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Journal of Plastic, Reconstructive & Aesthetic Surgery 75 (2022) 3622–3627

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FFP3 Feelings and Clinical Experience (FaCE). Facial pressure injuries in healthcare workers from FFP3 masks during the COVID-19 pandemic

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Received 18 July 2021; accepted 10 June 2022

KEYWORDS
FFP3;
COVID-19;
Facial injuries;
Coping strategies;
"Face mask"

Summary *Aims:* Prolonged wear of filtering facepiece 3 (FFP3) masks during the COVID-19 pandemic has led to dermatoses, including pressure sores. This study aimed to better understand the local scale and nature of the problem, coping strategies, and impact on those affected.
Methods: A survey was designed by plastic surgeons, tissue viability nurses, and critical care doctors. Key elements were demographics, mask-wearing behaviours, facial injuries, coping mechanisms, and impacts, such as time off work or redeployment. Question types were multiple-choice questions, visual analogue scales, and blank space. It was distributed for voluntary completion at a London NHS Trust via staff update emails and posters.
Results: Between 24th April–15th May 2020, 178 surveys were completed in full. Participants were 84% female, 55% worked in ITU, and 48% were nurses. Grade 1 facial pressure injuries were reported by 79% of respondents (n=124). Other significant occupational dermatoses included pain (70%), dry skin (50%), and acne (41%). The cheeks and bridge of nose were most affected. Staff used barrier creams (17%), dressings (17%), and analgesia (10%) to manage facial injuries. Half of those who modified their mask were not re-fit tested. A total of 33% required redeployment to a non-FFP3 area or time off.
Conclusions: FFP3 masks worn beyond the recommended 1 h are associated with facial injuries. When advanced PPE (i.e., powered airflow masks) is unavailable, we must provide targeted

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https://doi.org/10.1016/j.bjps.2022.06.057

skincare support (prevent and manage), modify shift patterns to reduce mask wear intensity, and amend fit test protocols to optimise protection against COVID-19.

Introduction

The protection of Healthcare Workers (HCWs) during the COVID-19 pandemic requires enhanced personal protective equipment (PPE). In the UK, enhanced PPE constitutes disposable gloves, a fluid-repellent gown, eye/face protection, and a filtering facepiece 3 respirator (FFP3) which is mandated in high-risk areas. An FFP3 mask prevents the inhalation of 99.95% of small particles ($< 0.5\ \mu m$)[1] thus is the current recommended protection when performing an aerosol-generating procedure (AGP) on a patient with confirmed or suspected COVID-19. These masks necessitate an airtight seal to perform their intended function. This mask-skin interface for prolonged periods of time has led to a high prevalence of significant occupational dermatoses mainly at the contact site but also within the mask area due to an occlusive microclimate (i.e., sweating, skin coverage, and dehydration).

A pressure ulcer is defined as 'localised damage to the skin and underlying soft tissue usually over a bony prominence or related to a medical or other devices'.[2] FFP3 device-related pressure ulcers (DRPU) can affect any area where there is direct contact between the mask or its straps and the skin. Typically, this affects the nasal bridge, around the ears, and along the angle of the mandible [3]. The Health and Safety Executive (HSE, UK) recommends that they are not worn for longer than 1 h continuously (BS EN 149).[4] However, given the intensity of work performed by HCWs during the current global pandemic, this is unrealistic, and guidance is changing to advocate sessional use. Sessional use is defined as the period of time where the HCW is performing duties in a specific care setting or exposure environment (up to 12 h duration).[5] This approach aims to reduce the risk of inadvertent transmission and to facilitate the efficient delivery of patient care in clinical areas.

NHS England published guidance regarding the prevention and management of pressure sores related to medical masks [6] based on advice from the HSE.[7] The reach of this guidance to frontline staff and their adherence to it is unclear.

The recent surge in time spent wearing FFP3 masks for a significant number of healthcare staff warrants investigation into the patterns of use, associated injuries, and management strategies.[8] This study sets out to increase understanding of the population at risk, the mask-wearing behaviours of staff, the nature of DRPUs, and the current strategies used by staff to prevent and treat DRPU with regard to their alignment with current local and national guidelines. The findings will act as a historical snapshot of an unusual behaviour adopted during a global health crisis and may help to develop clinical protocols for staff to respond safely to further waves of COVID-19 or other respiratory virus pandemics.

