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Prevention and occupational hazards for the skin during COVID-19 pandemic

Razvigor Darlenski, MD, PhD^{a,b,*}, Jana Kazandjieva, MD, PhD^c, Nikolai Tsankov, MD, PhD, DrSci^a

^a Department of Dermatology and Venereology, Acibadem City Clinic, Tokuda Hospital, Sofia, Bulgaria

^b Department of Dermatology and Venereology, Medical Faculty, Trakia University, Stara Zagora, Bulgaria

^c Department of Dermatology and Venereology, Medical University Sofia, Sofia, Bulgaria

Abstract The life of medical specialists worldwide has dramatically changed due to the spread of the coronavirus disease 2019 (COVID-19) pandemic. Health care professionals (HCPs) have personally faced the outbreak by being on the first line of the *battlefield* with the disease and, as such, compose a significant number of people who have contracted COVID-19. We propose a classification and discuss the pathophysiology, clinical findings, and treatments and prevention of the occupational skin hazards COVID-19 poses to HCPs. The multivariate pattern of occupational skin diseases during the COVID-19 pandemic can be classified into four subgroups: mechanical skin injury, moisture-associated skin damage, contact reactions, and exacerbation of preexisting dermatoses. The clinical pattern is versatile, and the most affected skin sites were the ones in contact with the protective equipment. Dermatologists should recognize the plethora of HCPs' occupational skin reactions that are occurring during the COVID-19 pandemic and implement treatment and preventive strategies.

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Introduction

The year 2020 has seen the lives of medical specialists worldwide change dramatically due to the coronavirus disease 2019 (COVID-19) pandemic. The health systems of many countries have encountered immense difficulties in providing adequate medical care facing the pandemic; however, many health care professionals (HCPs) have personally confronted the outbreak on the first line of the *battlefield* with the disease. In April 2020, 19% of all reported COVID-19 cases in the United States were composed of HCPs.¹ The toll for HCPs is high, and, against this background, their occupational skin diseases directly related to COVID-19 remain underestimated.²

We propose a classification, discuss the pathophysiology, present clinical findings, and examine the treatments and prevention of occupational skin hazards contracted by HCPs.

A recent study among 4300 HCPs in China indicated that the overall prevalence of occupational skin diseases was 42.8%, with multiple affected skin sites observed in almost 77% of all responders.³ The multivariate pattern of occupational skin diseases during the COVID-19 pandemic can be classified into four subgroups:

Mechanical skin injury

Mechanical skin injury results from the prolonged and repeated friction of personal protective equipment (PPE) parts with the skin. Skin findings attributed to the use of PPE were observed in 97.0% of 542 frontline HCPs in China.^{4,5} Erythema, papules, maceration, and scaling are the most

* Corresponding author.

E-mail address: Darlenski@abv.bg (R. Darlenski).

