
Almost all the time (between 1 and 6 hours)	76	(27.4%)
Full time (>6 hours)	191	(68.9%)
Device Type	111	(40.07%)
Surgical	22	(7.94%)
FFP1	42	(15.16%)
FFP2	26	(9.39%)
FFP3	76	(27.44%)
Combined usage		
Health Department	74	(26.71%)
COVID- 19 units	203	(73.28%)
Other units		
Working role		
Physician	181	(64.87%)
Nurse	65	(24.01%)
Healthcare assistant	25	(8.96%)
Other	6	(2.15%)
Smoke habit		
Never	108	(38.98%)
Ex-Smoker	53	(19.13%)
eCigarette/IQOS	39	(14.07%)
Cigarettes<5 die	23	(8.30%)
Cigarettes between 5 and 10 die	24	(8.66%)
Cigarettes > 10 die	30	(10.83%)
Comorbidity		
Absence	129	(46.57%)
Allergic rhinitis	77	(27.79%)
Non-allergic rhinitis	18	(6.49%)
Asthma	35	(12.07%)
COPD	12	(4.33%)
Other	6	(2.16%)

Table 1 - Demographic and clinical features

Device type	Nasal complaints	Ocular complaints	Attention disorder	Pulmonary domain	Sleep Disorder	Avoid specific Environment	Drug usage Required	Reduced performance	Total score (0-32)
Surgical Mask									
Never	22 (7.94%)	43 (15.52%)	40 (14.44%)	67 (24.18%)	31 (11.91%)	75 (27.07%)	81 (29.24%)	42 (15.16%)	7.36[a, b, c, d] ± 4.85
Rarely	36 (12.99%)	30 (10.83%)	36 (12.99)	25 (9.02%)	39 (14.07%)	16 (5.77%)	18 (6.49%)	29 (10.46%)	
Sometimes	40 (14.44%)	20 (7.22%)	29 (10.46%)	13 (4.69%)	29 (10.46%)	18 (6.49%)	8 (2.88%)	29 (10.46%)	
Often	13 (4.69%)	16 (5.77%)	4 (1.44%)	2 (0.72%)	12 (4.33%)	2 (0.72%)	4 (1.44%)	10 (3.61%)	
Always	9 (3.24%)	2 (0.72%)	2 (0.72%)	-	0	0	0	1 (0.36%)	
FFP1 Mask									
Never	2 (0.72%)	3 (1.08%)	5 (1.8%)	8 (2.88%)	3 (1.08%)	6 (2.16%)	8 (2.88%)	9 (3.24%)	11.04[a] ± 4.44
Rarely	7 (2.52%)	5 (1.8%)	10 (3.61%)	6 (2.16%)	10 (3.61%)	8 (2.88%)	7 (2.52%)	5 (1.8%)	