Methods

A trust-wide voluntary survey study was designed. The survey structure and topics were developed following a consensus meeting attended by management staff and clinical staff from plastic surgery, intensive care, respiratory medicine, tissue viability, and occupational health departments.

The survey consists of 52 questions covering demographics (including age, ethnicity, location, department, role, and medical history pertaining to skin conditions), FFP3 mask-wearing characteristics and tendencies (including fit testing and duration of use), associated dermatoses (including location, severity, and nature of insult), and any management strategies that staff members have used (modifications to the mask, self-medication, use of bandages or dressings, and any changes to work schedule). Individual responses were gathered electronically on Qualtrics[9] using multiple-choice questions, visual analogue scales, drop-down boxes, and blank spaces for unrestricted reporting. Likert scales were used where appropriate to help quantify responses.

Following local ethical approval from Imperial College Healthcare NHS Trust (Ref: PLA_01), all staff members of a London NHS Trust received a survey link via a daily CEO bulletin E-Mail in April 2020 *(see Appendix)*. This was repeated once when response levels had reduced approximately two weeks later. Recruitment was supplemented by poster adverts displayed across three hospitals within the Trust and via staff champions within different wards and healthcare roles. All staff members working at the Trust were eligible for inclusion in the study, which employs around 14,500 individuals. The survey was sent as part of a daily Trust Communications Newsletter allowing respondents to voluntarily participate if they so wished. The survey was open for completion for 22 days between 24th April 2020 and 15th May 2020.

Statistical analysis

Survey responses were assessed for data quality, and all those with a valid healthcare role and location were included regardless of how much of the survey was completed. Descriptive statistics were calculated for quantifiable survey responses, and blank space questions were amalgamated and discussed by the authors for context. No further statistical tests were conducted with the data as the results of a voluntary survey study would be affected by selection bias and possibly misleading to interpret.

Table 1 Participant demographics and mask-wearing behaviours.

Demographic		Mask wear pattern (%)	
Age (median (IQR))	30 (27-38)	<1 h	8
Sex (% female)	84	>1 h	40
		Full shift	51
Location (may be >1 area) (%)		Other	1
ITU	55		
HDU	14		
Level 1 COVID-19 ward	20		
Theatres	5		
Other (e.g., A&E, other wards)	16		
		Full shift schedule	
Role (%)		Shift duration (h) (mean)	11.9
Allied health professional	27	No. of breaks (mean)	2.35
Doctor	15	Break duration (min) (mean)	47.9
Nurse	48	Continuous mask wear (h) (mean)	4.36
Other	10	Days worked per week (mean)	3.65

Results

During the study timeframe 27 April to 15 May 2020, 225 responses were submitted. Of the responses, 47 did not contain any completed questions (i.e., the respondent had opened the link but not filled in the questions) and thus were not included in the results. A total of 178 surveys contained at least one completed answer.

Demographics

Of the 178 respondents, 84 % were females (n = 149), 16% were males (n = 28), and 0.6% (n = 1) preferred not to say. The median age of respondents was 30 (IQR 27 - 38). The participants worked across five hospital sites within the Trust. The majority of participants wore FFP3 respirators in the intensive care setting (114/208; 55%), as depicted in Table 1. Eighty-five respondents (48%) were nurses, 53 (30%) were allied health professionals (e.g., healthcare assistant, physiotherapist), 23 (13%) were doctors, and the remainder had selected "other". The ethnicities of respondents were mixed, but predominantly English/Welsh/Scottish/Northern Irish/British (45%), any other White background (19%), and any other Asian background (10%). Fifty-three percent (93/175) of respondents reported no underlying skin condition, nor any of the selected comorbidities commonly associated with skin health. Of those with a skin condition (n = 50), the most prevalent was eczema (21%, 32 respondents), followed by psoriasis (6%, 10 respondents).