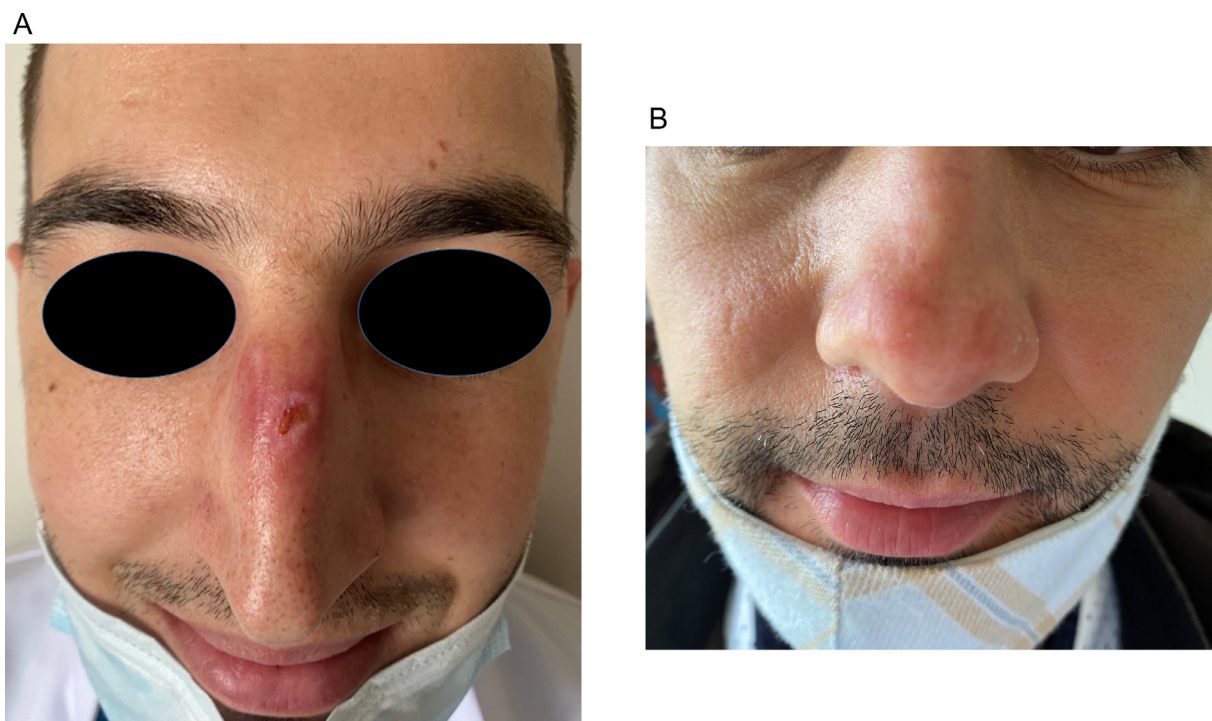


Fig. 1 (A) Ulceration of the nasal bridge with surrounding erythema. (B) Erythema, papules, and scaling of the nasal tip attributable to prolonged contact with a facial mask.



Fig. 2 Candidal erosion of the interdigital web in an HCP due to occlusion and maceration from protective gloves.

commonly reported. The typical affected skin sites include the nasal bridge (83% attributable to the use of protective goggles but not the hygiene mask [Figure 1]), cheeks, forehead, and hands.⁶ Symptoms have included burning, itching, and stinging. Of note, men demonstrate a preponderance of mechanical skin injury.³ Male sex, together with the length of time for mask wearing, use of grade 3 PPE (eg, disposable, cartridge, half or full face, as well as protective gloves) and sweating, have been the variables influencing mechanical skin injuries in a logistic regression model.³



Fig. 3 Transient aquagenic palmar hyperwrinkling resulting from prolonged immersion in water.