Sometimes	5 (1.8%)	9 (3.24%)	4 (1.44%)	4 (1.44%)	6 (2.16%)	6 (2.16%)	5 (1.8%)	5 (1.8%)	
Often	6 (2.16%)	4 (1.44%)	1 (0.36%)	2 (0.72%)	3 (1.08%)	2 (0.72%)	2 (0.72%)	3 (1.08%)	
Always	2 (0.72%)	1 (0.36%)	2 (0.72%)	-	0	0	0	0	
FFP2 Mask									
Never	6 (2.16%)	5 (1.8%)	7 (2.52%)	20 (7.22%)	11 (3.97%)	21 (7.58%)	24 (8.66%)	11 (3.97%)	10.09[b] ± 5.07
Rarely	9 (3.24%)	13 (4.69%)	19 (6.85%)	9 (3.24%)	17 (6.13%)	6 (2.16%)	10 (3.61%)	13 (4.69%)	
Sometimes	16 (5.77%)	13 (4.69%)	10 (3.61%)	12 (4.33%)	7 (2.52%)	6 (2.16%)	6 (2.16%)	10 (3.61%)	
Often	10 (3.61%)	6 (2.16%)	5 (1.8%)	4 (1.44%)	6 (2.16%)	8 (2.88%)	2 (0.72%)	8 (2.88%)	
Always	1 (0.36%)	5 (1.8%)	1 (0.36%)	1 (0.36%)	1 (0.36%)	1 (0.36%)	0	0	
FFP3 Mask									
Never	4 (1.44%)	4 (1.44%)	3 (1.08%)	3 (1.08%)	3 (1.08%)	3 (1.08%)	8 (2.88%)	5 (1.8%)	13.96[c] ± 5.40
Rarely	4 (1.44%)	5 (1.8%)	5 (1.8%)	9 (3.24%)	10 (3.61%)	6 (2.16%)	4 (1.44%)	6 (2.16%)	
Sometimes	8 (2.88%)	6 (2.16%)	10 (3.61%)	8 (2.88%)	10 (3.61%)	13 (4.69%)	10 (3.61%)	10 (3.61%)	
Often	9 (3.24%)	8 (2.88%)	6 (2.16%)	7 (2.52%)	3 (1.08%)	3 (1.08%)	4 (1.44%)	5 (1.8%)	
Always	1 (0.36%)	3 (1.08%)	2 (0.72%)	2 (0.72%)	0	1 (0.36%)	0	0	
Combined Usage									
Never	10 (3.61%)	12 (4.33%)	15 (5.41%)	29 (10.46%)	14 (5.05%)	32 (11.55%)	35 (12.63%)	23 (8.3%)	11.68 ± 6.46[d]
Rarely	21 (7.58%)	17 (6.13%)	21 (7.58%)	14 (5.05%)	18 (6.49%)	18 (6.49%)	9 (3.24%)	13 (4.69%)	
Sometimes	23 (8.3%)	23 (8.3%)	33 (11.91%)	15 (5.41%)	26 (9.38%)	16 (5.77%)	20 (7.22%)	26 (9.38%)	
Often	18 (6.49%)	19 (6.85%)	5 (1.8%)	14 (5.05%)	16 (5.77%)	9 (3.24%)	10 (3.61%)	16 (5.77%)	
Always	4 (1.44%)	5 (1.8%)	2 (0.72%)	3 (1.08%)	2 (0.72%)	1 (0.36%)	2 (0.72%)	1 (0.36%)	