Mask-wearing behaviours

Ninety-one percent of respondents wore an FFP3 mask at work (n = 158). Of these, 91% wore the mask for continuous periods over 1 h, and over half of those wearing it for the entire shift. The mean length of shift for participants was 12 h, with a mean length of time wearing an FFP3 mask for 4 h each shift. The mean number of breaks those individuals took during their shifts was 2.33, lasting a mean of 47.9 min each. This type of shift occurred on average four days per week (Table 1).

Table 2 Percentage of self-reported injuries.

Facial pressure injury (%)	
Stage 1 pressure ulcer	78
Skin redness	80
Skin soreness	70
Dry skin	50
New/worse acne	41
Facial itch	38
Increase pore size	33
Bruising	21
Rash	20
Broken skin	14
Local infection	3
Bleeding	3

Occupational dermatoses

Most participants (79%; 124/157) experienced redness or skin irritation lasting over 30 min after the removal of their FFP3 mask. Other significant occupational dermatoses included pain (70%), dry skin (50%), worsened acne (41%), and less commonly bleeding or broken skin with infections. The cheeks and bridge of nose were most affected, followed by behind the ears, the jawline, and the forehead (Table 2). The anatomical distribution of injuries is depicted pictorially in Figure 1.

Coping strategies

Participants reported changes to general skincare routines, such as enhanced daily face moisturisation (96%) and a

Table 3 Coping strategies as a percentage of respondents.

Coping strategies (%)		Staff absence/redeployment (%)	
Daily skin moisturiser	96	Time off work	3
Active hydration	80	Request time off	12
Barrier film	18	Change to non-FFP3 requiring role	8
Dressing	17	Requiring other PPE (e.g., hood)	10
Regular analgesia	11		
Post fit-test mask wear modification	30	Re-fit tested	51

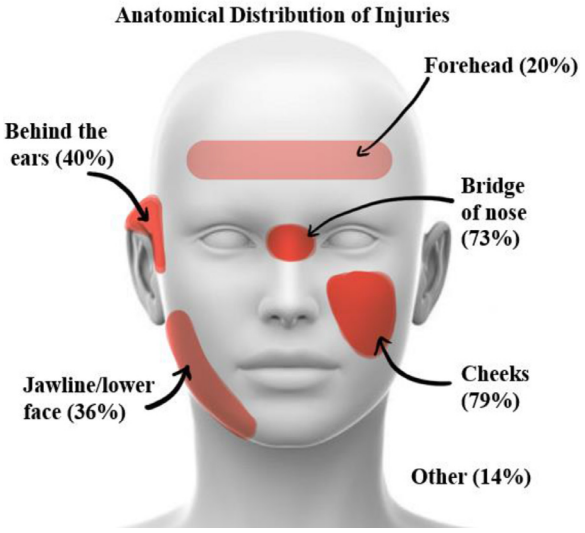

Figure 1 Anatomical distribution of injuries as a percentage of all injuries.

greater focus on hydration during the day (80%). Staff adopted strategies at work to protect their skin from mask wear including barrier films (e.g., Cavilon) (18%) and dressings under the masks (e.g., Duoderm) (17%). National and local guidelines regarding on preventative strategies for mask-related dermatoses were known to 40% and 59% of respondents, respectively (n = 154). A third of staff had modified their mask-wear technique; however, only 50% had been re-fit tested to confirm a sufficient seal. A small proportion used regular oral analgesia (11%) (Table 3).

Sick leave and redeployment

Mask-related injuries led to five participants (6.0%) reporting time off work, and 17 (20%) in the process of applying for leave or transfer. Thirteen participants (15%) changed to another role that did not necessitate the use of FFP3 masks, and 14 participants (16%) changed the PPE that they used (i.e. used a hood or other respirator).

Participants' feelings

The participants' free-text responses to 'additional comments' are presented as a word cloud (Figure 2).

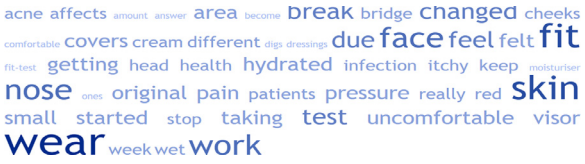

Figure 2 Word cloud of participants' free-text responses to 'additional comments'.