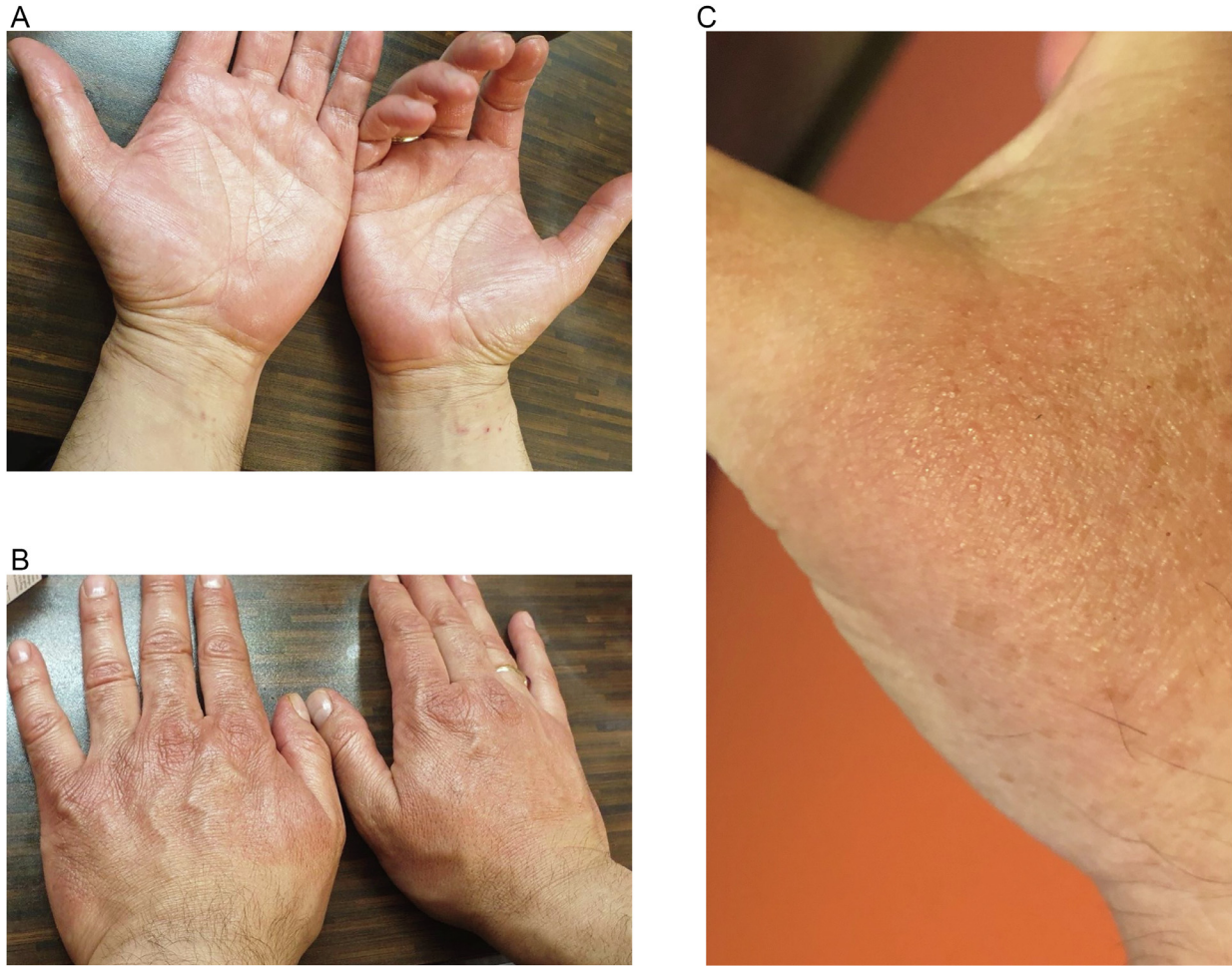


Fig. 4 Hand irritant dermatitis from exaggerated contact with water and detergents on the (A) volar and (B) dorsal surfaces of the palms. (C) Closer view of erythema and papule formation on the dorsum of the hand as a manifestation of irritant dermatitis.

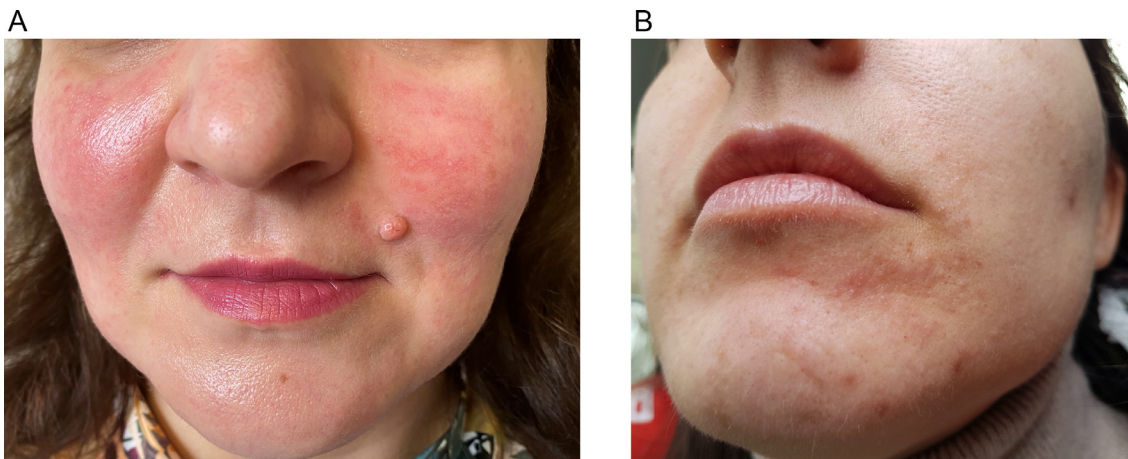


Fig. 5 Worsening of (A) erythema-telangiectatic rosacea and (B) perioral dermatitis attributable to contact with facial mask.