Figure 6 - Box and Whiskers Chart. Multiple boxplot scores of different protective devices are represented

	No.	Percentage
TOTAL NUMBER	277	
Sex		
Male	156	56.3%
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Absence	129	(46.57%)
Allergic rhinitis	77	(27.79%)
Non-allergic rhinitis	18	(6.49%)
Asthma	35	(12.07%)
COPD	12	(4.33%)
Other	6	(2.16%)

Table 2 - Percentage of HCWs' response divided according to type of protective device used. a) Total score Surgical mask vs FPP1 Mask p=0.0006; b) Total score Surgical mask vs FPP2 Mask p=0.0028; c) Total score Surgical mask vs FPP3 Mask p<0.0001; d) Total score Surgical mask vs Combined Usage p<0.0001. A specific 17 item survey was carried out to interview via email all subjects enrolled in the study (Figure 1).

Device type	Nasal complaints	Ocular complaints	Attention disorder	Pulmonary domain	Sleep Disorder	Avoidspecific Environment	Drug usage Required	Reduced performance	Total score (0-32)
Surgical Mask									
Never	22 (7.94%)	43 (15.52%)	40 (14.44%)	67 (24.18%)	31 (11.91%)	75 (27.07%)	81 (29.24%)	42 (15.16%)	7.36[a, b, c, d] ± 4.85
Rarely	36 (12.99%)	30 (10.83%)	36 (12.99)	25 (9.02%)	39 (14.07%)	16 (5.77%)	18 (6.49%)	29 (10.46%)	
Sometimes	40 (14.44%)	20 (7.22%)	29 (10.46%)	13 (4.69%)	29 (10.46%)	18 (6.49%)	8 (2.88%)	29 (10.46%)	
Often	13 (4.69%)	16 (5.77%)	4 (1.44%)	2 (0.72%)	12 (4.33%)	2 (0.72%)	4 (1.44%)	10 (3.61%)	
Always	9 (3.24%)	2 (0.72%)	2 (0.72%)	-	0	0	0	1 (0.36%)	
FFP1 Mask									
Never	2 (0.72%)	3 (1.08%)	5 (1.8%)	8 (2.88%)	3 (1.08%)	6 (2.16%)	8 (2.88%)	9 (3.24%)	11.04[a] ± 4.44
Rarely	7 (2.52%)	5 (1.8%)	10 (3.61%)	6 (2.16%)	10 (3.61%)	8 (2.88%)	7 (2.52%)	5 (1.8%)	
Sometimes	5 (1.8%)	9 (3.24%)	4 (1.44%)	4 (1.44%)	6 (2.16%)	6 (2.16%)	5 (1.8%)	5 (1.8%)	
Often	6 (2.16%)	4 (1.44%)	1 (0.36%)	2 (0.72%)	3 (1.08%)	2 (0.72%)	2 (0.72%)	3 (1.08%)	
Always	2 (0.72%)	1 (0.36%)	2 (0.72%)	-	0	0	0	0	
FFP2 Mask									
Never	6 (2.16%)	5 (1.8%)	7 (2.52%)	20 (7.22%)	11 (3.97%)	21 (7.58%)	24 (8.66%)	11 (3.97%)	10.09[b] ± 5.07
Rarely	9 (3.24%)	13 (4.69%)	19 (6.85%)	9 (3.24%)	17 (6.13%)	6 (2.16%)	10 (3.61%)	13 (4.69%)	
Sometimes	16 (5.77%)	13 (4.69%)	10 (3.61%)	12 (4.33%)	7 (2.52%)	6 (2.16%)	6 (2.16%)	10 (3.61%)	
Often	10 (3.61%)	6 (2.16%)	5 (1.8%)	4 (1.44%)	6 (2.16%)	8 (2.88%)	2 (0.72%)	8 (2.88%)	
Always	1 (0.36%)	5 (1.8%)	1 (0.36%)	1 (0.36%)	1 (0.36%)	1 (0.36%)	0	0	
FFP3 Mask									
Never	4 (1.44%)	4 (1.44%)	3 (1.08%)	3 (1.08%)	3 (1.08%)	3 (1.08%)	8 (2.88%)	5 (1.8%)	13.96[c] ± 5.40
Rarely	4 (1.44%)	5 (1.8%)	5 (1.8%)	9 (3.24%)	10 (3.61%)	6 (2.16%)	4 (1.44%)	6 (2.16%)	
Sometimes	8 (2.88%)	6 (2.16%)	10 (3.61%)	8 (2.88%)	10 (3.61%)	13 (4.69%)	10 (3.61%)	10 (3.61%)	
Often	9 (3.24%)	8 (2.88%)	6 (2.16%)	7 (2.52%)	3 (1.08%)	3 (1.08%)	4 (1.44%)	5 (1.8%)	
Always	1 (0.36%)	3 (1.08%)	2 (0.72%)	2 (0.72%)	0	1 (0.36%)	0	0	
Combined Usage									
Never	10 (3.61%)	12 (4.33%)	15 (5.41%)	29 (10.46%)	14 (5.05%)	32 (11.55%)	35 (12.63%)	23 (8.3%)	11.68 ± 6.46[d]
Rarely	21 (7.58%)	17 (6.13%)	21 (7.58%)	14 (5.05%)	18 (6.49%)	18 (6.49%)	9 (3.24%)	13 (4.69%)	
Sometimes	23 (8.3%)	23 (8.3%)	33 (11.91%)	15 (5.41%)	26 (9.38%)	16 (5.77%)	20 (7.22%)	26 (9.38%)	
Often	18 (6.49%)	19 (6.85%)	5 (1.8%)	14 (5.05%)	16 (5.77%)	9 (3.24%)	10 (3.61%)	16 (5.77%)	
Always	4 (1.44%)	5 (1.8%)	2 (0.72%)	3 (1.08%)	2 (0.72%)	1 (0.36%)	2 (0.72%)	1 (0.36%)	