Discussion

The COVID-19 pandemic has led to the biggest shift in the use of PPE in modern healthcare history. The unprecedented scale and speed of arrival of COVID-19 put added pressure on designing and implementing evidence-based guidelines. During the first wave of COVID-19 in the UK, tight-fitting FFP3 masks were a fundamental piece of PPE required to prevent the respiratory spread of the COVID-19 virus from patient to HCWs. It is clear now that a side effect of the rapid implementation of this type of mask was a substantial burden of occupational facial dermatoses, as well as other systemic and psychological effects.

This survey of HCWs at a Central London Hospital acts as an historic snapshot of the issues experienced by staff, and whilst the numbers cannot accurately quantify the impact due to limitations in methodology, the responses point towards significant harm, which is likely to have compounded staff sickness and shortages in this critical window.

The demographic of survey respondents suggests that those most affected by face mask dermatoses were nursing staff on the intensive care unit, given that those who have a personal interest in a topic are more likely to complete a questionnaire.[10] The authors were careful not to bias the participant demographic by targeted advertising; hence, the approach was to send a generic trust-wide email and place posters in common areas such as outside lift banks in the main hospital entrance. However, it is plausible that ITU nurses would spread the word to colleagues after completing the survey, exaggerating the demographic of the respondents. The mask-wearing behaviour appears to reflect the standard working patterns, particularly the patient contact hours of hospital staff. The nursing staff in ITU tend to spend prolonged periods at the bedside and work 12 h shifts for three to four days in a row, in part to reduce the number of handovers required. The ITU physicians usually see the patients for shorter episodes, such as during the ward round, and during procedures, with the remainder of the time in the office where FFP3 masks were not mandated.

Data from our survey suggest that nursing staff continued to work standard patterns, despite the recommendation of a maximum wear time of 1 h for FFP3 masks. It is likely that the potential for harm from prolonged mask wear has never truly been tested at this scale or intensity before, and arguably was overlooked. Indeed, in times of a global pandemic, minor facial injuries may have been considered a manageable consequence.

A range of facial dermatoses was reported, with the most concerning being a high proportion of pressure sores. Staff photographs emerged in the media of such injuries, providing the general public with a harrowing insight into the 'frontline' of the pandemic. More than two-thirds of respondents reported localised skin redness which persisted for more than 30 min after the mask was removed. This is clear evidence of cumulative skin damage, which causes bleeding and infection in some cases and pain in many. Staff reported in the free-text areas turning up to work dreading the pain and stifling experience of re-donning the mask, with some even pre-medicating with analgesia. The main location of the sores was the bridge of the nose and the cheeks, and the sores were less frequently located behind the ears, forehead, and jawline.

These details provide information which may be useful in understanding the mask-face interface, which informs further guidance on how to individuals should customise their masks, such as moulding the malleable parts and adjusting the tension in the elastic straps. It also allows staff to preempt at-risk areas and potentially use prophylactic padding such as silicone dressings or barrier creams to minimise the risk of pressure sores. There was also a feeling amongst staff that lack of a range in sizes of masks led to greater discomfort and more problems in those with faces most different to the 'average' size and structure used by the manufacturer. This may have unequally affected those of a certain gender or ethnicity. Our data cannot reliably prove or disprove this hypothesis, and therefore, the necessary statistical tests were not performed.

Other physical symptoms experienced included skin changes expected with the change in the local microenvironment, such as acne and increased pore size as well as the irritant effect of the material causing itching and rashes in some cases. Whilst these are likely mask related, they are more generalisable skin issues and are at higher risk of compounding by other variables, including stress and associated behaviours.[11]

Another area of interest was surveying the awareness and compliance of staff to local and national guidance regarding mask wear and associated dermatoses. This broadly includes general strategies such as hydration and skin moisturising, and more specific guidance on barrier creams and dressings over the contact areas. The local guidelines are usually made by occupational health practitioners and supported by tissue viability, dermatology, and other related specialties. The added value of local over national guidelines comes from the local availability of resources, in particular advice on how to use particular brands. Roughly half of the staff were aware of these guidelines, and a quarter regularly used a barrier or dressing in conjunction with their mask. All staff who adjust their mask-wear technique should repeat the fit-test to ensure an appropriate mask seal remains with those adjuncts in place. Only half of those who modified their masks repeated the fit testing, putting those HCWs at risk of exposure to virus in the circulating air. It is unclear whether mask modification or incorrect use of PPE, in general, contributed to the high prevalence of COVID-19 in HCWs and their local communities.