Table 1 Summary of occupational aspects of skin damage during the COVID-19 pandemic

Pathology	Pathophysiology	Clinical examples	Therapy	Prevention
Mechanical skin injury	Direct traumatic effect of mechanical parts of PPE on the skin epidermis and dermis	Nasal bridge ulceration	<ul style="list-style-type: none"> - Hydrocolloid dressing at pressure points - Emollient cream/ointment (b.i.d.–q.i.d.) - Topical fusidic acid cream (b.i.d.) if bacterial superinfection is present 	<ul style="list-style-type: none"> - Stop or decrease contact with responsible PPE (eg, goggles, mask, helmet) - Apply insulating foam dressing/film before applying PPE - Verify that PPE fits ideally - Application of emollient (b.i.d.) upon PPE removal - Regular breaks from mask/goggle/helmet use
Moist associated skin damage	Maceration and occlusion lead to breakdown of the epidermal barrier/immersion/hyperhydration state of stratum corneum	Inflammatory tinea, immersion foot, dyshidrosis, intertrigo, miliaria	<ul style="list-style-type: none"> - Astringents (aluminum acetate and aluminum sulfate plus calcium acetate) - Zinc topical preparations - Antimycotic agent (topical or systemic) and topical steroid in case of inflammatory tinea - Topical fusidic acid cream (b.i.d.) 	<ul style="list-style-type: none"> - Stop or decrease contact with responsible PPE (gloves, boots, etc) - Apply skin powder before PPE application - Decrease shift duration - Apply sweating blocking agents - Regular breaks from PPE use
Contact reactions	<p>Irritant dermatitis: Barrier breakdown by extensive washing, detergents, disinfectants</p> <p>Allergic dermatitis: Delayed (type IV) hypersensitivity</p> <p>Urticaria contact or delayed pressure type; IgE and non-IgE dependent liberation of histamine</p>	Face and hand dermatitis Contact urticaria	<ul style="list-style-type: none"> - Topical steroids/topical calcineurin inhibitors (b.i.d.) - H1-non sedating antihistamines (contact urticaria) - Emollients (b.i.d.) 	<ul style="list-style-type: none"> - Allergen/irritant contact avoidance - Barrier creams before each shift - Emollients (b.i.d.) between shifts - Use of pH-neutral, soap-free cleansing agents in daily hygiene
Aggravation of preexisting and chronic skin conditions in remission	Occlusion, friction, immersion, prolonged contact to potential irritants and allergens	Acne, rosacea, perioral dermatitis, seborrheic dermatitis, atopic dermatitis	- Use standard disease-specific treatment protocols	<ul style="list-style-type: none"> - Stop or decrease contact with responsible PPE (eg, mask, helmet, goggles) - Emollients (b.i.d.) between shifts - Regular breaks from PPE use

b.i.d. = 2 times a day; q.i.d. = 4 times a day; PPE = personal protective equipment; IgE = immunoglobulin E.

For those afflicted, 45% required therapy (dressings and oil agents), but only 17.7% undertook preventive measures.

Higher grades of PPE, longer working periods, and enhanced wearing times of PPE were correlated with the ap-

pearance of facial skin lesions.⁷ Facial cutaneous findings can lead to more frequent facial touching for relief of mechanical pressure or pruritus while possibly increasing the risk of COVID-19 infection.⁸ Applications of hydrocolloid

dressings at the site of the injury may be advisable as well as use of a double mask fitting test and application of emollients between shifts.

Moisture-associated skin damage

Prolonged occlusion or water immersion results in hyperhydration of the stratum corneum, which in turn results in a compromised epidermal barrier function. We have registered increased dermatology consultations for inflammatory fungal and yeast infections of the skin. The most commonly affected sites have been the folds (Figure 2). Erosion of the interdigital web and tinea pedis are among the most frequent patterns.⁹ Beyond that, cases of dyshidrosis and immersion foot have also been observed. The prolonged wearing of PPE, such as suits and boots, can lead to increased temperature and humidity of the skin, simulating microclimatic conditions similar to those experienced by the US army during the Vietnam War.⁴

Since the pandemic outbreak began, we have described a case of aquagenic syringal acrokeratoderma, also known as transient aquagenic palmar hyperwrinkling¹⁰ This condition resulted from prolonged immersion with water. A week later, we documented a second case of this rare condition, again influenced by excessive hand hygiene (Figure 3).

The proposed preventive measures in cases of moisture-associated skin damage include decreased contact with responsible PPE (eg, gloves, boots, etc), application of skin powder before PPE application, and decreased shift duration.

Contact reactions

Irritant and allergic contact dermatitis, as well as contact urticaria, have been described in HCP during the COVID-19 pandemic.^{8,9} Epidermal barrier breakdown by frequent contact with water, detergents, and disinfectants predispose to the development of skin irritancy, clinically manifested as irritant contact dermatitis (ICD). The most involved skin sites include the dorsal surface of the hands, the interdigital web, and the fingertips (Figure 4). The clinical signs include erythema, papules, desquamation, and fissuring. Long-term use of protective gloves leads to occlusion and a hyperhydration state of the epidermis clinically observable as maceration and erosions,¹¹ possibly leading to the development of irritant contact dermatitis. Two-thirds of HCPs were washing their hands more than 10 times a day, but only 22% applied skin protective cream¹² The use of emollients and barrier creams is necessary in the treatment and prevention of ICD.¹³

Contact allergy of the delayed type to elements of PPE has been described during the pandemic outbreak. The allergens include textile, textile dyes, and rubber additives, as well as biocides used in the transportation process of the materials. Allergic contact dermatitis (ACD) from isocyanates in the sponge underlying the facial mask has also been delineated.¹⁴

Multiple sensitization to material in the elastic mask bands may occur, with proven contact allergy to carba mix, thiuram mix, zinc diethyldithio-carmate, and zinc dibutyldithio-carbamate¹⁵ Occupational airborne ACD from formaldehyde releasers and isothiazolinones even occurred in a woman with a known history of rosacea.¹⁶ Retroauricular dermatitis of both types, ACD and ICD, has been attributed to the elasticized ear loop of the face masks.¹⁷

Among the 61 workers who regularly used latex gloves (average of 3.5 mo, 10 h/d), 88.5% reported adverse skin reactions, including dry skin (55.7%), pruritus (31.2%), dermatitis (23.0%), and chapped skin (21.3%).¹⁸

Aggravation of preexisting and chronic skin conditions in remission

Prolonged contact with masks and goggles may cause a variety of cutaneous diseases ranging from contact and pressure urticaria or contact dermatitis to aggravation of preexisting dermatoses (Figure 5).¹¹ An earlier study reported that more than one-third of health care workers complained of acne, facial itching, and even dermatitis from wearing N95 masks.¹⁹ The use of protective headwear and the accompanying occlusion may induce pruritus and folliculitis or exacerbate seborrheic dermatitis.^{11,20} In acne, prolonged occlusion and increased humidity imposed by the masks may lead to occlusion of the pilosebaceous ducts.⁹ This, together with the exaggerated psychological stress, may contribute to the worsening of acne.

Conclusions

Skin changes related to the use of PPE and disinfection have been revealed. The development of *de novo* contact reactions to PPE as well as the exacerbation of preexisting dermatologic conditions should be suspected. Mechanical skin injury, moisture-associated skin damage, contact reactions, and exacerbation of preexisting dermatoses are the most common findings in HCPs working with patients who have COVID-19. Various preventive strategies include diminishing contact to PPE, application of epidermal barrier restoring agents, and protection from the culprit agent (Table 1).

Conflict of interest

The authors declare no conflict of interest.

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