There is evidence that a practical, stepwise approach to the management of facial injuries can be successfully implemented for patient-facing staff. Miranda et al.[12] created an algorithm for preventing and managing skin injuries caused by PPE, which involve some of the aforementioned strategies, such as skin protection, cleansing, and moisturising; limiting the use of FFP3 masks for 4 h; monitoring any skin lesions, and avoiding moisturisers which contain acrylate or dimethicone polymers. An educational and informative leaflet on this topic has been procured by Salomé et al.[13], highlighting the scope for innovation and multidisciplinary collaboration in tackling the occupational dermatoses.

The true impact on the healthcare service of facial dermatoses from mask wear is unknown. In this study, there does appear to be a conversion from symptoms to time off work or moving to an environment which did not require the use of FFP3 masks. Such environments in the UK included Level 1[14] COVID-19 wards where AGP were not being performed. Fluid-resistant surgical masks (FRSM) were recommended during that time, which have a reduced intensity of pressure and contact with the facial skin compared to FFP3. Staff may have wanted to transfer or leave working on ITU for multiple reasons, but it seems as though the physical conditions contributed somewhat. Furthermore, falling staff morale and the difficulties of being able to recruit staff into those positions have a direct impact on the strength of the workforce, which has been stretched significantly throughout the pandemic.[15] Gaps in staff rotas due to illness only put more pressure on the remaining staff which can quickly spiral into the collapse of healthcare services. As such, any steps that can be taken to minimise work-related stress should be taken.

In the aftermath of the first wave of the COVID-19 pandemic, guidance on the appropriate use of PPE has become more widely reported in the literature, offering patient-facing staff improved accessibility to information. Pontes et al.[16] produced a booklet that provides information regarding the prevention of PPE-related injuries. This has also been converted to a mobile-friendly resource providing insight into appropriately wearing and removing PPE to prevent their associated injuries.[17] During this time, staff included in the study were given some respite, and new guidance and approaches to respiratory PPE were made. One significant change leading into the second wave was the introduction of personal respirator masks which have several potential advantages. They come in different sizes and brands, use air filters which may ease the work of breathing, and the materials are less abrasive.[7,18] All staff were fitted with personalised respirators in a process which involved qualitative or quantitative fit testing.[19] This may have reduced the occurrence of facial sores and would have been the most obvious recommendation to be derived from this work. Other potential changes to consider are improving the visibility of national and local guidance to minimise facial sores, whilst ensuring the availability of products which may feature in such guidelines. Also, reducing the intensity of mask wear

through rota changes which decrease both the duration and frequency of shifts may prevent cumulative skin damage.

This work acts to characterise the damage caused from the high-intensity use of FFP3 masks during the first UK wave of the COVID-19 pandemic. The nature of the data precludes one from making any quantitative conclusions as to the scale of the problem or establishing any absolute risk factors for facial dermatoses. Most of the aims of the paper have been met by establishing typical mask wear behaviour, characterising facial dermatoses, outlining staff coping strategies, and ultimately the consequences of this unfortunate but largely unavoidable occupational hazard. Interesting comparisons may be made from the collection of similar data from these staff groups during the second UK wave to assess the impact of changes implemented as a result of lessons learnt. Furthermore, work is underway to survey the impact of FRSM-type masks, which although may be milder, affect a much larger proportion of our workforce and population.

Previous publication

Presented virtually at BAPRAS Conference 2020.

Authors' statement

The current Guide for Authors has been read, thereby indicating compliance with those instructions and acceptance of the conditions posed. The authors have seen and agreed to the submitted version of the paper, and bear responsibility for it; that all who have been acknowledged as contributors or as providers of personal communications have agreed to their inclusion; that the material is original; and that it has been neither published elsewhere nor submitted for publication simultaneously. In addition, the paper will not be published elsewhere in the same or similar form, in English or in any other language, without written consent of the copyright holder.

Funding

This study was unfunded.

Ethics Approval

Ethics approval was provided locally by Imperial College Healthcare NHS Trust reference number PLA_01.

Conflict of Interest

None.

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